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KINGSTON FOSSIL PLANT RETIREMENT

DRAFT ENVIRONMENTAL IMPACT STATEMENT

TENNESSEE VALLEY AUTHORITY
KNOXVILLE, TENNESSE

May 2023

COVER SHEET

Kingston Fossil Plant Retirement

Proposed action:	The Tennessee Valley Authority (TVA) proposes to retire and demolish the nine coal-fired units at the Kingston Fossil Plant (KIF) in Kingston, Roane County, Tennessee, and to construct and operate natural gas-fired or solar generating facilities to replace the retired generation. The replacement generation alternatives assessed in this document would be (1) a single gas-fired combined cycle (CC) gas plant paired with 16 dual-fuel Aeroderivative combustion turbines (CT), or (2) multiple solar generating facilities and battery energy storage systems within portions of Eastern Tennessee.
Type of document:	Draft Environmental Impact Statement
Lead agency:	Tennessee Valley Authority
Cooperating agencies:	U.S. Department of Interior, National Park Service U.S. Environmental Protection Agency
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Comments due date:	July 3, 2023

Abstract:
TVA prepared this environmental impact statement (EIS) to evaluate the environmental and social effects of the proposed retirement and demolition of the nine existing KIF units and the addition of at least 1,500 megawatts (MW) of replacement generation for commercial operation by the end of 2027. In addition to the No Action Alternative, TVA is evaluating two Action Alternatives for replacement of generation lost because of retiring the KIF units. Each of the two proposed Action Alternatives would provide at least 1,500 MW of generating capacity, to replace capacity from the proposed retirement of the existing KIF coal units plus additional capacity to allow for anticipated growth in regional energy demand (i.e., regional load growth). The two alternatives are: Action Alternative A (Alternative A), construction and operation of a single combined cycle (CC) combustion turbine gas plant paired with 16 dual-fuel Aeroderivative (Aero) combustion turbine (CT) units (CC/Aero CT Plant), 3- to 4-MW solar site, and a 100-MW battery storage system at the existing KIF site on the Kingston Reservation; and Action Alternative B (Alternative B), construction and operation of multiple solar generation and energy storage facilities at alternate locations, of

which, portions of which would be in East Tennessee. This EIS also evaluates related actions[1] associated with gas supply and transmission components for each alternative. Under the No Action Alternative, TVA would not retire the KIF units and additional repairs, maintenance, and upgrades would be necessary to maintain reliability. Existing conditions at KIF and in the vicinity would be maintained. TVA's proposed Action Alternatives align with TVA's 2019 Integrated Resource Plan (IRP) near-term actions to evaluate engineering end-of-life dates for aging generation units to inform long-term planning and to enhance system flexibility to integrate renewables and distributed resources. TVA's Preferred Alternative is Alternative A, because as indicated in TVA's Alternatives Analysis (Appendix C), a CC gas plant paired with dual-fueled Aero CTs is the best overall solution to provide low-cost, reliable energy to the TVA power system. Further, the proposed CC/Aero CT Plant could be built and made operational sooner than the other Action Alternative, which reduces economic, reliability, and environmental risks. TVA has also selected Alternative A as its Preferred Alternative because the proposed CC/Aero CT Plant at Kingston would provide the flexibility needed to reliably integrate 10,000 MW[2] of solar onto the system by 2035 and enables the KIF coal-fired units to be retired by the projected end-of-life estimates for those units and before significant water treatment investments become necessary under recent and anticipated new regulations such as the Effluent Limitation Guidelines (ELGs).

[1] *See* 40 C.F.R. §1501.9(e)(1).

[2] Solar and battery storage proposed under Alternatives A and B would be new solar in addition to the 10,000 MW of solar that TVA plans to bring onto the system by 2035. Multiple projects would be required to achieve the 10,000 MW target and those projects are currently in various stages of development.

SUMMARY

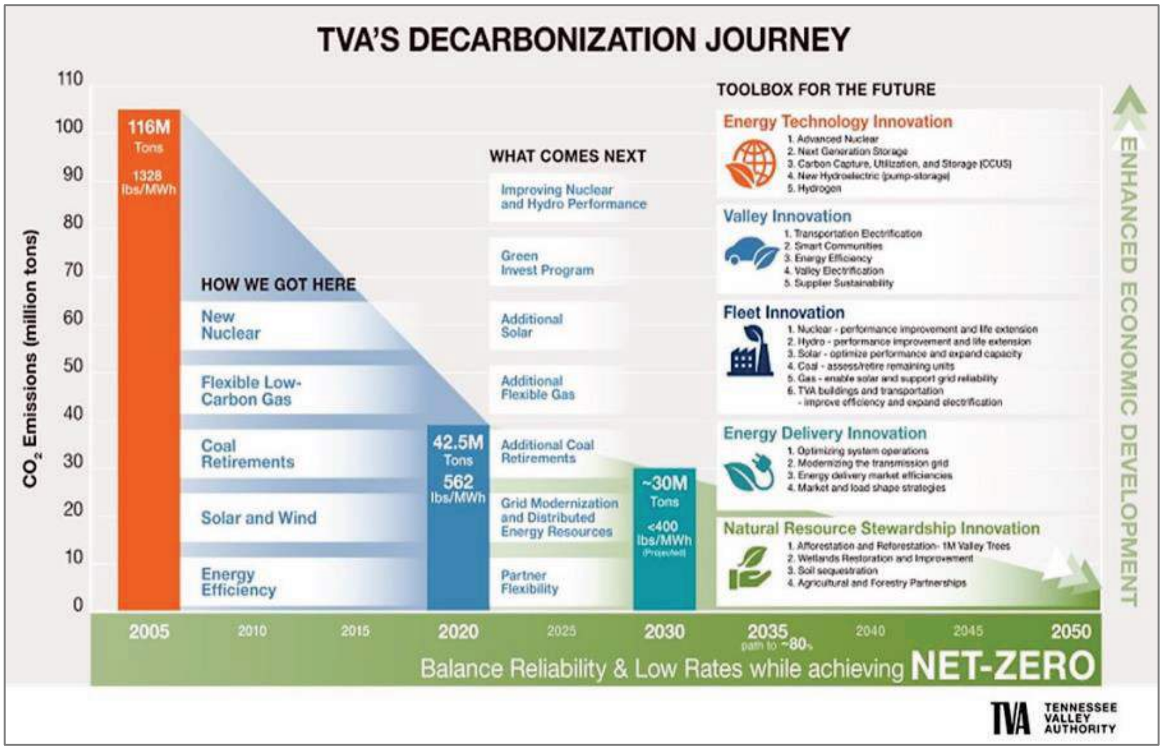
Introduction

The entire utility industry is undergoing a transition as it faces the need to lower carbon emissions, address aging infrastructure, and meet load growth driven by development and electrification. TVA continues to build the energy system of the future to achieve carbon reductions, while not compromising the goal of maintaining low electric rates and the high reliability that sustains the communities we serve and is critical to achieving economy-wide decarbonization. The possible retirement and replacement of coal generation at Kingston is one piece of the larger decarbonization effort that TVA is undergoing. TVA is a leader in clean energy, operating one of the largest, most diverse, and cleanest energy systems in the nation, with more than half its energy supply last year (2022) coming from clean energy sources. TVA has reduced carbon emissions by roughly 60% against the 2005 benchmark and is continuing to pursue opportunities for progress incorporating clean energy generation to achieve the carbon reduction goals identified in TVA's Strategic Intent and Guiding Principles document (TVA 2021h).

The transition to a clean energy economy is a generational transition requiring the development, refinement, and installation/operation of technologies and generating sources that can contribute to TVA's ability to meet system-wide generation demands. The role and contribution to system-wide generating capacity by these technologies/generating sources are likely to change over time or be replaced by newer technologies. Natural gas is one example of a generating source whose role and contributions to meeting TVA's annual generation demands will change over time. TVA has solar expansion targets of 10,000 MW of solar energy in place by 2035 and is continuing to expand its solar and carbon-free commitments through procurement methods such as requests for proposals, while exploring opportunities at existing TVA sites, and working with solar developers. Beyond the plan for 10,000 MW of solar, TVA continues to work with their long-term Local Power Company (LPC) customers to deploy additional solar through the Flexibility option under TVA's Long-Term Agreement with each individual LPC customer.

TVA prepared this EIS to evaluate the environmental and social effects of the proposed retirement and demolition of the nine existing KIF coal units and the addition of at least 1,500 MW of replacement generation for commercial operation by the end of 2027. System analysis indicates that the 1,500 MW of replacement power would need to be firm, dispatchable capacity (i.e., able to meet load in any given hour) to cover many periods of time where other resources are not available and to maintain reliability and system stability for East Tennessee.

In addition to the No Action Alternative, TVA is evaluating two Action Alternatives for replacement of generation lost because of retiring the KIF units. Each of the two Proposed Action Alternatives would provide at least 1,500 MW of replacement generation: (1) construction and operation of a CC combustion turbine gas plant paired with dual-fuel Aeroderivative combustion turbine (Aero CT) units (CC/Aero CT Plant), 3- to 4-MW solar site, and a 100-MW battery energy storage system (BESS) at the existing KIF site on the Kingston Reservation (Alternative A); and (2) construction and operation of multiple solar generation and energy storage facilities at alternate locations with a portion in East Tennessee (Alternative B). TVA's Proposed Action Alternatives align with TVA's 2019 IRP near-term actions to evaluate engineering end-of-life dates for aging generation units to inform long-term planning and to enhance system flexibility to integrate renewables and distributed resources. The possible retirement and replacement of coal generation at KIF is one piece of the larger decarbonization effort that TVA is undergoing, as illustrated in the graphic provided below.



Following the completion of the TVA 2019 IRP (TVA 2019a), TVA began conducting end-of-life evaluations of its operating coal-fired generating plants not already scheduled for retirement to inform long-term planning (TVA 2021g). This evaluation confirmed that the aging TVA coal fleet is among the oldest in the nation and is experiencing deterioration of material condition (i.e., more frequent repairs or equipment failures) and performance challenges. The performance challenges are projected to increase because of the coal fleet's advancing age and the difficulty of adapting the fleet's generation within TVA's changing generation profile.

KIF is located on the Kingston Reservation in Harriman, Roane County, Tennessee, approximately 35 miles west of downtown Knoxville. The 2,254-acre reservation includes the original 1,255-acre plant site located on a peninsula formed by the confluence of the Clinch and Emory Rivers and additional property purchased by TVA after 2008.

Built between 1951 and 1955, the nine-unit, coal-fired steam-generating plant originally had a summer net generating capability of 1,398 MW[3]. In recent years, the KIF units have been subject to a much greater degree of cycling to meet fluctuating loads. The intensive cycling of the KIF units, reflected in start-up/shutdown events are averaging greater than 85 times per year, which is outside the intended design basis of the plant. Additionally, KIF has been

[3] The original nameplate generating capacity of the existing KIF plant is 1,700 MW. The nameplate capacity is the intended or designed full load sustained output capacity that could theoretically be produced by the plant. However, the net generating capacity for KIF that is output to the grid is 1,398 MW net summer capacity, which is less than the generator nameplate capacity as the components connecting plant generators to the power grid also use some of the capacity produced at KIF.

dealing with significant material condition issues (resulting from long-term wear and tear of machinery) over the last five years, including repairs to the lower boiler drum. These types of repairs are often indicators of material condition failures, which are difficult to proactively address. As such, TVA has developed planning assumptions for the retirement of the existing KIF Plant. The Proposed Action to retire KIF and pursue alternative power generation sources would provide cost-effective replacement generation, consistent with the 2019 IRP and near-term future TVA energy production goals.

Summary of the Purpose and Need for the Proposed Action

The purpose of the Proposed Action is to retire and decommission the nine coal-fired KIF units by the end of 2027, and to provide replacement generation that can supply at least 1,500 MW of firm, dispatchable power plus capacity to account for modest load growth by the time the units are retired; which is consistent with the 2019 IRP and near-term future TVA energy production goals. The 2019 IRP's recommendations on near-term actions that would provide benefits across multiple futures (TVA 2019a) include:

- evaluation of engineering end-of-life dates for aging generation units to inform long-term planning;
- the addition of solar capacity based on economics and customer demand to enhance system flexibility to integrate renewables and distributed resources; and
- the development of distribution resource planning for integration into TVA's planning process.

The need for the Proposed Action is to ensure that TVA continues to meet the required year-round generation and maximum capacity system demands and planning reserve margin targets, particularly during peak load events; and to provide voltage transmission system support to the local area to maintain overall system stability and reliability.

Summary of the Alternatives

Under the No Action Alternative, TVA would not retire the nine existing KIF units; therefore, additional upgrades, repairs and maintenance would be necessary to continue operation of the units, maintain generation reliability, and meet requirements under new and anticipated environmental regulations. Existing conditions at KIF and in the vicinity would be maintained and the continued management of coal combustion residuals (CCRs) would be required. Under the No Action Alternative, TVA would plan to construct and operate a new wet flue gas desulfurization (WFGD) wastewater treatment (WWT) facility and modify existing processes at KIF to achieve compliance with the October 2020 Effluent Limitation Guidelines (ELGs) general applicability category. This action would enhance the wastewater quality to meet regulatory limits established by the United States Environmental Protection Agency's (USEPA's) ELGs and would improve the marketability of gypsum produced in the WFGD process.

Under both Action Alternatives A and B, the nine KIF units and associated components and structures would be retired and demolished. Both Action Alternatives are capable of providing at least 1,500 MW of replacement generation plus capacity to account for modest load growth: construction and operation of a CC gas plant paired with dual-fuel Aero CT units, 3- to 4-MW solar site, and a 100-MW battery energy storage system (BESS) on the Kingston Reservation (Alternative A); and construction and operation of multiple solar generation and BESS facilities at alternate locations within portions of East Tennessee

(Alternative B). This EIS also evaluates related actions associated with gas supply, including a 122-mile natural gas pipeline and gas compressor station, along with the transmission components for each alternative.

Preferred Alternative

TVA's Preferred Alternative for replacing generation after the retirement of KIF is Alternative A because a CC gas plant paired with sixteen dual-fueled Aero CT's would be the best overall solution to supply low-cost, reliable, and cleaner energy to the TVA power system consistent with the 2019 IRP. The proposed CC/Aero CT Plant would enable the accelerated retirement of the KIF coal-fired units by the end of 2027 (their projected end-of-life date) and provide the flexibility needed to reliably integrate 10,000 MW of solar onto the system by 2035. Therefore, TVA's Preferred Alternative could be built and be operational sooner than Alternative B, which would reduce economic, reliability, and environmental risks. The Preferred Alternative would replace coal-fired generation, consistent with the target supply mix adopted in the 2019 IRP and the Coal End-of-Life Evaluation for the aging coal fleet (TVA 2021g) and would meet the purpose and need of the Proposed Action to have the replacement generation operating by the end of 2027.

Summary of the Preferred Alternative

The following summary of affected resources focuses on Alternative A. A summary level comparison of all three alternatives is provided in Section 2.2, and detailed information about the affected environment and environmental consequences associated with the three alternatives for each resource area is contained within Chapter 3. The proposed pipeline to provide natural gas to the Alternative A CC/Aero CT Plant is subject to Federal Energy Regulatory Commission (FERC) approval and FERC will prepare a separate EIS on the proposed natural gas pipeline and associated structures. Available information (as of December 2022 revised Resource Reports) on the affected environment and environmental consequences of the construction and operation of the pipeline provided by East Tennessee Natural Gas (ETNG), the pipeline developer and operator, is incorporated into TVA's review in this KIF EIS. Resource effects summaries provided below are presented separately for proposed TVA Actions and proposed ETNG actions associated with the natural gas pipeline and associated structures.

Environmental Justice

TVA's EIS first identifies Environmental Justice (EJ) populations in proximity to each Alternative, then incorporates analyses of potential effects in relation to each of the subsequent resource areas. The identification of EJ qualifying populations is based on the "meaningfully greater comparison" criteria, as defined in Section 3.4. A summary of the anticipated effects by resource area is provided in Section 3.4.2 and provided in abbreviated form below.

<u>Affected Environment</u>

The Kingston Reservation EJ Study Area was determined to be a 10-mile radius of the Kingston Reservation. Within this area, one of the 49 census block groups was identified as a minority EJ population and eight of the 49 census block groups were identified as low-income EJ populations. One of the low-income population block groups also included individuals who reported speaking English less than well.

The study areas for the proposed off-site transmission line upgrades include the existing Western Transmission Corridor (Lines [L]5383) and Eastern Transmission

Corridor (L5108, L5302, L5116, L5280, and L5381) and their associated rights-of-way (ROW) and access roads with a one-mile buffer, collectively referred to as the Transmission Corridor EJ Study Area. The Transmission Corridor EJ Study Area identified two of the 34 census block groups as minority populations, four as low-income populations, one block group as both a minority and low-income populations, and one of the census block groups as having minority and low-income populations with individuals who reported speaking English less than well. Overall, based on the EJ evaluation described in Section 3.4, the Kingston Reservation and Transmission Corridor EJ study areas had a higher poverty ratio than the state average.

The TVA Expanded EJ Study Area included an area encompassed by the ETNG Construction ROW with a 1.0-mile radius buffer. Seven of the 50 census block groups within this area were identified as minority EJ populations, eight were identified as low-income EJ populations, six were identified as both minority and low-income, and one of the 50 the census block groups was identified as minority and low-income and with individuals who reported speaking English less than well.

<u>Environmental Consequences</u>

TVA Actions

Under Alternative A, the retirement and demolition of the KIF coal units may have certain amplified effects to EJ populations. Minor effects to soils, water resources, air quality, recreation, land use, transportation, socioeconomics, noise, and aesthetics (visual resources) near the Kingston Reservation and existing transmission lines may have both temporary and permanent minor impacts to nearby populations residents, some of which are EJ populations. Minor beneficial effects to EJ and non-EJ populations may also occur due to the change in power generation with implementation of Alternative A as KIF would cease coal combustion activity. Therefore, waste streams associated with electricity generation at a coal plant would also cease discharging. Although these discharges meet all water quality criteria and are in compliance with Clean Water Act (CWA) permitting, these discharge streams would be eliminated entirely, along with the risks associated with them. Water quality would likely improve due to reduced loading of metals in the coal plant's discharge. Additional beneficial effects would likely include the reduction in fish mortality from impingement and entrainment at the intake of the existing KIF plant. Furthermore, employment in the TVA EJ Study Area is expected to temporarily increase because of construction needs, and air quality for nearby residents would improve due to reduced air emissions because natural gas is a cleaner energy source than coal.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Minor, temporary effects to EJ and other populations would occur due to impact to soils, water resources, air quality, recreation, land use, transportation, socioeconomics, noise, and aesthetics (visual resources) near the natural gas pipeline ROW and associated structures. Minor but permanent effects to EJ and other populations would occur due to the loss and conversion of prime farmland, the chosen location of waste disposal, and local socioeconomics effects caused by the construction of the Ridgeline Expansion Project. Minor effects to EJ and other non-EJ human populations would be experienced during construction due to potential indirect effects to aquatic life used for subsistence and loss of forested areas (permanent and temporary) within the ETNG Construction ROW. Adverse effects to EJ populations could potentially be amplified because these communities often experience compounding effects and social disadvantages compared to non-EJ human populations.

Physical Characteristics (Geology, Soils, Prime Farmland, and Floodplains)

Affected Environment

The Kingston Reservation lies at the physiographic boundary of the Western Valley and Ridge and the Cumberland Plateau Physiographic Provinces of Tennessee. This area is characterized by northeast-trending ridges underlain by resistant rock separated by valleys underlain by less resistant rock. Multiple subsurface fault lines are in the vicinity of Kingston Reservation. The presence of carbonate rocks can contribute to the formation of karst-related features. The geologic formations underlying the proposed Project Area may contain fossiliferous remains of marine invertebrates. While invertebrate fossils may be found in Tennessee, unique paleontological resources are not known to exist within the proposed project area.

The Western Transmission Corridor (consisting of L5383) is also located in the Cumberland Plateau Physiographic Province. The Crossville Fault, part of the Cumberland Plateau Overthrust, trends northeast to southwest and crosses the Western Transmission Corridor near the eastern extent of the proposed Western Transmission Corridor upgrades. The Eastern Transmission Corridor (consisting of L5108, L5302, L5116, L5280, and L5381) are in the western Valley and Ridge Physiographic Province and have the same geological hazards identified for the Kingston Reservation.

The ETNG Construction ROW would cross the Cumberland Plateau, then the Eastern Highland Rim, and terminate within the Nashville Basin Physiographic Province. The corridor crosses areas with high sensitivity to karst and a high incidence of sinkhole and cave development.

Soils and Prime Farmland

Fourteen soil types occur on Kingston Reservation, with approximately 9.5 acres of prime farmland. No hydric soils are present. The prime farmland is outside of the Alternative A boundaries for the proposed CC/Aero CT Plant and switchyard, 3- to 4-MW solar facility, 100-MW BESS, and on-site transmission line corridors.

Forty-four soil types occur within the Eastern Transmission Corridor, however approximately 60.4 percent of this area does not have digital data available. Of the available data, 95.7 percent of the corridor contains non-hydric soils and 4.3 percent classified as predominantly non-hydric soils. Approximately 3.2 percent of the corridor is designated as prime farmland.

Eight soil types are present within the Western Transmission Corridor, two of which are hydric (associated with named creeks), totaling less than 1.8 percent of the corridor. Approximately 22.2 percent of the corridor supports prime farmland.

The ETNG Construction ROW contains approximately 181 soil types, with approximately 3.2 percent of soils classified as predominantly non-hydric, 0.1 percent predominantly hydric, and 0.5 percent hydric (the remaining 96.2 percent classified as non-hydric). Approximately 30.0 percent of the ETNG Construction ROW is designated as prime farmland.

Floodplains
Half of Kingston Reservation is formed as a peninsula by the Emory River on the northern side and the Clinch River on the eastern and southern sides. Small areas of the 100-year floodplain are present on the margins of the Kingston Reservation boundary from these waterbodies.

Approximately 8.4 acres of the proposed CC/Aero CT Plant site would be located within the 100-year floodplain of the Clinch River. If chosen, Battery Site 1 would also overlap with a small portion (0.15 acre) of the 100-year floodplain from the Emory River; Battery Sites 2 and 3 fall outside of the 100-year floodplain boundary. Approximately 1.5 acres of the existing on-site transmission line corridor, and 0.58 acre of the proposed Battery Transmission Corridor would fall within the 100-year floodplain. No floodplains are present within the 3- to 4-MW solar facility area.

The existing off-site transmission corridors cross over several floodways (totaling 18.1 acres) and 100-year floodplains (totaling 59.7 acres) along the Eastern Transmission Corridor and one mapped 100-year floodplain of the Western Transmission Corridor (1.9 acres).

The ETNG Construction ROW would cross FEMA-mapped floodways and floodplains, however aboveground facilities would be constructed outside of the floodplain. The ETNG Construction ROW crosses 181 acres of mapped 100-year floodplain and 14 acres of regulatory floodway.

<u>Environmental Consequences</u>

TVA Actions
The proposed KIF retirement and demolition activities would affect geologic resources by the removal of the fossil plant and associated structures with controlled explosives, which would result in vibrations at the surface in the immediate vicinity of the facility when they are felled. Due to the small size of the subsurface disturbances and existing industrial development of the site, potential impacts to subsurface geological resources would be minor.

Minor direct effects to potential subsurface geological resources are anticipated from the construction of the CC/Aero CT Plant and related components (i.e., transmission corridors, BESS, and 3- to 4-MW solar facility due to the construction of foundations and/or transmission structures. Minor impacts from vegetation clearing, grading, and other site preparation activities associated with the construction of the CC/Aero CT Plant have the potential to disturb soil stability and increase erosion across 55 acres, plus an addition 8.5 acres at the switchyard. Minor permanent soil impacts would occur within the bounds of the 35-acre 3-to 4-MW solar facility for the installation of solar structures, however beneath the structures will be only temporarily impacted and revegetated following facility construction. This area has also already been heavily disturbed in the past. Minor soil disturbance would occur within the existing on-site transmission line corridors due to upgrade activities; this would be minor and temporary. Approximately 41 acres of soil would be disturbed with the construction of the Battery Transmission Corridor, consisting of vegetation clearing and permanent habitat conversion (i.e., conversion of forested areas to shrub or emergent vegetation communities). Between 30 and 40 acres would be impacted by permanent fill impacts associated with the battery site. Impacts to soils would be less if Battery Site 1 is chosen as this site is already considered developed or otherwise previously disturbed. Effects to soils associated with grading and site preparation activities from pipeline construction would be temporary and mitigated through Best Management Practices (BMPs).

Portions of the proposed CC/Aero CT Plant site are located within the 100-year floodplain of the Clinch and Emory Rivers, which would cause permanent impacts to up to 8.4 acres of floodplain on the proposed CC/Aero CT Plant site. No changes in flood elevations would be anticipated. The proposed locations for the solar facility and Battery Sites 2 and 3 are located outside the 100-year floodplains and would therefore not result in any impacts during construction or operation. However, approximately 0.15 acre of the proposed Battery Site 1 is located within the 100-year floodplain. and would result in minor permanent impacts to approximately 0.6 acres. Small portions of the transmission line ROW would be located within 100-year floodplains, consisting of approximately 0.58 acre (total) within the on-site transmission line corridor and 0.68 acre (total) within the Battery Transmission Corridor; although the floodplain may have minor disturbance, changes to floodplain capacity are not expected. Although the off-site transmission corridors cross over floodways, 100-year and 500-year floodplains, no impacts to these areas from transmission line upgrades are expected. If access roads are needed to be modified for crossing of floodways, it would be completed in a way that upstream flood elevations would not increase more than 1.0 foot.

ETNG Actions - Natural Gas Pipeline and Associated Structures

No mineral resources identified within 0.25-mile of the pipeline workspaces would be impacted. Mitigation measures would be utilized in karst prone or sloped areas to reduce the risk of geologic hazards and impacts during pipeline construction. Effects to soils associated with grading and site preparation activities from pipeline construction would be temporary and mitigated through BMPs and revegetation. Effects on prime farmland soils would be reduced using appropriate BMPs to control erosion and limit sediment and soil from leaving the project sites, as well through adherence to FERC's Upland Erosion Control, Revegetation, and Maintenance Plan (FERC Plan). Temporary minor effects to 100-year floodplains and floodways may occur as a result of pipeline construction; however, no permanent impacts are anticipated to floodplain functionality.

Water Resources (Groundwater, Surface Waters and Wetlands, and Water Quantity and Quality)

Affected Environment

The Kingston Reservation overlies the Cambrian-Ordovician carbonate aquifer system and the KIF facilities are situated on a peninsula formed by the confluence of the Clinch and Emory rivers. Several surface water features on the Kingston Reservation drain to the Clinch River arm of the Watts Bar Reservoir and/or are influenced by the reservoir. Nineteen wetlands totaling 4.64 acres, 33 streams or other wet weather conveyances (WWCs) totaling 20,551 linear feet (LF), and 7 ponds totaling 4.96 acres are located on Kingston Reservation. Most wetlands on the Kingston Reservation were categorized as persistent emergent with herbaceous vegetation communities (totaling 3.23 acres), followed by forested, broad-leaved wetlands (totaling 1.4 acres), and one small scrub-shrub wetland (0.01 acre).

Two WWCs totaling 1,333 linear feet (LF) and three wetlands totaling 0.15 acre are present within the proposed CC/Aero CT Plant boundary. No streams or wetlands occur within the bounds of the 3- to 4-MW solar facility. Up to four WWCs totaling up to 1,682 LF and one 0.12 acre pond is present on BESS sites 1, 2, or 3; no wetlands are present on any of the sites. Seven WWCs totaling 3,659 LF and one 23 LF intermittent stream are present within the existing on-site transmission corridor. Five WWCs totaling 607 LF are present within the proposed on-site Battery Transmission Corridor. No wetlands are within the Battery Transmission Corridor, however five wetlands totaling 0.68 acre are within the existing on-site transmission corridor.

The Western Transmission Corridor crosses 11 wetlands encompassing approximately 8.26 acres, five isolated wetlands totaling 0.58 acres, 18 streams totaling 4,571 LF, and 3 ponds totaling 1.54 acres. The Eastern Transmission Corridor crosses 28 jurisdictional wetlands encompassing 11.84 acres, five isolated wetlands totaling 0.49 acres, 55 streams totaling 14,159 LF, and 5 ponds or lakes totaling 7.97 acres.

KIF withdraws approximately 1,107 million gallons per day (MGD) from a surface water intake structure on the Clinch River for cooling and plant process water (e.g., sluice water, fire protection, boiler feed water, and other miscellaneous uses). Approximately 99 percent of the water withdrawal (1,096 MGD) is used for cooling, while approximately one percent is used for other purposes including process water. The withdrawn water is returned to the river after appropriate treatment via Outfalls 001, 002, 004 and 006, and complies in compliance with the KIF National Pollutant Discharge Elimination System (NPDES) permit number TN0005452.

From Outfall 001, KIF is authorized to discharge treated ash pond effluent (including Bottom Ash Transport Water [BATW], coal yard run off, utility building drainage area, fire protection flushes), combustion residual leachate, chemical and nonchemical metal cleaning wastes, ammonia storage area runoff, water treatment plant wastes (including reverse osmosis system reject and backwash), drainage from sluice line trench, station sump discharge, stormwater from the flue gas desulfurization (FGD) area sump, and American Air Filter area sump with precipitator wash and raw water leakage (Tennessee Department of Conservation (TDEC) 2021a).

At Outfall 002, KIF is permitted to discharge once-through condenser cooling water (CCW) discharge plus flows from Outfall 001, boiler blowdown, discharge from underflow ponds with fire protection flushes, raw water leakage and transformer/switchyard runoff, intake screen backwash from Outfall 004 and FGD drainers, discharge from FGD stormwater pond Internal Monitoring Point (IMP) 01A, and discharge from Outfall 006 (TDEC 2021a). Due to the discharge of once-through CCW, the Clinch River downstream of Outfall 002 is subject to thermal discharges in this area; the existing NPDES permit states that a thermal variance of 36.1°Celcius (°C) is authorized under CWA Section 316(a) and extended for this permit cycle. Effluent limitations and monitoring requirements for discharges from outfalls 001 and 002 are outlined in the KIF NPDES permit. Discharges from outfalls 001 and 002 have effluent limitations and monitoring requirements as outlined in the NPDES permit.

Outfall 004 discharges raw river water used for intake screen backwash, and Outfall 006 discharges air conditioning condensate, fire protection flushes, and plant water leakage (TDEC 2021a). None of the discharges from these outfalls have numeric limits or reporting requirements under the current NPDES permit.

Environmental Consequences

TVA Actions

There is a potential for indirect minor, temporary effects to groundwater from the demolition of the existing coal site and the construction of a new CC/Aero CT Plant. These potential effects would be mitigated with the use of appropriate BMPs. Additionally, sink holes and other karst features would be identified and either protected with buffer zones or filled in with grout if determined appropriate.

Permanent and temporary impacts to surface waters would occur under Alternative A. Permanent impacts would primarily occur due to fill of WWCs (1,453 to 2,815 LF) and potentially one pond (0.12 acre), depending on the battery site selected. WWCs do not support aquatic life due to the impermanence of water flow, as these features convey water only during significant rain events. Temporary impacts could occur to WWCs and an intermittent stream within the existing on-site transmission line corridors or Battery Transmission Corridor due to upgrade activities or corridor construction. BMPs would be used as needed to prevent soil erosion and sedimentation to downstream waterbodies.

Surface water withdrawals would not be required under the proposed construction of the CC/Aero CT Plant. Therefore, surrounding surface waters would benefit from the technology upgrade.

No wetlands are present within the proposed Battery Transmission Corridor. One wetland (0.02 acre) within the existing on-site transmission corridor was classified as an emergent/forested wetland. This wetland located on the boundary of the existing transmission line and likely has undergone previous maintenance to maintain the wetland as herbaceous or scrub-shrub within the corridor; a remaining portion of the wetland extending from the transmission line corridor to the Emory River is, and would remain, forested.

Wetlands within the existing off-site transmission corridors could be temporarily impacted during upgrade activities. Wetlands within these corridors are already subject to regular control and treatment for maintaining wetlands as herbaceous or scrub-shrub. During field surveys, several wetlands were classified as forested. Typically, these wetlands were early successional forested areas with small trees, located along ROW margins or unmaintained access roads. Temporary impacts would be incurred through the use of matting within wetlands to avoid permanent construction impacts due to the movement of construction equipment. Areas of potential temporary impacts would be restored to pre-construction conditions. Additional BMPs such as the use of silt fence and straw wattles will be implemented to minimize and avoid additional permanent and temporary impacts.

Applicable CWA Section 404 and 401 permits would be obtained from the U.S. Army Corps of Engineers (USACE) and Tennessee Department of Environment and Conservation (TDEC), and necessary mitigation credits purchased in the event that wetlands and streams cannot be avoided. Erosion and sediment control BMPs would be used to minimize indirect effects to wetlands and streams. Minor effects to surface water may occur but would be mitigated through the use of BMPs. Avoidance, minimization, and mitigation efforts are expected to reduce or eliminate the potential for cumulative effects to streams and wetlands.

ETNG Actions - Natural Gas Pipeline and Associated Structures
The proposed ETNG Construction ROW crosses a total of 567 waterbodies (including 192 perennial streams), 150 intermittent streams, 195 ephemeral channels, and 30 ponds or impoundments. Temporary impacts during construction would result from clearing activities, horizontal direction drilling (HDD), dry open cut crossing installation methods, temporary access road crossings, temporary workspaces, and hydrostatic test discharges. Minor, temporary impacts from potential spills or leaks of hazardous liquids from refueling procedures, and potential blasting activities could occur but would be by minimized through the use of standard BMPs. Turbidity would increase temporarily in streams that are trenched; however, trenched streams would be returned to their natural, original grade following completion of the pipeline installation and associated activities.

The permanent impact as a result of the installation of the natural gas pipeline would be related to the creation and maintenance of new permanent easement for the operation of the pipeline. This would result in the permanent conversion of 0.4-acres of forested wetland to emergent wetland habitat type (from forested to emergent) for 0.4 acre of wetlands within the ROW. Temporary effects from construction of the natural gas pipeline would also occur due to temporary workspaces and access roads needed for construction.

Air Quality and Greenhouse Gases, Climate Change

Affected Environment
The Kingston Reservation is in Roane County, which is an attainment area for all criteria pollutants; however, a portion of the county that includes the Kingston Reservation is a maintenance area for particulate matter less than or equal to 2.5 microns in width ($PM_{2.5}$). Based on its potential to emit (PTE), KIF currently operates under the conditions stipulated by Tennessee Air Pollution Control Board, Title V Operating Permit No. 572149.

All upgrade efforts for the Eastern Transmission Corridor would occur within Roane and Anderson counties, which are both counites in attainment with criteria pollutant ambient air quality standards except for $PM_{2.5.}$ Western Transmission Corridor upgrades would occur within Cumberland County, which is in attainment with criteria pollutant ambient air quality standards. The proposed 122-mile natural gas pipeline would pass through Roane, Morgan, Fentress, Overton, Jackson, and Smith counties. Except for Roane County, all counties that would be transected are currently in attainment for all criteria pollutants, and only the Kingston Reservation portion of Roane County is in maintenance status for $PM_{2.5}$.

Environmental Consequences

TVA Actions
Decontamination and deconstruction of KIF and the construction of the CC/Aero CT Plant proposed in Alternative A is expected to have temporary, localized, and minor effects on air quality and temporary, regional, and minor effects from Greenhouse Gas (GHG) emissions on climate change. With the decommissioning and demolition of the KIF coal-fired plant, the operation of the CC/Aero CT Plant is expected to have long-term, moderate, and beneficial effects on local air quality. Reductions in future regional GHG emissions are expected to have long-term, minor, and beneficial effects on climate change in comparison to the No Action Alternative.

The transmission line construction and upgrade activities are expected to have temporary, minor effects on air quality and no appreciable direct or indirect effect on regional climate change.

ETNG Actions - Natural Gas Pipeline and Associated Structures
The construction and operation of the new natural gas pipeline and associated infrastructure would have temporary, localized, and minor effects on air quality and temporary, regional, and minor effects from GHG emissions on climate change. The transmission line construction and upgrade activities are expected to have temporary, minor effects on air quality and no appreciable direct or indirect effect on regional climate change.

Conclusions of Analysis of Greenhouse Gas GHG and Social Cost of Carbon Dioxide Analysis

TVA completed an analysis of GHG and Social Cost of Carbon Dioxide (SCC), using methods consistent with the 2023 National Environmental Policy Act Interim Guidance on Consideration of Greenhouse Gas Emissions and Climate Change (Council on Environmental Quality [CEQ] 2023).For Alternative A, the potential social benefit from carbon dioxide (CO_2) operational emissions reductions is estimated to be a reduction in social costs between $11.5 million and $105 million dollars the first year of operation, in nominal dollars, and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative A life cycle social costs of GHG emissions ranges from approximately $559 million to $7 billion in nominal dollars. These values equate to between approximately $163 million and $1.9 billion in Net Present Value (NPV) to 2023 dollars. On a TVA system-wide basis, the estimated total Alternative A life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $373 million to $4.1 billion in nominal dollars. These savings/benefit values equate to between approximately $164 million and $1.7 billion in NPV to 2023 dollars.

In comparison to Alternative B, Alternative A has a higher estimated GHG life cycle emissions and associated estimated future social costs; however, other considerations, such as the need for firm, dispatchable power and the need to have this power in place by the end of 2027, would still lead TVA to identify Alternative A as the Preferred Alternative. In addition, the design of Alternative A is such that future implementation of hydrogen fuel blending, as this technology becomes viable, could result in further significant GHG emissions reductions.

Biological Environment (Vegetation, Wildlife, Aquatic Life, Threatened and Endangered Species)

Affected Environment
The Kingston Reservation and surrounding areas are located within the Southern Limestone/Dolomite Valleys and the Rolling Hills Ecoregion, a subdivision of the Ridge and Valley ecoregion. The vegetation found on the Kingston Reservation is largely a function of the land use history of the site, of which a large proportion has been heavily disturbed by the construction, operation, and maintenance of the generation and transmission infrastructure present on the Reservation. In general, the most heavily disturbed and degraded habitats are currently covered by early successional plant habitats, scattered areas of forest, and herbaceous vegetation dominated by non-native

plant species that possess little conservation value and have no potential to support federally or state-listed plant species or unique plant communities. Some areas of herbaceous vegetation, early successional and/or scrub-shrub habitat, principally along transmission line rights-of-way (ROW), contain significant populations of native plants but constitute marginally intact habitat. The proposed CC/Aero CT Plant area consists primarily of a heavily disturbed, herbaceous vegetative plant community.

The terrestrial wildlife found on Kingston Reservation is directly related to the vegetation and habitats present on-site. Herbaceous fields and fragmented forests located on the Kingston Reservation provide habitat for common terrestrial animal species, including a variety of common birds and mammals. The aquatic resources on Kingston Reservation include three perennial streams, four intermittent streams, seven ephemeral channels, 19 other WWCs (such as ditches and swales), seven ponds, and 19 wetlands totaling approximately 4.6 acres. The perennial and intermittent streams, and seasonally flooded wetlands may support aquatic or semi-aquatic life such as reptiles and amphibians.

The Western Transmission Corridor crosses the Cumberland Plateau, a subdivision of the Southwestern Appalachians ecoregion and consists mostly of open fields. The Eastern Transmission Corridor crosses the Southern Limestone/Dolomite Valleys and the Rolling Hills ecoregion, a subdivision of the Ridge and Valley ecoregion. Most of these corridors consist of fields or shrub habitat, as they are existing ROWs that undergrow regular vegetation maintenance. Overall, wildlife habitats present along the transmission line corridors and access roads are common to the region and, as habitats, are not unique or uncommon. Numerous streams, creeks, rivers, and ponds are crossed by the existing off-site transmission corridors and likely contain common fish taxa. No federally designated critical habitat has been identified along the transmission corridors.

ETNG Construction ROW encompasses portions of the Ridge and Valley, the Southwest Appalachians, and the Interior Plateau ecoregions. The corridor is located within the Old Hickory Lake, Cordell Hull, Obey River, Emory River, and Lower Clinch River watersheds of the Tennessee River Basin. The natural gas pipeline crosses the following subdivisions of the Ridge and Valley ecoregion: the Southern Limestone/Dolomite Valley and Low Rolling Hills; and the Southern Dissected Ridges and Knobs. Vegetation in the Ridge and Valley portions of the ETNG Construction ROW consist of approximately 50 percent forests. Habitat along the Construction ROW is likely to support game species of Tennessee as well as some non-game mammals, such as opossum and groundhog. The corridor does not include Essential Fish Habitat. Critical habitat for spotfin chub (*Erimonax monachus*) has been identified as potentially occurring within the ETNG Construction ROW in Fentress, Morgan, Putnam, and Roane counties.

<u>Environmental Consequences</u>

TVA Actions

Under Alternative A, minor, temporary impacts to wildlife, such as birds, reptiles, or amphibians, would be anticipated during the KIF demolition and the construction phases of the CC/Aero CT Plant, 3- to 4-MW solar facility, 100-MW Battery Site, and transmission line upgrades. Resident wildlife in affected areas are likely to be temporarily displaced into a variety of available adjacent habitats, located outside of the

Kingston Reservation demolition and construction boundaries and outside of the off-site transmission line corridors. Minor, permanent impacts would also occur due to the removal or conversion of habitat related to new facilities (e.g., battery storage, Battery Transmission Corridor). Upon project completion, remaining and stabilized habitats would be recolonized by new or previously displaced wildlife.

The retirement of KIF would result in the elimination of entrainment and impingement mortality of fish and mollusks in the vicinity of the KIF cooling water intake structure. Thermal discharges would also cease, generally improving water quality. There would be no long-term impacts to surface waters, and therefore to aquatic life, associated with the Alternative A CC/Aero CT Plant, or Transmission Corridors. No aquatic life is present on the proposed CC/Aero CT Plant site, and therefore it is unlikely that aquatic life would be affected by this alternative. Potential negative effects to aquatic resources during construction would be minimized through erosion and sediment control BMPs. Minor beneficial effects would occur from the elimination of entrainment and impingement of fish and mollusks and improvements to water quality by eliminating KIF discharges; those improvements may provide a minor beneficial effect to community anglers.

Direct effects to federally or state-listed threatened and endangered aquatic species are not anticipated to occur from KIF retirement and demolition. No impacts to protected plant, fish, mussel, or crayfish species are expected due to the construction and operation of the CC/Aero CT Plant, natural gas pipeline, or transmission line corridors. Overall, the impacts to protected species from the construction and operation of the proposed CC/Aero CT Plant, 3- to 4-MW solar facility, 100-MW Battery Site, and on-site and off-site transmission line corridors would be temporary and minor. Effects to protected bat species from the proposed construction actions are primarily caused by clearing for the Battery Transmission Corridor, resulting in a reduction in summer roosting habitat, however bats will likely continue to use the new corridor for foraging., Removal of suitable summer roosting habitat for federally listed bats required for project activities proposed under Alternative A require consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act. This consultation with the USFWS is underway. If feasible, to minimize effects to bat species, any tree removal would occur between November 15 and March 31 when these bats are not roosting in trees. Tree removal during this timeframe would also avoid direct effects to most nesting migratory birds of conservation concern.

Approximately 54.7 acres of vegetation within the proposed CC/Aero CT Plant site and 8.5 acres of vegetation within the proposed switchyard footprint would be impacted due to permanent clearing of vegetation. These areas primarily consist of herbaceous plant communities typically found in heavily disturbed areas and offer little habitat value for wildlife. Construction areas of the proposed CC/Aero CT Plant and proposed new on-site transmission line ROW would need to be cleared of vegetation and then managed under TVA's Transmission System Vegetation Management Final Environmental Assessment (TVA 2020b). Clearing required for installation of the proposed new on-site transmission lines would affect vegetation by converting forested areas to industrial land uses and/or maintained corridors. Impacts to vegetation during the proposed upgrades to existing off-site and on-site transmission lines would be minor and temporary. Generally, after completion of the Proposed Action, areas within the transmission line and pipeline easements would be maintained as scrub/shrub and herbaceous land.

ETNG Actions - Natural Gas Pipeline and Associated Structures
Construction of the natural gas pipeline and associated aboveground facilities would require clearing forested areas (755 acres) and maintenance of early successional and/or herbaceous habitat (agricultural fields, herbaceous and scrub-shrub habitat; 1,086.1 acres), as well as crossing of streams and wetlands. The proposed pipeline crosses a total of 567 waterbodies, including 192 perennial streams, 150 intermittent streams, 195 ephemeral channels, and 30 ponds or impoundments. In addition to surface waters, the pipeline would also cross 291 wetlands totaling 25.5 acres, including emergent, scrub-shrub, and forested wetlands. Minor and temporary impacts to surface waters and wetlands would occur during dry open cut and/or HDD pipeline installation. Applicable surveys for protected species and associated consultation with the agencies would be conducted prior to construction activities commencing. Erosion and sediment control BMPs would be deployed and USACE and TDEC permits would be obtained. Construction across these features would be temporally limited, completed within 24 to 48 hours, with natural flow restored and streambanks stabilized.

A variety of species may use the forested areas within the proposed ETNG Construction ROW. Prevalent habitat in the adjacent and surrounding area of the pipeline would minimize effects to species; mobile species are likely to leave the area once construction activities commence and may return upon completion of the project if habitat is appropriate. While species associated with forested habitat may leave areas cleared for the ETNG Construction ROW, species associated with early successional or field habitats may colonize the permanent ROW following construction.

Following construction, routine vegetation management within the Permanent ROW would result in periodic but temporary effects on habitats within the ROW. Resident species would be expected to be displaced intermittently with the presence of maintenance crews and in response to the alteration of habitats.

Natural Areas, Parks, and Recreation

Affected Environment
The area within and surrounding the Kingston Reservation includes several public and commercial recreation and natural areas. Nearby residents often use a public boat ramp for angling on Kingston Reservation near the discharge channel. In addition to the boat ramp, which is publicly accessible and provides access to the Emory and Clinch Rivers, there are several public and commercial recreation and natural areas are in the vicinity of KIF.

Major recreational and natural areas in the Eastern Tennessee region include the Great Smoky Mountains National Park and the Obed Wild and Scenic River. The Great Smoky Mountains National Park is located approximately 30 miles, 37 miles, and 38 miles southeast of the off-site transmission upgrades, Kingston Reservation, and natural gas pipeline, respectively. The Obed Wild and Scenic River is located approximately 0.5 mile west of the natural gas pipeline, five miles east of the off-site transmission upgrades, and 14 miles northwest of the Kingston Reservation.

The Eastern Transmission Corridor crosses natural areas, parks, or recreation areas, including Watts Bar Reservoir, Oak Ridge Reservation (ORR) Wildlife Management Area (WMA) (encompassing many sub-areas such as the Oak Ridge National Laboratory (ORNL), Black Oak Ridge Conservation Easement, various natural areas, and Manhattan Project National Historic Park), and the North Ridge Trail. No natural areas, parks, or recreation areas are crossed by the Western Transmission Corridor, however the Charles Russell Obed Reserve, a 50-acre conservation easement, exits within a 0.5-mile radius.

Natural areas, parks, and recreation areas are also located in proximity to the proposed natural gas pipeline lateral and transmission corridors. The proposed ETNG Construction ROW crosses eight natural and recreational areas, including the Old Hickory WMA and Recreation Area, Cordell Hull WMA and Recreation Area, Lone Mountain State Forest, the Cumberland Trail State Park, Dixona Farm Conservation Easement, and tributaries to the Obed Wild and Scenic River.

Environmental Consequences

TVA Actions

Minor but temporary adverse effects could occur to recreational uses of the sections of the Emory and Clinch rivers adjacent to the Kingston Reservation. Public access to the boat ramp located in the Kingston Reservation boundary could be temporarily interrupted during construction or deconstruction activities. Adverse effects to boat launching activities would be temporary and minor during construction. Because of the temporary nature of transmission upgrades, off-site transmission impacts on dispersed outdoor recreational activities, as well as natural areas and parks, would only include minor and temporary impacts from construction traffic along the corridors aside from areas where corridors directly intersect with managed forested areas.

ETNG Actions - Natural Gas Pipeline and Associated Structures

The proposed pipeline under Alternative A is anticipated to temporarily disturb 21 acres of natural and recreational resources during construction. Approximately 7.6 acres of this disturbance falls within an existing, permanent ROW. The minor temporary adverse effects to these resources would result from construction-related effects from increased local traffic and noise and visual disturbances from construction activity.

Land Use

Affected Environment

Kingston Reservation is categorized largely as medium and high intensity developed area, deciduous forest, and hay/pasture according to the National Land Cover Dataset (NLCD). The Kingston Reservation is a previously disturbed area within existing TVA property. The proposed CC/Aero CT Plant site largely consists of previously disturbed earth and hay/pasture. Battery Sites 2 and 3, as well as the Battery Transmission Corridor are primarily forested.

The Western Transmission Corridor is predominantly pasture/hay land with small areas of forest land and developed space. Land use in the Eastern Transmission Corridor is primarily agricultural and cleared forest land with smaller areas of developed space and open water.

Land within the proposed ETNG Construction ROW is largely designated as forest and pastureland, meaning the land is likely unused forest land or is farmed pastureland or timber.

Environmental Consequences

TVA Actions

Permanent changes to land use would occur in response to implementation of Proposed Alternative A. Approximately 55 acres associated with the CC/Aero CT Plant proposed on the Kingston Reservation would be converted from largely hay/pasture to industrial.

The 8.5 acres associated with the switchyard and 35 acres associated with the solar facility site would have minor to negligible impacts to land use, as these sites were previously disturbed for industrial use. Depending on which battery site is selected, 30-40 acres may be impacted. The land use of Battery Site 1 (30 acres) would not change, as it is already categorized as medium and high-intensity developed. Battery sites 2 (35 acres) and 3 (40 acres) would have large permanent impacts, as these sites are both forested and would require vegetation clearing prior to construction. Under Alternative A, the Battery Transmission Corridor constructed would result in the land use conversion from forested to herbaceous or scrub/shrub. The land use of the existing on-site transmission corridor would remain unchanged; TVA would make upgrades and continue the regular maintenance schedule that the existing transmission line corridor currently undergoes. Similarly, no land use changes are proposed within the Eastern or Western Transmission Corridors, as the ROWs are existing and will continue to be maintained as they have in the past. Overall, moderate, adverse, permanent impacts would occur due to Alternative A construction. No cumulative effects to land use would occur.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Pipeline construction would result in moderate impacts 230.3 acres of open land temporarily and 0.7 acre permanently; 867.0 acres of agricultural land temporarily and 26.2 acres permanently; 483.0 acres of forested land temporarily and 271.0 acres permanently; 13.8 acres of residential area temporarily; and 10 acres of wetlands temporarily and 16.2 acres permanently, including aboveground facilities. No cumulative effects to land use would occur.

Transportation

Affected Environment

The Kingston Reservation is served by highway, railway, and waterway modes of transportation. The proposed gas pipeline lateral corridor and transmission corridors are served by highway and railway modes of transportation. Larger roadways, such as Interstate-40 (I-40), State Route (SR) 58, SR 95, SR 61, and SR 62, would be used to access the Eastern Transmission Corridor, and I-40, SR 127, and SR 298 would be used to access the Western Transmission Corridor along with a number of smaller, rural roads in the vicinity of the corridors.

Environmental Consequences

TVA Actions

The majority of traffic impacts resulting from Alternative A would be on public roads near the Kingston Reservation, as transmission line activities associated with Alternative A are more dispersed than those from the CC/Aero CT Plant construction and would have a reduced localized impact to any set of roadways. Assuming one person per commuting vehicle, there would be a daily average morning inbound traffic volume of 500 vehicles and a daily outbound traffic volume of 500 vehicles for a total of 1,000 vehicles per day to the CC/Aero CT Plant site, with a maximum of 1,200 vehicles per day. Minor increases in traffic volume would also occur because of the construction and operation of the proposed solar BESS.

ETNG Actions - Natural Gas Pipeline and Associated Structures
Additional traffic impacts resulting from Alternative A would be on public roads near the proposed natural gas pipeline and facilities associated with Alternative A as those activities are more dispersed than those occurring on Kingston Reservation and would have a reduced localized impact to any particular set of roadways.

Overall, the effect from traffic volume generated by the construction workforce and the construction-related vehicles would have a moderate, temporary impact to driver safety and roadway degradation.

Utilities

Affected Environment
The Kingston Reservation is currently served by a variety of telecommunication providers and the Harriman Utility Board. Due to the ETNG Construction ROW being predominantly outside of incorporated municipality limits, some utilities may not be available and water supply may be provided by private wells and septic. Electric services are provided by the Clinton Utilities Board, the Cumberland Utility District, and Rockwood Electric Utility to the Eastern Transmission Corridor and Cumberland Connect and the Cumberland Electric Membership Corporation to the Western Transmission Corridor. Potable water supply to Kingston Reservation is provided by the Harriman Utility Board.

Environmental Consequences

TVA Actions
During demolition of the KIF coal plant, all buried utilities would be cut and capped within the project boundary and abandoned in place if they do not interfere with other ongoing projects in the vicinity. Prior to starting CC/Aero CT Plant construction, TVA would coordinate with existing telecommunications, electricity, natural gas, and water and sewer utilities. Overall, long-term beneficial impacts would occur due to decreased water use for the CC/Aero CT Plant. Service disruptions associated with Alternative A construction are expected to be minimized through coordination with impacted utilities. Transmission lines, switchyards, and the solar and battery storage facilities do not require water to operate, so water supply use would be limited to the construction period and therefore temporary. Project operations are not expected to result in adverse impacts to public or private water supplies unless operation and maintenance activities involving pipe excavation and repairs are needed. Minor beneficial impacts from the solar facility would occur due to the increased power generation and interconnection to the TVA grid.

ETNG Actions - Natural Gas Pipeline and Associated Structures
Project operations are not expected to result in adverse impacts to public or private water supplies unless operation and maintenance activities involving pipe excavation and repairs are needed. Overall, long-term beneficial impacts would occur due to improved reliability and service costs as a result of Alternative A.

Cultural Resources

Affected Environment

There are 16 recorded archaeological sites within the Kingston Reservation. One archaeological site (40RE45) that TVA has determined is eligible for listing in the National Register of Historic Places (NRHP) is located on the KIF Reservation but outside the proposed construction footprint. One site that is considered of undetermined NRHP eligibility, 40RE626, is located partially within the on-site transmission line upgrades portion of the project footprint, but the portion in the footprint lacks data value. There are no NRHP-listed, -eligible, or -potentially eligible archaeological sites in the footprints of the proposed 3- to 4-MW solar facility or the three alternative battery storage sites. There are no previously recorded historic architectural resources within the 0.5 half-mile buffer of the Kingston Reservation aside from the NRHP-eligible Green Cemetery.

There are three archaeological sites within the off-site transmission line corridors; all are recommended not eligible for the NRHP. The only previously recorded historic architectural resource near the transmission line upgrades for L5116, L5280, and L5381 not already covered in L5108, L5302, and L5383 is Bethel Cemetery, which is listed in the NRHP. There are 35 previously recorded archaeological sites within 0.5 mile of the transmission line upgrades not already covered in L5108, L5302, and L5382. Two of these sites are potentially eligible for the NRHP; the NRHP eligibility status of the remainder is unknown.

A total of 133 archaeological sites were recorded during the current survey of the proposed ETNG Construction ROW. A total of 44 newly and previously recorded sites are considered potentially eligible for the NRHP; additional testing investigations is recommended to evaluate their NRHP eligibility. Additionally, there are four previously recorded sites that are eligible for the NRHP; additional data recovery investigations are required if these sites cannot be avoided by construction activities. A preliminary historic architectural resources review conducted for the proposed ETNG Construction ROW identified 23 previously recorded resources located within a 0.5-mile radius. Of these sites, four are listed in the NRHP and one is eligible for the NRHP. Additionally, there are 17 cemeteries located within, or immediately adjacent to, the current natural gas pipeline area of potential effect (APE).

Environmental Consequences

TVA Actions

There is one recorded archaeological site (40RE45) within the potential CC/Aero CT Plant footprint at the Kingston Reservation. A Phase II investigation (HDR 2022a) was performed along mapped portions of the 40RE45 site boundary that fall upon elevated terrace landforms west and east of the Clinch River cove, south of a delineated wetland, and within a 20-meter (m) buffer. TVA finds that 40RE45 is eligible for inclusion in the NRHP, however, the site is located outside of the project footprint and therefore would not be affected.

To fulfill its obligations under Section 106 of the National Historic Preservation Act (NHPA), TVA has initiated consultation with the Tennessee State Historic Preservation Office (SHPO) and federally recognized Indian tribes regarding potential project-related effects to cultural resources from TVA actions proposed under Alternative A.

ETNG Actions - Natural Gas Pipeline and Associated Structures

To fulfill its obligations under Section 106 of the National Historic Preservation Act (NHPA), TVA and FERC would each consult with the Tennessee State Historic Preservation Office (SHPO) and federally recognized Indian tribes on their respective actions regarding specific effects to cultural resources along the ETNG Construction ROW. The 17 cemeteries within or adjacent to the current natural gas pipeline would be avoided.

In December 2021, [ETNG], in consultation with the SHPO, defined the Indirect APE for historic architectural resources along the ETNG Construction ROW. It was determined that the proposed underground facilities along the ETNG Construction ROW have a minimal potential to affect historic architectural resources. The pipeline component of the project would be located primarily within an existing ETNG right-of-way, when practicable, to minimize impacts to cultural resources, landowners, and the environment. To the extent practicable, ETNG does not plan to directly impact or remove existing historic buildings or historic structures, and upon completion of the project, any impacted landscape features, such as fences, would be restored post-construction; as such, potential for affects to historic architectural resources along the ETNG Construction ROW to be affected are very low.

Solid and Hazardous Waste

<u>Affected Environment</u>

The primary solid wastes that result from the operation of KIF are CCRs in the form of ash and gypsum. In Tennessee, CCRs require special approval for the wastes to be disposed of at a landfill specifically permitted to receive those types of wastes (Class I or II disposal facility). KIF is considered a RCRA conditionally exempt small quantity generator of hazardous waste by TDEC and a small quantity handler of universal waste. There are no active spills or compliance issues relating to activities at the environmental sites near the proposed ETNG Construction ROW or off-site transmission line corridors associated with Alternative A.

<u>Environmental Consequences</u>

TVA Actions

Demolition and construction debris would be generated during the demolition of KIF's metal buildings, footings, asphalt, etc. Direct effects would be minor due to the limited potential for hazardous waste to be discharged and/or released into the environment during demolition activities. The proposed CC/Aero CT Plant site is approximately 55 acres and has been permitted for landfill expansion, but that expansion has not been constructed or received waste. The site is not likely to contain or produce solid or hazardous waste, although any excavated materials may need to be tested for waste characterization if intended for off-site disposal or land application. Construction of the CC/Aero CT Plant would generate typical construction debris and small volumes of solid waste.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Under Alternative A, proposed pipeline construction activities would result in a potential increase in generation of solid and hazardous waste. Land clearing activities for construction along pipeline and transmission line corridors will likely generate vegetative solid waste. Land clearing debris will be disposed as appropriate by either chipping onsite or transported to a land clearing debris landfill facility.

Appropriate spill prevention, containment, and disposal requirements for hazardous wastes would be implemented to protect construction and plant workers, the public, and the environment. Once construction is completed, the generation of hazardous waste during operations would be similar to the current waste generation rates.

Safety

Affected Environment

Public emergency services in the vicinity of the Kingston Reservation include law enforcement services, fire protection services, urgent care clinics, and a hospital in the City of Harriman. Public emergency services in the area of the proposed pipeline include urgent care clinics, hospitals, law enforcement services, and fire protection services. Along the Eastern Transmission Corridor, fire protection services would be provided by the Roane County or Anderson County Fire Departments, and law enforcement services would be provided by the Roane County or Anderson County Police Departments. Along the Western Transmission Corridor, fire protection services would be provided by the Cumberland County Fire Department, and law enforcement services would be provided by the Cumberland County Police Department.

Environmental Consequences

TVA Actions

TVA's Standard Programs and Processes related to safety would be strictly adhered to during implementation of all the action alternatives. The safety programs and processes are designed to identify actions required for the control of hazards in all activities, operations, and programs. They also establish responsibilities for implementing Section 19 of the Occupational Safety and Health Act of 1970 (OSHA). TVA and its contractors are required to comply with OSHA regulations and follow a Site-Specific Safety & Health Plan. With proper planning, adherence to OSHA regulations and health and safety plans, and implementation of BMPs, effects from the project in relation to public health and safety would not occur.

ETNG Actions - Natural Gas Pipeline and Associated Structures

ETNG has outlined various preventive, emergency, patrolling, and safety measures in Resource Report 11 (ETNG 2022l). These measures include design specifications, selection of suitable construction materials, the use of a cathodic protection system to prevent corrosion, the installation of remote-control shutoff valves and sectionalizing block valves, and comprehensive patrols by well-qualified personnel. The pipeline would also be monitored 24/7 by qualified operators in a high-tech control center located in Houston, Texas, and a secondary Pipeline Control Center in Nashville, Tennessee. ETNG pipeline facilities would be built to meet or exceed the DOT safety standards.

Socioeconomics

Affected Environment

The Kingston Reservation labor market area, which includes counties in Tennessee, and the pipeline and transmission corridors socioeconomic study areas, which include census tracts in Tennessee, are largely rural. From 2010 to 2020, population growth was generally less than the growth for Tennessee, for the most part. Based on the 2016-2020 American Community Survey (ACS) 5-year estimates (ACS 2020), the populations were generally older than the overall state population. The percent of high school graduates was generally comparable to that of the state. Housing units were generally owner-occupied and varied in age compared to those from across the state. The study areas generally had varied unemployment rates and lower per capita income when compared to the associated state. A comparison of local and state levels in the study areas indicated that employment in the education industry was generally at comparable levels between the counties and Tennessee. Manufacturing was lower in each of the counties except for

McMinn, Meigs, and Monroe counties where manufacturing employment is over ten percent higher than the state.

KIF directly employs 200 annual staff in a range of positions, such as general laborers, steamfitters, machinists, electricians, analysts, administrators, and supervisors. The KIF average annual salary range is between $50,000 and $200,000. KIF also employs contractors for both short- and long-term operations labor support and contracts with coal and limestone mining operations and transportation companies that support additional employment and account for significant contributions to the area economy. Indirect and induced effects on the local economy associated with KIF occur through effects to sales, income, and employment in the region and the recirculation of money received through direct and indirect income sources and subsequent creation of new jobs and economic activities.

Environmental Consequences

TVA Actions

With KIF retirement, contracts associated with coal operations and indirect and induced economic activities would be canceled or cease. The people currently employed by KIF may become temporarily unemployed. TVA would help offset this loss by placing some interested employees in open positions across the TVA region. KIF employees and associated family members may also temporarily relocate for work or follow recent depopulation trends and permanently relocate elsewhere, though these changes may affect familial and community relations in the labor market area. The retirement of the KIF coal facilities may result in indirect employment effects to the nearby mining, trucking, and barge industries and likewise affect familial and community relations in the region from which these KIF products are purchased.

Employment in relation to construction and operations of the new CC/Aero CT Plant, switchyard, and transmission connections on the Kingston Reservation, would include new, temporary, and permanent employment options in the KIF labor market area. Effort would be made to locally source employees for the Kingston project.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Employment in relation to construction and operations of the natural gas pipeline and associated gas system infrastructure would provide new, temporary, and permanent employment options in the pipeline and transmission corridors socioeconomic study area. Construction activities would create minor, temporary adverse effects on transportation systems in the associated communities.

Noise

Affected Environment

Noise generating sources in the vicinity of the project site include boat traffic, routine vehicle operations at the project site, and the existing coal facility. Sensitive noise receptors in the vicinity of the Kingston Reservation include mostly residences with some commercial areas. The Eastern and Western Transmission corridors are within the vicinity of many noise receptors, consisting of mostly residences and vacant buildings, with some businesses, churches, farm buildings, industrial areas, schools, and campgrounds/sports fields. Sensitive noise receptors in the vicinity of the proposed pipeline and transmission corridors include mostly residences/vacant buildings with some businesses, churches, farms, and industrial areas, and one sports field.

Environmental Consequences

TVA Actions

Temporary and minor noise effects would occur during deconstruction and demolition of the KIF coal units and as a result of construction traffic for the CC/Aero CT Plant and related transmission lines. The use of explosives for portions of the demolition activities may result in moderate but temporary noise effects. With warning to the public prior to blasting activities, residents would be prepared for a single loud noise; therefore, direct impacts to noise levels in the area associated with blasting would be minor and temporary.

Noise effects from construction-related traffic are expected to be temporary and minor. The majority of noise disturbances would occur during construction of Alternative A components. Typical noise levels from construction equipment used for the CC/Aero CT Plant, 3- to 4-MW solar, BESS, and transmission line components are expected to be 85 dBA or less at a distance of 50 feet from the construction activities (Federal Highway Administration [FHWA] 2017). The increase in current noise levels is estimated to be less than 3 dBA. Construction would not result in the generation of, or exposure of persons to, excessive noise or vibration levels for lengthy periods, and noise mitigation efforts would be implemented by both TVA.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Temporary and minor noise effects would be anticipated during construction activities for the ETNG Construction ROW, similar to those from the TVA actions under Alternative A. After the construction of the pipeline, there would be little to no noise during its operation aside from occasional maintenance activities, including the periodic mowing of the pipeline ROW.

Ambient sound surveys and acoustical analysis for the NSAs nearest to the compressor station will be completed to determine operational noise impacts and appropriate control measures as a part of ETNG’s final Resource Reports to be submitted to FERC.

Visual Resources

Affected Environment

Aside from the Kingston Reservation, the surrounding region is undeveloped with residential development to the west and commercial development in the vicinity of Interstate-40 to the south. Scenic attractiveness of the area is considered common, and scenic integrity is considered moderate due to human alteration in the area. The ratings for scenic attractiveness assigned to the project sites are due to the ordinary or common visual quality. The proposed CC/Aero CT Plant site is an area of common scenic attractiveness, as the site contains viewscapes comparable to the surrounding land use. The viewscape of the proposed pipeline and transmission line corridors are pre-disturbed open space and forest.

Environmental Consequences

TVA Actions

Most of the Proposed Alternative A deconstruction actions on Kingston Reservation are not expected to be discernible due to the screening effects of terrain and overall distance, nor would they contrast with the overall existing industrial landscape of the Kingston Reservation. The proposed CC/Aero CT Plant would generally be absorbed by surrounding industrial components and would become visually subordinate to the overall landscape character associated with the plant site.

ETNG Actions - Natural Gas Pipeline and Associated Structures

While most of the pipeline would not be visible once buried and operational; there would be long-term visual effects within the Permanent ROW from conversion of forest to herbaceous fields.

Minor, temporary visual impacts would occur during construction due to equipment on-site and construction activities. Long-term, adverse visual impacts would occur in areas where land uses are converted to maintained open space. Areas such as pasture, agricultural fields, or lawns would be returned to their former condition or stabilized with vegetation.

In sum, permanent visual effects would occur as a result of the construction of the CC/Aero CT Plant and accompanying equipment, aboveground facilities along the ETNG Construction ROW, and areas along transmission line and pipeline corridors where forestland is converted to maintained herbaceous habitat or open space. Where applicable, fencing and vegetative screening would be used to mitigate visual effects. Overall, the construction of Proposed Alternative A would largely blend in with the existing industrial environment and would not create significant visual discord.

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Symbols, Acronyms and, Abbreviations, and Glossary of Terms

Acronym	Description
AADT	Annual Average Daily Traffic
AC	Alternating Current
ACM	Asbestos-Containing Material
ADA	Americans with Disabilities Act
AERO	Aeroderivative
AJD	Approved Jurisdictional Determination
Alternative A	Action Alternative A
Alternative B	Action Alternative B
APE	Area of Potential Effect
ARAP	Aquatic Resources Alteration Permit
ATWS	Additional Temporary Workspace
BA	Biological Assessment
BACT	Best Available Control Technology
BADW	Bottom Ash Dewatering
BATW	Bottom Ash Transport Water
BESS	Battery Energy Storage System
BG	Block Group
BGEPA	Bald and Golden Eagle Protection Act
BMP	Best Management Practice
BO	Biological Opinion
B.P.	Before present
CAA	Clean Air Act
CC	Combined Cycle
CCR	Coal Combustion Residuals
CCR Rule	Disposal of Coal Combustion Residuals from Electric Utilities final rule
CCS	Carbon Capture and Sequestration
CCW	Condenser Cooling Water
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CH_4	Methane
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CT	Combustion Turbine
CWA	Clean Water Act
D4	Decommissioning, Deactivation, Decontamination, and Demolition
DBA	Doing business as
dBA	A-Scale Weighting Decibels
DC	Direct Current

Acronym	Description
DCH	Designated Critical Habitat
DEIS	Draft Environmental Impact Statement
DER	Distributed Energy Resources
DO	Dissolved Oxygen
DOJ	Department of Justice
DR	Demand Response
Dth/d	dekatherms per day
E&SCP	Erosion & Sediment Control Plan
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental justice
EJScreen	Environmental Justice Screening and Mapping Tool
ELG	Effluent Limit Guidelines
EMA	Emergency Management Agency
EMD	Electric Motor Driven
EMF	Electromagnetic Field
EO	Executive Order
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
ETNG	East Tennessee Natural Gas
FAL	Fish and Aquatic Life
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
FERC Plan	Upland Erosion Control, Revegetation, and Maintenance Plan
FERC Procedures	Wetland and Waterbody Construction and Mitigation Procedures
FGD	Flue Gas Desulfurization
FHWA	Federal Highway Administration
FSLG	TVA Flood Storage Loss Guideline
FSZ	TVA Flood Storage Zone
GHG	Greenhouse Gas
GIS	Global Information System
GWP	Global Warming Potential
HAP	Hazardous Air Pollutants
HDD	Horizontal Directional Drilling
HRSG	Heat Recovery Steam Generator
HUD	U.S. Department of Housing and Urban Development
Hz	Hertz
I-40	Interstate 40
IMP	Internal Monitoring Point
IPaC	Information for Planning and Consultation
IRP	Integrated Resource Plan

Acronym	**Description**
IRR	Irrigation
IWG	Interagency Working Group on Social Cost of Greenhouse Gases
IWS	Industrial Water Supply
KIF	Kingston Fossil Plant
kV	Kilovolt
LCA	Life Cycle Analysis
Ldn	Day-Night Sound Level
LEP	Limited English proficiency
L_{eq}	Equivalent sound level
LF	Linear Foot/Feet
LOLE	Loss of Load Event
LPC	Local Power Companies
LWW	Livestock, Watering, and Wildlife
m	meters
MBTA	Migratory Bird Treaty Act
MMBtu	Million British Thermal Units
MGD	Million Gallons per Day
MLV	Mainline Valve
MMI	Modified Mercalli Intensity
MMT	Million Metric Tons
MP	milepost
MVA	Megavolt Amperes
MW	Megawatt
MWh	Megawatt-hour
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NESHAP	National Emissions Standard for Hazardous Air Pollutants
NH_3	Ammonia
NHD	National Hydrography Dataset
NHPA	National Historic Preservation Act
NLCD	National Land Cover Dataset
NO_x	Nitrogen Oxides
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NPV	Net Present Value
NRCS	Natural Resources Conservation Service
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NRTS	Naturally Reproducing Trout Stream
NSA	Noise sensitive area
NSPS	New Source Performance Standard

Acronym	Description
NWI	National Wetland Inventory
OPGW	Fiber-Optic Ground Wire
ORNL	Oak Ridge National Laboratory
ORR	Oak Ridge Reservation
O-SAR	Office-Level Sensitive Area Review
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyl
PEM	Palustrine Emergent Wetland
PHMSA	Pipeline and Hazardous Materials Safety Administration
PIR	Potential Impact Radius
PFO	Palustrine Forested Wetland
PJD	Preliminary Jurisdictional Determination
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter less than or equal to 2.5 microns wide
PPA	Power Purchase Agreement
ppm	Parts per Million
PSA	Power Service Area
PSD	Prevention of Significant Deterioration
PSS	Palustrine Scrub Shrub Wetland
PTE	Potential to Emit
PV	Photovoltaic
RBI	Reservoir Benthic Index
RBLC	Reasonably Available Control Technology, Best Available Control Technology/Lowest Achievable Emission Rate Clearinghouse Database
RCRA	Resource Conservation and Recovery Act
REC	Recreation
RFAI	Reservoir Fish Assemblage Index
RFFA	Reasonably Foreseeable Future Actions
RICE	Reciprocating Internal Combustion Engines
RM	River Mile
RMP	Risk Management Plan
ROD	Record of Decision
ROW	Right-of-Way
SAIPE	Small Area Income and Poverty Estimates
SCC	Social Cost of Carbon Dioxide
SC-GHG	Social Cost of Greenhouse Gases
SCM	Social Cost of Methane
SCN	Social Cost of Nitrous Oxide
SCR	Selective Catalytic Reduction
SELC	Southern Environmental Law Center
SERVM	Strategic Energy and Risk Valuation Model
SHPO	State Historic Preservation Office
SO_2	Sulfur Dioxide
SPCC	Spill Prevention Counter Measure and Control Plan

Acronym	**Description**
SR	State route
Study Area	Gas pipeline study area
SWDA	Solid Waste Disposal Act
SWPPP	Stormwater Pollution Prevention Plan
TCP	Traditional Cultural Properties
TDEC	Tennessee Department of Environment and Conservation
TDOA	Tennessee Division of Archaeology
TDOT	Tennessee Department of Transportation
TEMA	Tennessee Emergency Management Agency
TMDL	Total maximum daily load
TN	Tennessee
TN AAQS	Tennessee Ambient Air Quality Standards
TRAM	Tennessee Rapid Assessment Method
TSCA	Toxic Substances Control Act
TS	Trout Stream
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
TWS	Temporary Workspace
ULSD	Ultra Low Sulphur Diesel
USACE	U.S. Army Corps of Engineers
USBLS	U.S. Bureau of Labor Statistics
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USDOE	U.S. Department of Energy
USDOT	U.S. Department of Transportation
USEIA	U.S. Energy Information Administration
USEPA	U.S. Environmental Protection Agency
USET	United South and Eastern Tribes, Inc.
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
US PAD	U.S. Protected Areas Database
UST	Underground Storage Tank
VOC	Volatile Organic Compounds
WFGD	Wet Flue Gas Desulfurization
WMA	Wildlife Management Area
WWC	Wet weather conveyance
WWT	Wastewater treatment

GLOSSARY OF TERMS

Aeroderivative Combustion Turbine – Highly efficient peaking units that can ramp up very quickly to provide capacity and grid support when needed. Aero CTs operate like a jet engine where the compressor draws air into the unit, compressing it, mixing it with fuel, and igniting it. As combustion occurs, gas expands through turbine blades connected to a generator to produce electricity. Aero CTs are different from simple-cycle CTs as they provide high cycling capability and very fast startup.

Aqueous Ammonia System – A system that delivers aqueous ammonia using vaporizers (electric hot air or steam heat) to generate ammonia. Aqueous ammonia is considered a safer delivery system than systems using anhydrous ammonia, an extremely hazardous material.

Battery Energy Storage Systems (BESS) – Devices that store energy from the grid and renewable sources, typically during periods of surplus power or low demand.

Best Management Practice (BMP) – Practices chosen to minimize environmental effects to a variety of environmental resources. BMPs are typically standard practices and not customized for a particular proposed action.

Bus – A conductor, which may be a solid bar or pipe, normally made of aluminum or copper, used to connect one or more circuits to a common interface. An example would be the bus used to connect a substation transformer to the outgoing circuits.

Capacity Credit – The percentage of nameplate capacity that is counted as firm, dispatchable capacity for meeting peak load requirements.

Capacity Factor – The ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period.

Carbon Capture and Sequestration – A process that involves capturing manmade carbon dioxide (CO_2) at its source and storing it permanently underground.

Coal Combustion Residual (CCR) – Ash and residuals from the flue gas desulfurization process (e.g., synthetic gypsum) produced by the combustion of coal to generate electricity.

Combined Cycle (CC) Plant – An electrical generating unit consisting of a natural gas-fired turbine and generator, a heat recovery steam generator that produces steam from the hot exhaust gases from the turbine, and a secondary turbine and generator powered by the steam.

Combustion Turbine (CT) Plant – An electrical generating unit fueled by either natural gas or oil consisting of a turbine and generator. CT plants can quickly begin generating electricity and are usually used to meet peak needs in power demand. Their efficiency is lower than that of CC plants. CT plants are also known as simple cycle plants to better distinguish them from combined cycle plants.

Cultural Resource – Resources may include historic buildings, structures, sites or objects, archaeological resources, Native American burials, funerary objects, sacred items, and other historic resources.

Cumulative Effect – Effects or impacts on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes the actions. Cumulative effects can result from individually minor but collectively significant actions taking place over a period of time.

Cycling – Short term and often large changes in the amount of electricity that a generating unit produces. The swinging of the generation load from high to low.

D4 – Decommissioning, Deactivation, Decontamination, and Demolition.

Deactivation (reroute and sever) – The process of removing energy sources from the structures to be demolished.

Decommissioning – The performance of activities required to ready a facility for deactivation, decontamination, and demolition.

Decontamination – Involves removing regulated materials, wastes, and chemicals prior to demolition.

Demolition – Removal of the plant and associated equipment and structures. Demolition also includes site restoration, creating conditions for proper site drainage, and stabilization.

Direct Effect – Effects or impacts which are caused by the action and occur at the same time and place.

Dispatchable Resource – Generating units whose electrical output can be adjusted (turned on or off) by operators according to system needs (electricity demand), unlike non-dispatchable renewable energy sources, such as solar photovoltaic or wind power. Can also include demand-side Demand Response products, which can be used for limited periods of time to reduce system load at peak hours.

Distributed Energy Resources (DER) – Small-scale unit of power provided by resources, such as solar, storage, wind, and combined heat and power, that are typically smaller in capacity than utility-scale and can be aggregated together in a program to function as a larger resource. They are typically owned by non-utility entities, such as homeowners (for rooftop solar) and commercial and industrial facilities.

Dual-Fuel Aero Derivatives – Gas turbine engines that can operate on both natural gas and liquid fuel. This allows the plant to switch between fuels depending on availability and cost, providing flexibility in fuel sourcing, and potentially reducing costs. Dual-fuel engines are commonly used in power generation facilities as they offer increased operational reliability and resilience, particularly during times of fuel supply disruption or price volatility.

Endangered Species – Plants or animals that are in danger of extinction through all or a significant portion of their ranges and that have been listed as endangered by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures outlined in the Endangered Species Act and its implementing regulations (50 CFR 424).

Environmental Assessment (EA) – An environmental assessment (EA) is prepared for a proposed action not qualifying as a categorical exclusion (CE) to determine whether an environmental impact statement (EIS) is necessary, or a finding of no significant impact (FONSI) can be prepared. An EA concisely communicates information and analyses about issues that are potentially significant and reasonable alternatives.

Environmental Impact Statement (EIS) – An environmental impact statement (EIS) is a detailed written statement that describes a proposed action and reasonable alternatives, including no action;, analyzes the potential environmental impacts associated with the proposed action, alternatives;, and identifies any mitigation measures to avoid, minimize, or compensate for impacts from a proposed action.

Environmental Justice (EJ) –The fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies.

Ephemeral Stream – Rain-dependent stream that flows only after precipitation.

Federal Register – The official daily publication for rules, proposed rules, and notices of federal agencies and organizations, as well as executive orders and other presidential documents.

Firm, Dispatchable Power – Refers to a generating resource that can adjust power output up or down on demand within the specific operating limitations of that resource. Firm, dispatchable power ensures that utility companies, like TVA, can call on the generating capacity year-round, particularly during peak load events – those periods of maximum electricity demand from customers, typically late afternoon in the summer and before or around dawn in the winter. Provides a backstop for solar resources that are unable to or are very limited in their ability to meet maximum demand that occurs in the pre-daylight or early-daylight hours of the winter season.

Fault Induced Delayed Voltage Recovery (FIDVR) – The unexpected delay in the recovery of voltage to its nominal value following the normal clearing of a fault.

Flexibility – The extent to which a power system can modify electricity production or consumption in response to variability, expected or otherwise.

Floodplain – The lowland and relatively flat areas adjoining flowing inland waters and reservoirs. Floodplain generally refers to the base floodplain, i.e., that area subject to a 1 percent or greater chance of flooding in any given year.

Fugitive Dust – An air pollutant consisting of very small particles suspended in air from dispersed sources and not from a stack or duct.

Greenhouse Gas (GHG) – Gases in the atmosphere that absorb energy, slowing or preventing the loss of heat to space. Primary greenhouse gases of concern are carbon dioxide, methane, nitrous oxide, chlorofluorocarbons, hydrochlorofluorocarbons, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Other greenhouse gases include ground-level ozone and water vapor.

Indirect Effect – Effects or impacts which are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems.

Inertia – A property of matter by which it continues in its existing state of rest or uniform motion in a straight line unless that state is changed by an external force.

Intermittent Stream – Seasonal stream that flows during certain times of the year when smaller upstream waters are flowing and when groundwater provides enough water for stream flow.

Invasive Species – An alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health.

Inverter-Based Resource – Power generation where the inverter is supplied with direct current input and, using power electronics and control algorithms, creates an alternating current (AC) output. This type of generation is standard with solar arrays and battery storage.

Karst – An area where topography, with its characteristic erosional surface and subterranean features, is developed as the result of dissolution of limestone, dolomite, or other soluble rock. Characteristic physiographic features present in karst terrains include sinkholes, sinking streams, caves, and large springs.

Line-pack – The amount of gas stored in a pipeline at a given moment, which is used to meet fluctuations in demand and balance short-term imbalances between supply and demand.

Loss of Load Event (LOLE) – In the event of adverse condition or disturbance on the TVA system, or on any other system directly or indirectly interconnected with it, TVA may interrupt service to customers.

Mitigation – Measures that avoid, minimize, or compensate for the environmental impacts of an action.

Nameplate Capacity –The maximum generating output that a power plant can produce under specific conditions designated by the manufacturer.

National Environmental Policy Act (NEPA) – The federal law that establishes a national policy on the environment and requires federal agencies to consider the effects of their proposed actions on the environment before final decisions are made and involve the public in the decision making. NEPA does not mandate particular results or substantive outcomes.

National Register of Historic Places (NRHP) – A list of places and objects maintained by the National Park Service based on their integrity of location, design, setting, materials, workmanship, feeling and association, and: 1) association with important historical events;

or 2) association with the lives of significant historic persons; or 3) embodiment of distinctive characteristics of a type, period, or method of construction or represent the work of a master, or have high artistic value; or 4) have yielded or may yield information important in history or prehistory.

Natural Gas Act (NGA) – A 1938 law regulating the transportation and sale of natural gas in interstate commerce and for other purposes.

No Action Alternative – The alternative in a NEPA study that would continue with the present course of action and in which the proposed activity would not take place.

Notice of Intent (NOI) – A public notice that an agency prepares to signify beginning the preparation of an environmental impact statement.

Perennial Stream – A stream that typically has water flowing in it year-round.

Photovoltaic Power Generation – The direct conversion of light into electricity at the atomic level.

Potable Water – Water that is safe and satisfactory for drinking and cooking.

Power Purchase Agreements (PPA) – A contract between two parties, one who generates and intends to sell electricity, and one who is looking to purchase electricity, defining the commercial terms for the sale of electricity between the two parties.

Power Service Area (PSA) – The area in which TVA provides energy, which is an area that encompasses 80,000 square miles covering most of Tennessee and parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia.

Practicable – Refers to the capability of an action being performed within existing constraints.

Preferred Alternative – The action alternative in a NEPA study which the agency believes would fulfill its statutory mission and responsibilities, considering economic, environmental, technical and other factors, and would meet a proposed project's purpose and need.

Primary Frequency Response – Primary frequency control (PFC) enables a frequency response to maintain grid stability. PFC maintains the correct frequency for a turbine/generator by adjusting the total MW output.

Prime Farmland – Land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops and is also available for these uses. It has the soil quality, growing season, and moisture supply needed to produce economically sustained high yields of crops when treated and managed according to acceptable farming methods, including water management.

Purpose and Need – A statement by an agency in a NEPA document to describe what it is trying to achieve by proposing an action. The purpose and need statement explains why an agency action is necessary and serves as the basis for identifying the reasonable alternatives that meet the purpose and need.

Reconductoring – To replace the cable or wire on an electric circuit, typically a high-voltage transmission line, usually to afford a greater electric-current-carrying capability.

Record of Decision (ROD) – The formal announcement by a federal agency, following the issuance of a final environmental impact statement, of the alternative that the agency decides to implement. It includes the reasons why the agency selected the alternative, identification of the alternative with the least environmental impacts, and mitigation measures, including any enforcement and monitoring commitments, for the selected alternative.

Reliability – The degree to which the performance of the elements in a bulk system result in electricity delivered to customers within accepted standards and in the amount desired.

Reserve Margin Target – Capacity carried for unplanned events related to weather, load forecast error, and system performance. Currently, TVA's summer reserve margin target is 18 percent and winter reserve margin target is 25 percent.

Reserve Margin Study – Routine probabilistic analysis to determine appropriate reserve margin targets to ensure resource adequacy for serving electricity demand in the Tennessee Valley service territory. It considers the uncertainty of unit availability, transmission capability, weather-dependent unit capabilities (e.g., hydro, wind, and solar), economic growth, and weather variations to compute expected reliability impacts and costs. TVA selects planning reserve margins for summer and winter that target an industry best-practice standard of one loss of load event (LOLE) in 10 years.

Rotating Generator – A device that converts mechanical rotation into direct current electric power using electromagnetism.

Shipper – An entity (person, company, or agency) that purchases services with respect to the transmission of natural gas by way of a natural gas transmission pipeline from the owner or operator of the pipeline, whether or not the gas is transported for the entity's own use.

Stability – The ability to return to normal or stable operation after having been subjected to some form of disturbance.

Selective Catalytic Reduction (SCR) – A clean air system used to reduce nitrogen oxides.

Surcharge – Adding rock or dirt to structure footing.

Target Power Supply Mix – Final recommendation from TVA’s 2019 IRP. This target, expressed in ranges, reflects the mix of supply and demand side resources that best position the Valley for success in a variety of alternative futures while preserving the flexibility necessary to respond to uncertainty.

Threatened Species – Any plants or animals that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their ranges and which have been listed as threatened by the U.S. Fish and Wildlife Service or the National Marine Fisheries Service following the procedures set out in the Endangered Species Act and its implementing regulations (50 CFR 424).

Title V (of the Clean Air Act) – Title V of the Clean Air Act (CAA) requires states to establish an air operating permit program for stationary sources that exceed major source thresholds, which are dependent on the attainment status of the area. The permits required by these regulations are often referred to as Title V permits.

Uprating – To increase the electrical features of a power line, such as allowing larger electrical clearances or improved electrical capacity, so uprating allows to increase the utilization factor of existing assets.

Wetland – An area inundated by surface or ground water with a frequency sufficient to support, and that under normal circumstances does or would support, a prevalence of vegetation or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction.

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CHAPTER 1 – INTRODUCTION

1.1 Purpose and Need for Action

Following the publication of the Tennessee Valley Authority (TVA) 2019 Integrated Resource Plan (IRP; TVA 2019a), TVA began conducting end-of-life evaluations of its operating coal-fired generating plants not already scheduled for retirement to inform long-term planning (Appendix A). TVA's Aging Coal Fleet Evaluation (TVA 2021g) confirmed that the TVA coal fleet is among the oldest in the nation and is experiencing deterioration of material condition and performance challenges. Performance challenges are projected to increase in the future because of advancing age and difficulty of adapting the fleets' generation to the changing generation profile. The continued long-term operation of some of TVA coal plants, including the Kingston Fossil Plant (KIF or KIF Plant), contributes to environmental, economic, and reliability risks.

KIF is located in Harriman, Roane County, Tennessee, approximately 35 miles west of downtown Knoxville. The plant is situated on a 2,254-acre plot of land (i.e., Expanded Kingston Property), which includes additional property purchased by TVA after 2008 and the 1,255-acre original plant site, which is situated on a peninsula formed by the confluence of the Clinch and Emory rivers (see Figure 1.1-1).

The nine-unit, coal-fired steam-generating plant has a summer net generating capacity of 1,298 MW; this capacity is down from 1,398 MW reported for 2020 due to long-term fuel blend changes at KIF[4].

KIF was built between 1951 and 1955. Frequent cycling of the large super-critical KIF units, reflected in start-up/shutdown events averaging greater than 85 times per year, is outside the intended design of the plant, and presents reliability challenges that are difficult to anticipate and expensive to mitigate. Additionally, KIF has experienced significant decline in material condition over the last five years, including the need for repairs to the lower boiler drum, which are symptomatic of age-driven material condition failures (i.e., failures due to aging and wear and tear) that are difficult to proactively address. As TVA continues to transition much of its fleet to cleaner and more flexible technologies, KIF would continue to be challenged to reliably operate outside of baseload operations. Based on this analysis, TVA proposes retiring all nine KIF units and the addition of at least 1,500 MW of firm, dispatchable replacement generation to recover generation capacity lost from retirement of KIF. Replacement generation of this capacity, plus additional capacity to account for load growth, would allow TVA to recover the dependable capacity of the nine units, as well as account for modest load increases driven by population growth from an increasing trend of immigration to the Tennessee Valley paired with increasing economic development. The replacement generation would need to be online prior to retirement of the KIF coal units.

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[4] Although the original nameplate capacity of KIFs nine units was 1,700 MW; effects of aging equipment and long-term fuel blend changes have reduced the actual annual generation at KIF from 1398 to 1298 MW. As such, TVA assumed at least 1,500 MW of firm, dispatchable replacement generation would be needed to recover generation capacity lost from the retirement of KIF, and to account for growth in demand in the Tennessee Valley from growing populations and increased economic development.

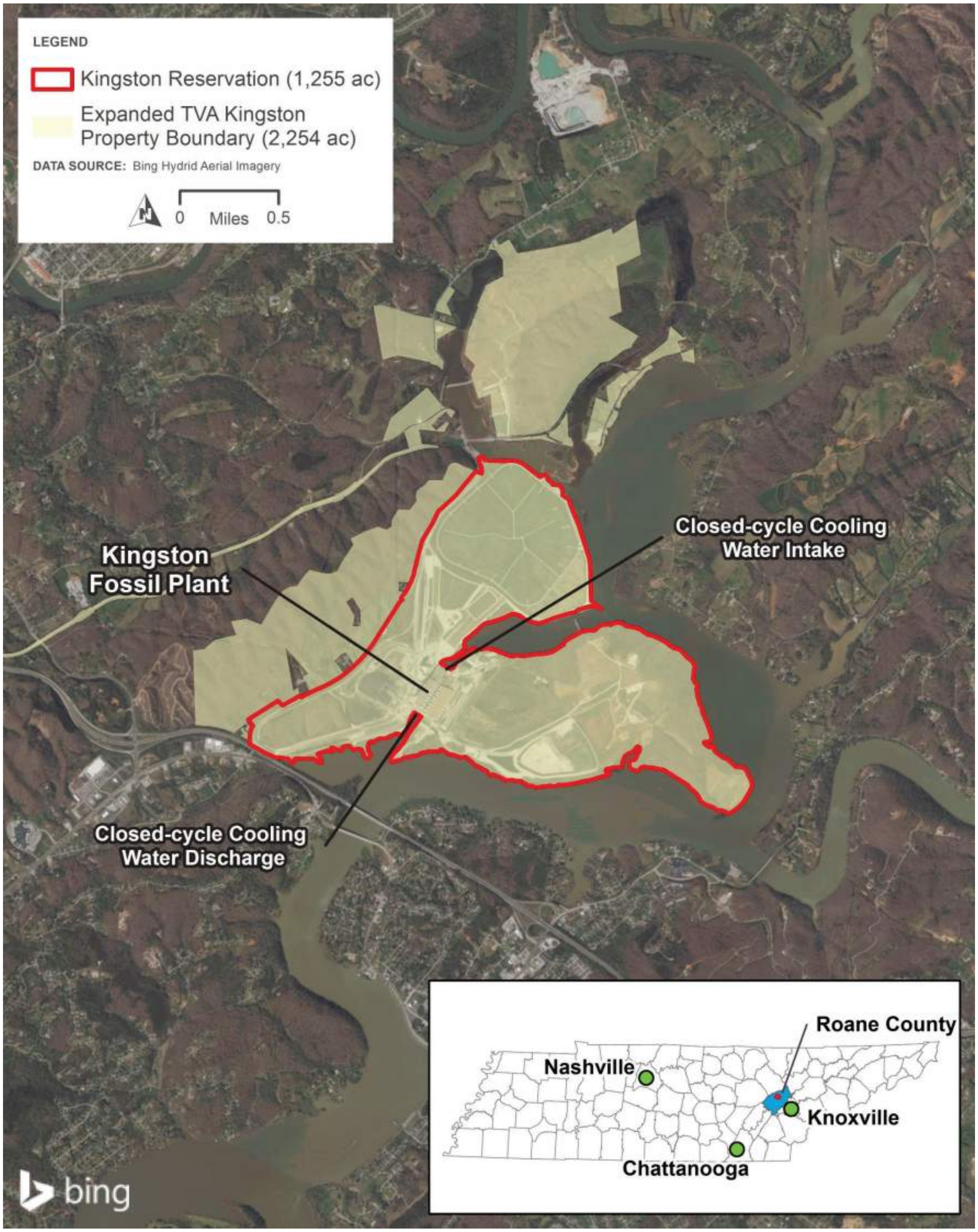

Figure 1.1-1. Kingston Reservation Boundary

Additionally, depending on the location of the replacement generation, regional transmission system upgrades would also need to be operational prior to the retirement of all KIF coal units. KIF's location on the transmission system, specifically on the 161-kilovolt (kV) system near the Knoxville load center, makes KIF an integral part of the system power flows and stability. The retirement of KIF would create a large gap in the power system in the Knoxville area and decreases the system stability for Watts Bar and Sequoyah nuclear plants. Significant transmission system upgrades in the local area would be needed if replacement generation is not provided and located on the 161-kV system near Knoxville. Retirement of KIF without replacement generation in the area or appropriate transmission upgrades would, significantly impact the ability to add additional load in the area, degrade the stability of Watts Bar and Sequoyah nuclear plants to a point where generation would need to be curtailed, and potentially violate North American Electric Reliability Corporation Transmission Planning (TPL-001) standard criteria.

The goal of this draft EIS is to address the potential environmental effects associated with the proposed retirement and demolition of nine KIF units and the addition of replacement generation. Consistent with the 2019 IRP, the Aging Coal Fleet Evaluation (TVA 2021g), and the Strategic Intent and Guiding Principles (TVA 2021h), the purpose of the Proposed Action is to retire and decommission all nine of the existing KIF units by the end of 2027 and implement replacement generation that can supply at least 1,500 MW of firm, dispatchable power by the time the units are retired in 2027. The need for the Proposed Action is to ensure that TVA continues to meet the required year-round generation and maximum capacity system demands and planning reserve margin targets, particularly during peak load events; and to provide voltage transmission system support to the local area to maintain overall system stability and reliability.

1.2 Background

TVA's core statutory objectives under the TVA Act are to provide the people of the Tennessee Valley with low-cost and reliable electricity, environmental stewardship, and a prosperous economy (16 U.S.C. §§831 et seq.). Consistent with, and as mandated by the Energy Policy Act of 1992, TVA engages in a long-range, "least-cost planning" process that "evaluates the full range of existing and incremental resources (including new power supplies, energy conservation and efficiency, and renewable energy resources) in order to provide adequate and reliable service to electric customers of [TVA] at the lowest system cost" (16 U.S.C. §831m-1(b)(1)).

1.2.1 Integrated Resource Planning

Every few years TVA publishes an Integrated Resource Plan (IRP), a comprehensive study of how TVA can best meet the future energy demand in its power service area, which encompasses approximately 80,000 square miles covering most of Tennessee and parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia. To accomplish the best blend of diverse resources for capacity to meet the Tennessee Valley's future demand for power, this least-cost system planning approach is leveraged to develop a better, more robust, IRP. The IRP helps TVA develop a Target Power Supply Mix to meet the Valley's future demand for power. The IRP serves as the central mechanism in establishing TVA's overall Asset Strategy. The least-cost planning occurs through the IRP studies process, which evaluates, based on the entire system, ranges of MW additions and subtractions that are consistent with TVA's least-cost planning mandate. Projects within the ranges identified in the IRP identified in TVA's Asset Strategy are consistent with TVA's system-wide least-cost as reflected in the IRP's Target Power Supply Mix.

TVA conducts the IRP process in a transparent, inclusive manner, using input from a diverse group of stakeholders, inclusive of the public, to help shape the IRP. TVA typically updates its IRP every four to five years to ensure that its power system adapts to changing demands and regulations. Prior to the 2019 IRP (TVA 2019b), the most recent TVA IRP updates were released in 2011 and 2015.

In June 2019, TVA published the 2019 IRP (TVA 2019a), which a comprehensive study of how TVA can best meet the future energy demand in its power service area. It evaluated six scenarios (plausible futures) and five strategies (potential TVA responses to those futures) and identified a range of potential energy resource additions and retirements. TVA noted in its development of the 2019 IRP that the quantity of air pollutant emissions, intensity of greenhouse gas emissions, and coal waste generation are anticipated to decrease under all strategies upon the utilization of a Target Power Supply Mix; therefore, use of this Target Power Supply Mix was adopted by the TVA Board. The Target Power Supply Mix identified the addition of up to 500 MW of demand response and 2,200 MW of energy efficiency (demand-side options); 4,200 MW of wind; 5,300 MW of storage; 8,600 MW of combustion turbines (CT); 9,800 MW of combined cycle (CC); and 14,000 MW of solar by 2038. The Target Power Supply Mix recommended in the IRP optimizes TVA's ability to create a more flexible power-generation system that can successfully integrate increasing amounts of renewable energy sources while ensuring reliability. The 2019 IRP acknowledged that reliance on only one strategy would not ensure reliability and resilience and, therefore, provided for a target supply mix made up of different generation resources. Additionally, the 2019 IRP recommended a series of near-term actions, including evaluating engineering end-of-life dates for aging fossil units, to determine whether retirements greater than 2,200 MW would be appropriate to inform long-term planning.

The strategic direction established by the 2019 IRP (TVA 2019a), and results from recommended near-term actions, formed the basis for TVA's Asset Strategy, which continues to support affordable, reliable, and cleaner energy for customers. The action alternatives evaluated in this EIS fit within the combination of resource technologies in the overall Asset Strategy including:

- Maintaining the existing low-cost, carbon-free nuclear and hydro fleets;
- Retiring aging coal units as they reach the end of their useful life, expected by 2035;
- Adding 10,000 MW of solar by 2035 to meet customer demands and system needs, complemented with storage;
- Using natural gas-fueled generation to enable needed coal retirements and solar expansion as other technologies develop;
- Leveraging demand-side options, in partnership with local power companies (LPCs); and
- Partnering to develop new carbon-free technologies for greater reduction in carbon emissions.

The inclusion of natural gas-fired CTs and CCs in the Target Power Supply Mix is driven by the demand for reliable electricity, the increased amount of solar penetration, system firm capacity requirements, commodity prices, costs relative to alternative resource options, and transmission system reliability (TVA 2019a). TVA's Target Power Supply Mix requires firm, dispatchable power, which refers to a generating resource that can adjust power output up or down on demand within the resource-specific operating limitations of that resource. For example, natural gas-fired CC and CT units can be operated year-round to meet the fluctuating demand on the power system, including overnight, during cold pre-dawn winter mornings, and during warm summer evenings as solar generation fades. Solar resources are typically only available on average about 20 to 25 percent of the year, and their availability can vary significantly during daylight hours as cloud cover and precipitation events occur. As such, solar power must be paired with firm, dispatchable power or battery storage to meet year-round capacity needs. Battery storage pairing is constrained in that batteries are energy limited (e.g., typically providing a 4-hour duration) and are net consumers of electricity. Pairing solar with flexible, firm, dispatchable resources provides a backstop to ensure system reliability is maintained during the hours that solar resources are not available, and during daylight hours when solar resources may quickly ramp up or down in response to local weather conditions. The inclusion of firm, dispatchable power generation from, for example, natural gas-fired CTs and CCs, effectively enables system-wide integration of solar and the retirement of TVA's remaining coal plants while providing critical transmission-related benefits to ensure reliability and power quality by reducing system inertia[5] (TVA 2019a).

1.2.2 Inflation Reduction Act of 2022

A key beneficial result of TVA's Asset Strategy is the reduction in carbon emissions. As TVA implements the Asset Strategy, and as articulated in TVA's May 2021 Strategic Intent and Guiding Principles document (TVA 2021h), TVA is executing a plan to reduce carbon emissions 70 percent from a 2005 baseline by 2030. From this strategy, TVA also envisions a path to 80 percent carbon reduction by 2035 and aspires to net-zero carbon emissions by 2050, while continuing to provide affordable and reliable power for customers. These goals are consistent with the climate goals of the United States (as detailed in Executive Order [EO] 14008 and EO 14082) to reduce greenhouse gas (GHG) emissions 50–52 percent below 2005 levels in 2030 and achieve net zero emissions by no later than 2050. They also make significant advancements towards meeting the current Administration's objective of achieving a carbon-free electric sector by 2035 to the extent this objective is compatible with the mandates of least-cost planning and other provisions of the TVA Act requiring TVA to take into account diversity, reliability, dispatchability, resiliency, and other related factors.

While the recently enacted Inflation Reduction Act (IRA) of 2022 (Public Law No: 117-169) may improve pricing and availability for renewable and storage resources in the long-term, the actual effect of that legislation on these markets is unknown at this time. TVA is optimistic that the legislation will enable faster adoption of renewable resources on TVA's system in the long-term. Relevant to this EIS, while the provisions of the IRA provide substantial incentives for various forms of clean energy, for a number of reasons, those provisions are of limited applicability with respect to the generation choice decisions confronting TVA at Kingston that are the subject of this EIS.

For example, the tax incentive provisions of the IRA are likely to take more time to implement than is available to TVA for purposes of choosing replacement energy for the KIF Plant. The selected replacement generation must be in place and operational prior to the retirement and demolition of KIF, which is scheduled for retirement by the end of 2027. The Treasury Department must issue guidance to establish certain qualifications and processes for tax incentive provisions, which could take up to a year, if not longer. Generally, taxpayers do not make firm commitments with respect to projects that are substantially dependent upon tax incentives until such final implementation rules are issued. To meet the needed end of 2027 timeframe, TVA does not have the flexibility to

[5] A property of matter by which it continues in its existing state of rest or uniform motion in a straight line unless that state is changed by an external force.

wait to select a replacement power alternative until after the Treasury Department has developed and issued regulations and guidance for IRA implementation.

As another example, the main renewable energy generation sources, wind and solar, are intermittent resources requiring substantial energy storage capacity to “firm” their reliability in order for them to be considered as a substitute for a dispatchable resource. The IRA includes significant tax incentives for energy storage, perhaps most significantly, extending the section 48 investment tax credit to energy storage technology. The full effect of the IRA remains to be seen in the marketplace due to the effect of the opposing forces of tax credits and increased demand. Assuming the 30 percent investment tax credit offered by the recently passed IRA, energy storage technology remains more expensive compared to TVA's Preferred Alternative. For instance, according to the U.S. Energy Information Administration's (USEIA) 2022 Annual Energy Outlook, a new CC plant's estimated levelized cost, entering service by 2027, is $37.05/MW-hours (MWh) (capacity-weighted), compared to $123.84/MWh for a battery energy storage system (BESS; USEIA 2022a). While the quoted values were published before the IRA's passage, the tax credit is unlikely to significantly impact TVA's cost considerations.

TVA is optimistic that the IRA will enable faster adoption of renewable resources on TVA’s system in the long term, but its enactment does not alleviate the transmission-related time constraints described in the Draft EIS for Alternative B that impair the ability of this alternative to fully meet TVA’s purpose and need of firm, dispatchable generation by the end of 2027. For these reasons, the IRA does not alter TVA’s selection of the preferred alternative (Alternative A) nor does it change the least-cost planning analysis that led to TVA’s adoption of the target supply mix in the 2019 IRP.

There are several market factors that are affecting both the cost and availability in the solar industry and the applicable supply chains. The regulatory initiatives to reduce greenhouse gas emissions have increased solar demand, putting pressure on manufacturers and the transportation industry. Solar panels are primarily produced overseas, and, at this time, the U.S. has little competitive onshore solar manufacturing capability. One example of this is Polysilicon, which is produced in China, and the prices of Polysilicon have significantly increased since before the pandemic.

Additionally, U.S. tariffs on Chinese imports, recent anti-dumping investigations on Southeast Asian imports, and enforcement process uncertainty with the Uyghur Forced Labor Prevention Act have created supply uncertainty on obtaining solar panels from primarily available sources. Ocean freight costs have also increased, which puts downward pressure on the supply of solar panels sourced from outside of the U.S.

Although shipping costs are trending downward, levels remain higher than pre-pandemic. Additional demand and cost for materials, such as steel, for which solar racking and tracking equipment is highly dependent, has also increased significantly. These impacts have led to a reversal of decades-old trend of decreasing solar prices and has led to many solar projects being postponed or canceled. While the IRA incentivizes the transition of the solar supply chain to the U.S., it is projected that it will take 3-5 years for domestic supply chain to mature and ease the current constraints on the supply.

Additionally, the tax incentive provisions of the IRA are likely to take more time to implement than is available to TVA for purposes of choosing replacement energy for the KIF Plant. The selected replacement generation must be in place and operational prior to the retirement and demolition of KIF by the end of 2027. The Treasury Department must issue guidance to establish certain qualifications and processes for tax incentive provisions, which could take up to a year, if not longer.

The ongoing global supply chain issues and delays caused by the COVID-19 pandemic may reduce the credit's financial benefits. Compared to the No Action Alternative, the Proposed Alternatives A and B includes an energy storage component, the cost and other considerations discussed here pertain to utility-grade energy storage that can effectively replace the KIF generation while accommodating load growth.

In any event, even with the long-term benefits that are expected from the IRA, substantial transmission assets would need to be developed for Alternative B, which would not affect the transmission-related time constraints described below for Alternative B that impair the ability of this alternative to fully meet TVA's purpose and need of firm, dispatchable generation by the end of 2027. As such, the IRA will would not alter TVA's fundamental need for flexible, fast-ramping generation, and for inertia service and primary frequency response, of the type provided by Alternative A (TVPPA 2022).

Thus, the IRA does not alter TVA's selection of the Preferred Alternative (Alternative A) nor does it change the system-wide least-cost planning analysis that led to TVA's adoption of the target supply mix described in the 2019 IRP. To the extent that the IRA improves pricing and availability for renewable resources over the next several years, TVA's next IRP, which it will initiate no later than 2024, will account for the relevant IRA benefits in its system-wide least cost planning analysis.

1.2.3 Retirement of Aging Coal Units

In 2021, TVA completed an evaluation of its existing coal fleet; the Aging Coal Fleet Evaluation (2021g). This analysis considered whether the complete retirement of TVA's coal fleet, about 6,000 MW in total, should be expedited beyond the 2,200 MW of coal capacity retirement by 2038 that was identified in the Target Power Supply Mix of the IRP (TVA 2019a). The operating cost and reliability challenges posed by the aging coal fleet drove the need for the Aging Coal Fleet Evaluation. Additional drivers for conducting the Aging Coal Fleet Evaluation included:

- Substantial performance and cost risk from operating a coal fleet composed of some of the oldest plants (between 50 and 69 years old) in the nation;
- Public, political, regulatory, and marketplace pressures to reduce coal generation and its environmental effects;
- Integration of increasing amounts of intermittent, renewable resources and distributed resources, which drives the need for increased system flexibility;
- Long-term financial health of the coal mining industry, which could influence both the supply and price of coal; and
- Development of a plan to systematically replace coal plants reaching the end of their useful lives, allowing for more effective and proactive management of the financial, logistical, and workforce impacts.

TVA's Aging Coal Fleet Evaluation (TVA 2021g) concluded that a phased plan to retire TVA's coal fleet by approximately 2035 is aligned with least-cost planning and reduces economic, reliability, and environmental risks. The evaluation also recommended specific planning assumption retirement dates for each of the coal plants to facilitate the 2035 end-of-life timeline for the coal fleet. These assumed retirement dates were identified based on a high confidence of execution while also balancing economics and system reliability needs. The planning assumptions for coal retirement dates outlined in the Aging Coal Fleet Evaluation balances economics, system reliability, and portfolio needs. Kingston and Cumberland are retired sooner due to Kingston's high cost and challenged condition and Cumberland's lack of flexibility. Shawnee and Gallatin are retired later due to relatively better condition. Shawnee's retirement is currently projected by 2034 to meet anticipated air quality compliance requirements (TVA 2021g).

The results of the Aging Coal Fleet Evaluation (TVA 2021g) confirmed that TVA's coal fleet is among the oldest in the nation and is experiencing material condition and performance challenges typical for plants approaching the end of their useful lives. Age-driven issues are difficult to proactively address and can result in unplanned or extended unavailability of these units, which may increase replacement power and plant maintenance costs and could impact overall system reliability if coal-fired plants are unavailable at times of high system loads. Coal fleet end-of-life, expected by around 2035, is aligned with least-cost planning and reduces economic, reliability, and environmental risks. If replacement generation is not in place, it would leave TVA short on required generation and capacity to meet system demands and planning reserve margin targets. Due to the TVA coal fleet's lack of "fit" with TVA's overall portfolio, TVA would need to operate the coal units outside of their intended design for traditional baseload operations (i.e., near the full power output for many weeks or months at a time). For example, increases in baseload nuclear generation and expansion of intermittent solar generation require KIF's large, typically baseload-serving coal units to operate more flexibly, such as ramping power output up and down throughout the day or cycling on and off more frequently, outside of traditional baseload operations. Because the coal fleet no longer fits TVA's overall portfolio, the coal fleet is projected to experience increasing performance challenges, which would continue to add economic, reliability, and environmental risk to the system.

1.2.4 Timing Needs for Coal Unit Retirement and Replacement Generation

Based on TVA's Aging Coal Fleet Evaluation (TVA 2021g), TVA identified planned retirement dates that would advance the overall purpose of the 2019 IRP of achieving the optimal blend of energy resources to meet TVA's clean energy transition goals in a manner consistent with least-cost planning principles. Retirement dates were determined for the entire coal fleet based on relative material condition, cost, flexibility, and environmental impacts. TVA's evaluation determined that retiring the coal fleet by 2035 would best be achieved by using a phased retirement approach to achieve the best balance between economics and system reliability.

The planning assumptions for coal retirement dates outlined in the Aging Coal Fleet Evaluation (TVA 2021g) balances economics, system reliability, and portfolio needs. Kingston and Cumberland are retired sooner due to Kingston's high cost and challenged condition and Cumberland's lack of flexibility. Shawnee and Gallatin are retired later due to relatively better condition. Shawnee's retirement is currently projected by 2034 to meet anticipated air quality compliance requirements.

To meet TVA's phased 2035 retirement plans for the coal fleet, at least 1,500 MW of operational replacement generation is needed to replace the retiring units at KIF and must be operational before the KIF units are retired by at the end of 2027. If this replacement generation is not in place, required generation and capacity to meet system demands and planning reserve margin targets would not be met. A delay in implementation of the 1,500 MW of replacement generation likely would lead to the need for continued operation of the coal units for an undetermined period of time. The cost to operate and maintain the KIF coal units beyond their planned retirement date would be expected to increase (see Section 8.2.6 of the 2019 IRP). Further, a significant monetary investment would be required to comply with the requirements of the 2020 ELGs Operation beyond 2027 would also inject operational, and therefore reliability, risk back into the TVA system due to the deteriorating condition of the coal units. In addition, operation of the KIF coal units beyond 2027 likely would result in cascading delays for the later planned retirements in TVA's phased 2035 coal fleet retirement plan and could delay TVA's plans to integrate more solar assets onto the system.

1.2.5 Firm, Dispatchable Power

To implement the Target Power Supply Mix recommended by the 2019 IRP and to create a more flexible power generation system that can successfully integrate increasing amounts of renewable energy sources while ensuring reliability, TVA needs to implement the Target Power Supply Mix recommended by the 2019 IRP. This would require at least 1,500 MW of firm, dispatchable replacement generation by the end of 2027 to replace the nine retiring units at KIF. Because the capacity from the nine KIF units is firm, dispatchable power, and to retain all the attributes of the KIF generated power on the system, including the ability to adjust power output up or down on demand, the replacement generation must also be firm, dispatchable power to reliably meet system peak load demands. This would ensure that TVA can call on the generating capacity year-round, particularly during peak load events (i.e., periods of maximum electricity demand from customers, typically late afternoon in the summer and before or around dawn in the winter). This is particularly critical in the winter because firm, dispatchable generation provides a backstop for solar resources that are unable to or are very limited in their ability to meet maximum demand that occurs in the pre-daylight or early-daylight hours.

1.2.6 Other Dispatchable Power Solutions

Pairing solar resources with the appropriate level of battery storage can compensate for the deficiency to generate consistently but adds cost and introduces transmission stability and reliability issues that then must be addressed with transmission system improvements. KIF's location on the transmission system, specifically on the 161-kV system near the Knoxville load center, makes KIF an integral part of the system power flows and stability. The retirement of KIF would create a large gap in the power system in the Knoxville area and decreases system stability for the Watts Bar and Sequoyah nuclear plants. Significant transmission upgrades in the local area would be needed if replacement generation is not relocated on the 161-kV system near Knoxville. Some battery storage could be interconnected in the Knoxville area, but the batteries would provide significantly less dynamic reactive power, do not provide stabilizing system inertia, and must be charged daily to deliver power during high load periods. The addition of solar and a BESS as replacement generation would not eliminate the need for significant transmission upgrades in the Knoxville area on the 161-kV system to support the load and stabilize the area.

1.3 Decision to be Made

The primary decision before TVA is whether to retire the nine KIF units by the end of the effective useful life of the plant and to provide at least 1,500 MW of firm, dispatchable replacement generation by the end of 2027. If the proposed KIF retirement and subsequent replacement generation is to occur, other secondary TVA decisions are involved. These include the following considerations:

- Timing of the proposed retirement, decommissioning, and demolition;
- Most suitable location(s) for the proposed replacement generation resource(s);
- Timing of proposed transmission system upgrades, if needed;
- Most suitable route for proposed transmission lines, if needed; and
- Determination of any necessary mitigation and/or monitoring to meet TVA standards and to minimize the potential for damage to environmental resources.

A detailed description of the alternatives is provided in Section 2.1.

Related actions, such as the siting, construction, and operation of a natural gas pipeline by ETNG are also considered in this assessment.

1.4 Environmental Impact Statement Overview

The National Environmental Policy Act (NEPA) requires federal agencies to consider the environmental effects of their proposed actions in their decision-making. Actions, in this context, can include new and continuing activities that are conducted, financed, assisted, regulated, or approved by federal agencies, as well as new or revised plans, policies, or procedures. The NEPA review process is intended to ensure federal agencies consider the environmental effects of their actions in the decision-making process (40 CFR 1500.1(c), 2022). NEPA also requires that federal agencies provide opportunities for public involvement in the decision-making process.

This EIS was prepared in accordance with NEPA (42 U.S. Code [U.S.C.] §§4321 et seq.); the regulations implementing NEPA promulgated by the Council on Environmental Quality (CEQ; 40 Code of Federal Regulations [CFR] §§1500–1508, 1515-1518, as updated July 16, 2020); and TVA NEPA regulations and procedures (18 CFR part 1318). The EIS is consistent with the CEQ finalized rule amending certain provisions of its 2020 regulations (87 FR 23453, April 20, 2022) and NEPA Guidance on Consideration of Greenhouse Gas Emissions and Climate Change released by CEQ in January 2023 (CEQ 2023).

TVA has prepared this EIS to assess the environmental effects of the Proposed Action. TVA used the input from the public scoping period, summarized previously in Section 1.4, in developing this EIS. The EIS will be distributed to interested individuals, organizations, and federal, state, and local agencies for their review and comment. Following the 45-day public comment period for this draft EIS, TVA will review the comments received and additional available information and develop the final FEIS. The final EIS will include TVA's responses to the comments on the draft EIS.

TVA has provided an estimated schedule of draft EIS and final EIS availability on its website at www.tva.com/nepa. This schedule will be periodically updated as needed. When available, TVA will post the final EIS on the TVA website; notices of its availability will be sent to those who received the draft EIS or submitted comments on the draft DEIS. TVA will send the final EIS to the U.S. Environmental Protection Agency (USEPA), which will publish a notice of availability in the Federal Register. A Record of Decision (ROD) would be issued by TVA, no sooner than 30 days after the publication of the notice of availability of the FEIS. The ROD will include (1) the decision; (2) the rationale for the decision; (3) alternatives that were considered; (4) identification of the environmentally preferable alternative; and (5) associated mitigation measures, monitoring, and enforcement requirements.

1.5 Related Environmental Reviews

Related environmental documents and materials relevant to this assessment are listed below. The contents of these documents help describe the affected properties and are incorporated by reference as appropriate.

1.5.1 Kingston Fossil Plant Alternative Coal Receiving Systems New Rail Spur Construction near the Cities of Kingston and Harriman, Roane County, TN (April 1999)

This EIS evaluated the elimination of two heavily used railroad-highway intersections that receive coal deliveries via the existing rail line with minor upgrades. In addition, this EIS evaluated the construction of a new high-speed coal unloading/loading system in its existing coal yard at KIF (TVA 1999).

1.5.2 Installation of Flue Gas Desulfurization System on Kingston Fossil Plant Roane County, Tennessee Final Environmental Assessment (April 2006)

This EA evaluated a proposal to reduce sulfur dioxide (SO_2) emissions at KIF by installing flue gas desulfurization equipment that employs the wet limestone forced oxidation technology in response to the 1990 Clean Air Act (CAA) requirements (TVA 2006).

1.5.3 Kingston Bottom Ash Dewatering Facility Environmental Assessment (March 2016)

This Environmental Assessment (EA) evaluated the proposed design of a dewatering facility for the conversion of wet bottom ash generated at KIF to a dry CCR product in accordance with TVA’s recommendation to convert the wet bottom ash management system at KIF to a dry storage system (TVA 2016b).

1.5.4 Fossil Plant Ash Impoundment Closure EIS (June 2016)

This programmatic PEIS evaluated the closure of ash impoundments containing Coal Combustion Residuals (CCR) at fossil fuel plants across the Tennessee Valley to support the implementation of TVA’s goal to eliminate all wet CCR storage at its coal plants (TVA 2016a).

1.5.5 TVA Integrated Resources Plan and PEIS (July 2019)

This programmatic PEIS (TVA 2019b) evaluated the potential effects of TVA’s long-term IRP, which provides direction on how TVA can best meet future electricity demand. The 2019 IRP (TVA 2019a) evaluated six scenarios (plausible futures) and five strategies (potential TVA responses to those futures) and identified a range of potential resource additions and retirements throughout the TVA power service area.

1.5.6 Kingston Fossil Plant Landfill Expansion Supplemental Environmental Assessment (August 2019)

This EA evaluated the proposed expansion of the boundary for the on-site landfill at Kingston. The proposed expansion would include additional acreage for a new laydown area, stormwater management, new clay soil borrow sites, and the development of haul roads. The Proposed Action is needed so TVA can adequately and effectively construct the second phase of the landfill (TVA 2019c).

1.5.7 Kingston Fossil Plant Borrow Site #3, Environmental Assessment (January 2020).

This Environmental Assessment (EA) evaluated the proposed construction of a new borrow site (Borrow Site No. 3) in response to landfill project phasing indicating that soil types in

Borrow Site No. 3 may have been needed to supplement the soil types available in other borrow sites. This would support routine operations as well as upcoming construction projects (TVA 2020a).

1.5.8 TVA Aging Coal Fleet Evaluation (May 2021)

This evaluation was performed to recommend near-term retirement planning assumptions to reflect practical timelines for replacement generation. The first draft of the evaluation was completed during Fiscal Year 2020, with refinements made in May 2021 (TVA 2021g).

1.6 Public Involvement for the 2019 IRP and Programmatic EIS

1.6.1 Public Scoping

Public involvement was a particular focus throughout the IRP development process. After publishing a Notice of Intent (NOI) for the 2019 IRP and PEIS in the Federal Register, TVA then sent the NOI to local and state government entities and federal agencies; issued a news release to media; and posted the news release on the TVA website. TVA also sent 2,500 scoping notices to agencies, organizations, and the public, including those on the 2015 IRP mailing list and people who registered to receive additional information on the TVA IRP website. TVA also published notices regarding the NOI and scoping period in local newspapers, including the following cities and associated newspapers:

- Chattanooga, Tenn. – Chattanooga Times Free Press
- Huntsville, Ala – The Huntsville Times
- Memphis, Tenn. – The Commercial Appeal
- Nashville, Tenn. – The Tennessean
- Knoxville, Tenn. – Knoxville News Sentinel
- Paducah, Ky – Paducah Sun
- Bowling Green, Ky – Bowling Green Daily News

TVA held two public meetings and a public webinar during the scoping period. The public meetings presented TVA's project objectives and initial alternatives for input from the public and interested stakeholders. Participants included the public; congressional, state, and local officials; representatives from local power companies; non-governmental organizations and other special interest groups; and TVA employees. Ninety-one individuals attended the meetings in person or via webinar. At the conclusion of the public meetings and scoping period, TVA issued the 2019 IRP Scoping Report, which included copies of scoping materials and the 87 comment submissions received during the scoping period. The scoping report used public input to develop the 2019 IRP framework and to help determine which resource options should be considered. The NOI and Scoping Report for the 2019 IRP and PEIS are available on TVA's Environmental Reviews website: https://www.tva.com/environment/environmental-stewardship/environmental-reviews/nepa-detail/Integrated-Resource-Plan.

1.6.2 IRP Working Group

The formation of an IRP Working Group was a cornerstone of the public input process for the 2019 IRP and consisted of 20 external stakeholders representing 20 organizations, 8 of which represented the interests of entities purchasing power from TVA and 12 other members representing energy and environmental non-governmental organizations;

research and academia with expertise in DERs; state government; economic development organizations; and community and sustainability interests. Additional details regarding the IRP working group members and affiliation are provided in Section 3.2.1 of the 2019 IRP (TVA 2019a).

1.6.3 Public Outreach and Briefings

TVA hosted four webinars during the IRP process to keep the public informed of the progress of the 2019 IRP and IRP PEIS. Each webinar included a brief presentation by TVA staff, followed by a moderated question and answer session. During development of the IRP and PEIS, TVA used social media communications (including Facebook, Twitter, LinkedIn, and Instagram) to inform and educate the public about the IRP and its processes and to promote opportunities for public input. Specific information on public outreach and the use of social media for the 2019 IRP and PEIS is available in Section 3.3 of the 2019 IRP (TVA 2019a).

1.6.4 Public Review of Draft IRP and PEIS

TVA also worked to reach a broader, more diverse cross section of the public to ensure awareness about the 2019 IRP and to provide opportunities for making comments. TVA sought input from existing partners who serve diverse communities regarding the methods that would be most successful in reaching a broader constituency. Generally, the input received suggested that working through groups and entities that have existing relationships with various diverse communities would be the most successful way to achieve this. Given this input, TVA sought to join existing events where people of greater diversity already were engaged. TVA also provided the draft IRP and PEIS for public comment and held public meetings around the region to provide an opportunity for residents and stakeholders to learn more about the draft IRP and PEIS, ask questions, and provide general feedback. Over 1,200 people commented on the draft IRP and draft PEIS (DEIS). Comments were grouped into six categories and then TVA provided responses to those comments in an appendix to the IRP final PEIS (FEIS). Additional information and details on the public review of the draft IRP and PEIS is provided in Section 3.4 of the 2019 IRP (TVA 2019a).

1.7 Public Involvement for the Proposed Kingston Fossil Plant Retirement and Replacement Generation EIS

1.7.1 Scoping and Notice of Intent for the KIF Retirement EIS

On June 15, 2021, TVA published a NOI in the *Federal Register* announcing plans to prepare an EIS to address the potential environmental effects associated with the proposed retirement and demolition of the KIF Plant and construction and operation of facilities to replace the retired generation (TVA 2021a). The NOI initiated a 30-day public scoping period from June 15 to July 15, 2021. In the NOI, TVA requested comments on other reasonable alternatives and environmental resources that should be assessed in the EIS. The purpose of the scoping period was to present TVA's project objectives and initial alternatives for input from the public and interested stakeholders.

In addition to the NOI published in the Federal Register, TVA invited members of the public as well as federal, state, and local agencies and federally recognized Indian tribes, to comment on the scope of the EIS. Project-specific information and a news release were listed on TVA's website at www.tva.com/nepa, including a link to a virtual public scoping meeting room and an online public comment page (TVA 2021b). TVA sent notification of the NOI via email to local and state government entities and federal agencies and posted flyers in local businesses. TVA published notices regarding the NOI in local newspapers, including the following cities and associated newspapers:

- Cookeville, TN – Cookeville Herald-Citizen
- Gainesboro, TN – Jackson County Sentinel
- Hartsville, TN – Hartsville Vidette
- Jamestown, TN – Fentress Courier
- Kingston, TN – Roane County News
- Knoxville, TN – Knoxville News-Sentinel
- Livingston, TN – Overton County News & Livingston Enterprise
- Wartburg, TN – Morgan County News

The virtual meeting room was hosted online for the duration of the scoping period and provided navigation to the following materials: welcome board and video, project purpose and need board, project alternatives map and detailed maps of each alternative, overview of NEPA compliance process and scoping, a location to submit comments, information on the virtual scoping meeting, and links to other related websites. The virtual meeting room also contained text-accessible versions of the content.

1.7.2 Public Scoping Meeting

A virtual public scoping meeting was held on June 29, 2021, from 6:30 pm to 8:00 pm EDT via Adobe Connect. The meeting was attended by 51 members of the public, regulatory agencies, and other organizations. TVA used comments submitted prior to and during the virtual public meeting to develop a list of Frequently Asked Questions, which has been posted onto the TVA Kingston project website (TVA 2021b). In accordance with Section 1318.402(h) of TVA's NEPA regulations, the Final Kingston Fossil Plant Retirement EIS Scoping Report (TVA 2021c) is available to the public on TVA's project website.

No other environmental resources were identified during the scoping process that TVA has determined should be addressed in detail in this EIS.

1.7.3 Scoping Feedback

During the EIS scoping period, TVA received approximately 56 comments, a form letter from Sierra Club with 583 signatories, and a petition from Energy Alabama with eight signatories. Comments were received from members of the general public, including potentially affected landowners, and from multiple non-governmental organizations, two federal agencies, and one state agency. Comments received during the scoping period were related to the alternatives under consideration, land use, water resources, biological resources, GHGs, cultural resources, socioeconomic and environmental justice effects, and cumulative effects. In their comments, the National Park Service (NPS) requested to participate in the NEPA process as a cooperating agency.

A scoping report was developed and includes information about NEPA, federal and local laws, and EOs that are relevant to this EIS. The scoping report (TVA 2021c) was made available to the public on the TVA project website and presents the public comments received, as well as information on how the EIS is being developed. A summary of comment submissions received and TVA responses is provided in the scoping report; comment submissions were compiled and provided in Appendix C of the scoping report; and, where relevant, TVA's responses to the comments are incorporated into this EIS.

Based on internal and public scoping, identification of applicable laws, regulations, EOs, and policies, TVA identified the resource areas listed below as requiring review within the EIS:

- Land Use
- Physical Characteristics, including geology, soils, prime farmland, and floodplains
- Water Resources, including groundwater, surface water, water quality, and wetlands
- Biological Environment, including vegetation, wildlife, aquatic life, and rare, threatened, and endangered species
- Natural Areas, Parks, and Recreation
- Air Quality and Greenhouse Gases
- Cultural Resources
- Solid and Hazardous Waste
- Environmental Justice
- Safety
- Socioeconomics
- Transportation
- Utilities
- Visual
- Noise

1.7.4 Stakeholder Engagement and Communications on the Draft EIS

Since the initial NOI release, TVA has been communicating information on the proposed KIF retirement project to local officials, business and community leaders, LPCs, and the general public on the project as it evolves. Stakeholder engagement and communications completed or proposed to be completed in 2023 are summarized in Table 1.7-1 below.

Table 1.7-1. Stakeholder Engagement and Communications Completed or Proposed in 2023 for the Kingston Retirement Environmental Impact Statement

Outreach Activity	Date	Key Audiences
Mid-East Community Action Agency	January 24	Community Leaders
Briefed Harriman Utility Board	February 16	Local Power Company
Briefed Rockwood Utilities	February 22	Local Power Company
Briefed staff of State Sen. Ken Yager	February 14	Public Officials
Briefed State Rep. Monty Fritts	March 7	Public Officials
Briefed State Sen. Ken Yager	March 29	Public Officials
Spoke to Rockwood Civitan Club	March 24	Business & Community Leaders
STEM Check Presentations at Midtown Elementary, Ridgeview Elementary, and Rockwood High School	March 24	Public Officials, LPC, School Community
Kingston Street Festival	March 25	General Public
Distributed Kingston DEIS Fact Sheets to Mid-East Community Action Agency (MECAA) Clients	March 29-31	Commodity Distribution Recipients/EJ Populations

Outreach Activity	Date	Key Audiences
Distributed Kingston DEIS Fact Sheets to Kingston, Harriman, and Rockwood Public Libraries and Community Centers	March 31	General Public
Roane County Realtors Speaking Engagement	April 13	Business & Community Leaders
Roane County Rotary Club Speaking Engagement	April 13	Business & Community Leaders
Harriman Utility Board and Rockwood Electric Bill Stuffers	May 1	LPC Customers in EJ Communities
Distribute Kingston DEIS Fact Sheets to MECAA LIHEAP Distribution List	May 1	Low Income Community
Volunteer Event at MECAA	May 18	General Public
Distribute Kingston DEIS Document to Kingston, Harriman, and Rockwood Public Libraries and Community Centers	May 19	General Public
Roane County Commission	May/June	Public Officials
Harriman City Council	May/June	Public Officials
Kingston City Council	May/June	Public Officials
Rockwood City Council	May/June	Public Officials
Host Virtual Public Meeting	June 6	General Public
Host Public Meeting at Rockwood High School	June 13	General Public
Host Public Meeting at Kingston Community Center	June 14	General Public

(*) Denotes effort targeted at identified or potential environmental justice populations or communities.

1.8 Necessary Permits, Licenses, and Consultations

TVA holds the permits necessary for the current operation of KIF. A summary of the laws and EOs relevant to the Proposed Action is provided in Table 1.8-1.

Table 1.8-1. Laws and Executive Orders Relevant to the Proposed Action

Environmental Resource Area	Law / Executive Order
Geology, Soils, and Prime Farmland	Farmland Protection Policy Act
Water Resources	Administrative Code of Tennessee 69-3-108 Administrative Code of Tennessee Department of Environment and Conservation (TDEC), Chapter 0400-04 CWA Sections 401, 402, and 404 EO 11988 – Floodplain Management EO 11990 – Protection of Wetlands EO 13778 – Restoring the Rule of Law, Federalism, and Economic Growth by Reviewing the “Waters of the U.S.” Rule EO 14008 – Tackling the Climate Crisis at Home and Abroad Safe Drinking Water Act TDEC Aquatic Herbicides General Permit Section 7 of the Wild and Scenic Rivers Act (WSRA) Section 10 of the Wild and Scenic Rivers Act (WSRA)
Biological Resources	Administrative Code of TDEC, Chapter 0400 Bald and Golden Eagle Protection Act (BPEPA) Endangered Species Act (ESA) Section 7 (Consultation with U.S. Fish & Wildlife Service) EO 13112 – Invasive Species EO 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds Migratory Bird Treaty Act (MBTA) EO 14008 – Tackling the Climate Crisis at Home and Abroad
Air Quality and GHG Emissions	Clean Air Act (CAA) EO 13990 – Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis EO 14008 – Tackling the Climate Crisis at Home and Abroad EO 14057 – Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability Administrative Code of TDEC – Chapter 1200-3 and Chapter 0400-30
Cultural Resources	Administrative Code of Tennessee, Chapter 0400.02 Archaeological Resources Protection Act National Historic Preservation Act (NHPA) Section 106 Native American Graves Protection and Repatriation Act
Waste Management	Administrative Code of Tennessee, Chapter 0400.10-12 Comprehensive Environmental Response, Compensation, and Liability Act Emergency Planning and Community Right-to-Know Act (EPCRA) Resource Conservation and Recovery Act (RCRA) Solid Waste Disposal Act (SWDA) Toxic Substances Control Act (TSCA)

Environmental Resource Area	Law / Executive Order
Public and Occupational Health and Safety	Occupational Safety and Health Act
Environmental Justice	EO 12898 – Federal Actions to Address Environmental Justice in Minority and Low-Income Populations EO 14008 – Tackling the Climate Crisis at Home and Abroad
Intergovernmental Review	EO 12372 – Intergovernmental Review of Federal Programs

To implement the Proposed Action, TVA would have to maintain, obtain, or seek amendments to the following permits that are already in place at KIF:

- Tennessee Stormwater Multi-Sector General Permit for Industrial Activities: TNR050000
- Solid Waste Class II Disposal Permits from TDEC
- National Pollutant Discharge Elimination System (NPDES) permit: TN0005452
- Air permits for emissions (TN0000004714500013)
- KIF – Kingston Phase II PDA CCR Landfill Construction (TNR191877)
- KIF – Division of Water Resources Permits (TNR051787)

Necessary permits would be evaluated based on site-specific conditions. Other potential permits or consultation requirements relevant to the Proposed Action are identified in Table 1.8-2.

Table 1.8-2. Potential Permits and Consultation Requirements Relevant to the Proposed Action

Submittal/ Consultation	Reviewing Agency	Authorization	Applicability	Timing	Fees	Notes/ Assumptions
CWA 404/401 Permitting	U.S. Army Corps of Engineers (USACE) Nashville District	Section 404 Nationwide Permit	Effects to Wetlands & Waters	45 days. Typically, contingent on 401 Certification	N/A	Pre-Construction Notification may be required; mitigation may be required
		Section 404 Individual Permit	Effects to Wetlands & Waters (≥0.5-acre wetland)	6 to 12 months. Typically, contingent on 401 Certification	N/A	Mitigation required
	TDEC DWR	Section 401 Water Quality Certification – Aquatic Resources Alteration Permit (ARAP)	Effects to Tennessee State Waters & Wetlands	45 days	\$500 to \$5,000 depending on effect type	Mitigation may be required for effects; requires pre-filling or clearing notice 30 days prior to submission
CWA 402 NPDES Permitting	TDEC DWR – NPDES Stormwater Permitting Program	Section 402 General Permit for Stormwater Discharges Associated with Construction Activities	Stormwater discharges from activities ≥1 acre of disturbance during construction	Notice of intent (NOI) and stormwater pollution prevention plan (SWPPP) to be filed 30 days prior to construction	\$1,000 for 5-20 acres \$3,000 for 20-50 acres \$6,000 for 50-150 acres	Early coordination recommended; NOI and SWPPP for Construction Activity – Stormwater Discharges (Form CN-0940). If granted, Permit TNR100000 would authorize discharges associated with construction activities that result in a total land disturbance of 1 acre or greater

Submittal/ Consultation	Reviewing Agency	Authorization	Applicability	Timing	Fees	Notes/ Assumptions
Septic System or Pump-Out Septic Holding Tank Permit	TDEC Knoxville EFO	None	Installation of septic system, pump-out septic holding tank, or well on Kingston Reservation	The review process generally takes 10 days and must be completed within 45 days of the date the application was submitted	Dependent on design and gallons per day	If necessary, would submit Application for Ground Water Protection Services (Form CN-0971) (TDEC 2021b). If well installation required, a NOI (CN-1240) would be filed with TDEC
Encroachment and Crossing Permits	TDOT	Rules and Regulations for Accommodating Utilities within Highway Rights-of-Way (ROW), Chapter 1680-6-1)	Aboveground or below ground installation within state, federal-aid metro-urban, or State-aid highway system road ROWs	30-day review time	N/A	N/A
	USDOT	U.S. Department of Transportation’s Highway/Utility Guide (USDOT 1993)	Aboveground or below ground installation within U.S. highway ROWs	30-day review time	N/A	N/A
Burn Permit	TN Division of Forestry	N/A	N/A	N/A	N/A	Only trees and brush from the Project Site would be burned. Weather conditions would be monitored and considered to ensure safety and minimize degradation to air quality during the open burning of any vegetation cleared from the site
Protected Species Coordination	USFWS	Section 7 Consultation; Migratory Bird Treaty Act	Federal Listed species ; migratory birds	60-day period for review of agency findings	N/A	Consultation has been initiated

Submittal/ Consultation	Reviewing Agency	Authorization	Applicability	Timing	Fees	Notes/ Assumptions
	TDEC	State protected species	Varies	N/A	N/A	Informal consultation with TDEC recommended if project triggers an ARAP
Cultural Resources	Tennessee Historical Commission	National Historic Preservation Act; Section 106 Consultation	Historic Properties	30-day period for review of agency findings	N/A	Section 3.13 lists the tribes that have been consulted to date
Air Pollution Control Construction Permit	TDEC	N/A	Construction of a new air contaminant source or the modification of an air contaminant source which may result in the discharge of air contaminants	120 days prior to the estimated date of construction	N/A	N/A
Wild and Scenic Rivers Consultation	National Park Service (NPS)	Sections 7 & 10	Wild and Scenic Rivers	N/A	N/A	Applicable for ETNG natural gas pipeline. ETNG has initiated consultation with the NPS.

CHAPTER 2 – ALTERNATIVES

This chapter describes the Proposed Action of retiring, decommissioning, and demolishing the KIF Plant and the alternatives for the replacement of the retired generation.

2.1 Description of Alternatives

During initial project planning, TVA considered a range of alternatives and specific screening criteria to provide for the reliable replacement of generation as a result of retiring all nine units at KIF. This section describes the three alternatives TVA intends to evaluate in detail in its environmental review.

Alternatives to be evaluated in detail include:

- No Action Alternative – The KIF units would continue to operate as part of the TVA generation portfolio. Additional plant modifications would be necessary to ensure compliance with USEPA's CCR rules, ELGs, and other future applicable requirements.
- Action Alternative A (Alternative A) – The retirement of KIF, including the decommissioning and demolition of the coal units, and the construction and operation of a CC gas plant paired with a dual-fuel Aero CT Plant and new switchyard (hereafter referred to as the CC/Aero CT Plant), a 3- to 4-MW solar site, a 100-MW BESS, and new transmission line infrastructure and connections on the Kingston Reservation. Alternative A would also require off-site transmission system upgrades in the Eastern Transmission Corridor (Lines [L]5108, L5116, L5280, L5302, and L5381) and the Western Transmission Corridor (L5383). Upgrades would include uprating, reconductoring, or rebuilding transmission lines within existing rights-of-way (ROW), as well as replacing terminal equipment, bus work, or jumpers. Additionally, a fiber optic ground wire (OPGW) would be installed within the existing transmission corridor of Line 5108 along with two new poles and replacement guy/anchors in the existing locations at Structure 92. Alternative A would also include construction and operation by TVA of a natural gas pipeline and compressor station; and a related action of a natural gas pipeline project to be constructed, owned, and operated by ETNG pending FERC approval.
- Action Alternative B (Alternative B) – The retirement of KIF, including the decommissioning and demolition of the coal units, investment in the local and regional transmission system, and the construction and operation of multiple solar and BESS facilities through PPA agreements; a portion of which would be located at alternate locations in eastern Tennessee. To maintain stability on the TVA transmission system, TVA would also need to both accommodate the decreased influx of generated power from KIF as well as ensure the multiple (15+) solar generating locations can be connected without impacting the existing grid for the areas surrounding the new solar sites. In addition to transmission system upgrades as described in Alternative A, this alternative would include the construction, operation, and maintenance of new transmission line ROWs.

The action alternatives studied in the DEIS align with the 2019 IRP and TVA's overall strategic direction. The 2019 IRP studied a variety of scenarios and strategies. Study results indicate there is a need for new capacity in all scenarios to replace expiring or retiring capacity, gas additions provide reliability and flexibility, and solar expansion plays a substantial role in all futures.

The Target Power Supply Mix does not represent a single plan or TVA's current plan; it provides ranges by capacity type to consider as the future evolves. Recognizing that a variety of future scenarios are possible, all IRP results are included in the Target Power Supply Mix.

Figure 2.1-1 below shows the range of resource additions and retirements proposed by the end of the first 10 years of the study (2028) and by the end-year of the study (2038), shown in MW. The solid gray bars represent expiring or retiring capacity assumed in the baseline case. The patterned gray bars indicate where retirements were accelerated in some IRP cases. The solid blue bars represent the range of results from all strategies evaluated in the Current Outlook scenario, which represents our best estimation of the future. The broader range (shown in unshaded black bars) represents how the resource portfolio may respond in different future scenarios and if various conditions evaluated in the sensitivities materialize. The recommended ranges represent incremental additions (or retirements) from the existing resource fleet and include contracted (market) positions that can be sourced from resources that meet cost and performance requirements, providing flexibility for the portfolio. The results are bound by the full range of the IRP cases and sensitivity runs. TVA will closely monitor key input variables, including changing market conditions, more stringent regulations, and technology advancements to inform appropriate actions within the recommended ranges and appropriate timing for initiating the next IRP.

The decision to retire and replace Kingston Fossil aligns with the following from the 2019 IRP:

1) Near-term recommendation to evaluate coal retirements
2) The capacities proposed in all action alternatives align with the Target Power Supply Mix ranges for new CT, CC, solar, and storage capacity

TVA's addition of natural gas-fueled generating capacity is consistent with the planning direction in the 2019 IRP to retire coal capacity. The types of generation needed to replace the retired coal capacity is also guided by the 2019 IRP, which contemplates the addition of up to 9,800 MW of CC capacity, up to 8,600 MW of CT capacity, and up to 14,000 MW of solar capacity, by 2038. The Target Power Supply Mix adopted by the TVA Board in 2019 is consistent with least-cost planning obligations in 16 U.S.C. §831m-1 and aligns with the requirement in Section 15d(f) of the TVA Act to sell power "at rates as low as feasible." All of these considerations have informed the development of the purpose and need and alternatives in this EIS. The Preferred Alternative is expected to help TVA meet the goals reflected in the Strategic Intent and Guiding Principles (TVA 2021h) document to reduce carbon emissions 70 percent by 2030 with a path to an 80 percent reduction by 2035, and to attain the aspiration of net-zero carbon emissions by 2050. This also advances the Biden Administration's goal of achieving carbon-neutral electricity by 2035.

In sum, Alternative A (the Preferred Alternative) meets the purpose and need for this project and helps advance TVA's system-wide goals of integrating more solar and facilitating the retirement of coal plants. While Alternative B does not fully meet the purpose and need for this project, it is evaluated in detail in this EIS, describing a technologically proven and fully renewable replacement option that is responsive to public comments received in the EIS scoping process.

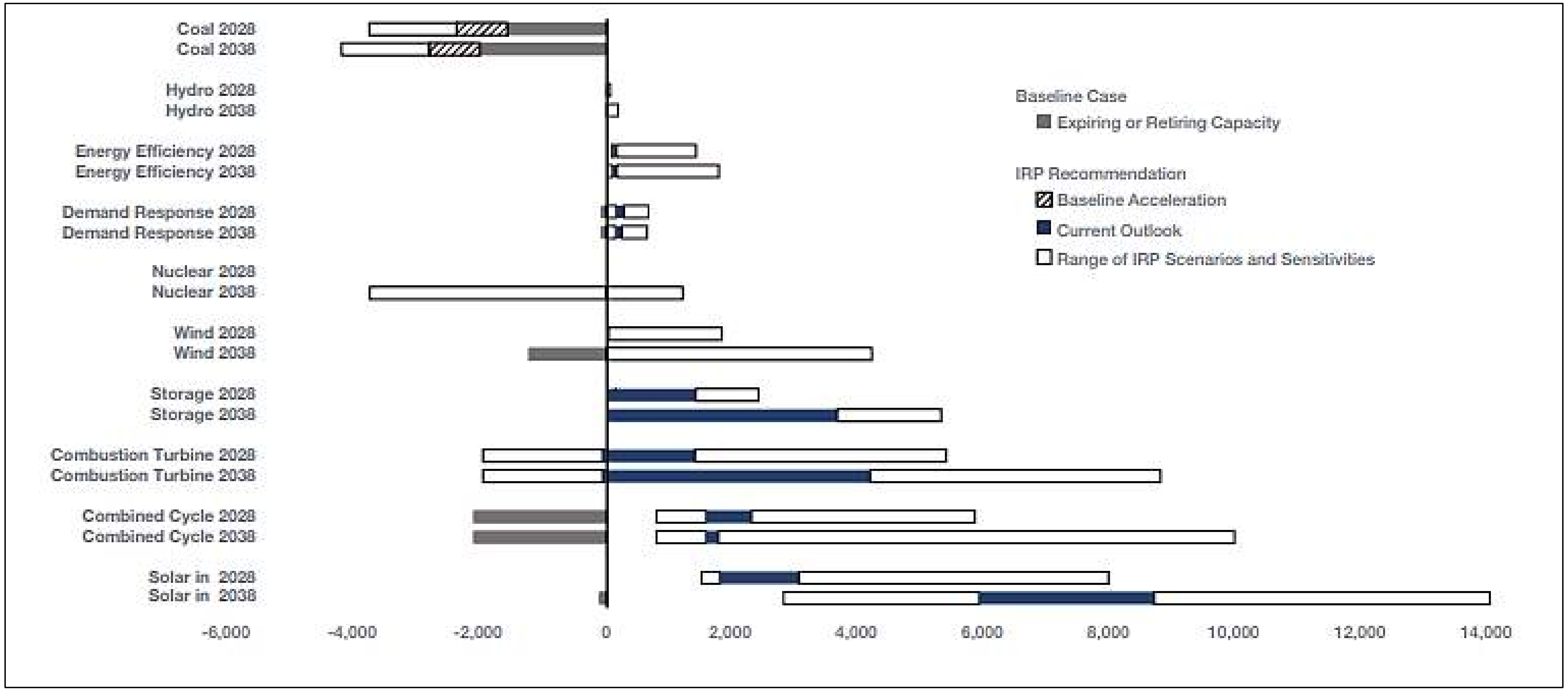

Figure 2.1-1. TVA ‘s 2019 Integrated Resource Plan Range of Megawatt Additions and Subtractions Recommended by 2028 and 2038 (Source: TVA 2019a)

2.1.1 Coal Combustion Residual Activities to Occur with All Alternatives

KIF has significant future capital needs to support compliance with the USEPA's CCR and ELG rules. TVA has previously conducted environmental reviews for activities necessary to comply with USEPA's CCR Rule and ELG Rules (USEPA 2018). Under the No Action Alternative and the Action Alternatives, TVA would implement specific actions related to wastewater treatment and the management and disposal of CCR, primarily solid wastes, at KIF. CCR management projects have been previously analyzed in NEPA documents listed in Section 1.3 or are future projects, which are either underway or would commence within the next five years. CCR management actions on Kingston Reservation would continue under the No Action Alternative (continuing to operate the KIF coal plant) or KIF coal plant is retired under one of the Action Alternatives.

2.1.2 No Action Alternative

Under the No Action Alternative, TVA would not retire the nine existing KIF coal units. These units would continue to operate as part of the TVA generation portfolio. For the existing units to remain operational, additional repairs and maintenance would be necessary to maintain reliability. In addition to repairs and maintenance, new systems and upgrades to current processes and systems (described in more detail below) would need to be added to comply with the current Effluent Limitation Guidelines (ELGs).

Under the No Action Alternative, TVA would not have a need to replace the capacity lost by the retirement of the nine KIF coal units and would therefore not construct new replacement generation. However, based on the age, material condition, and cost required to ensure reliability of KIF, this alternative of continuing to operate KIF for the long-term does not meet the purpose and need of TVA's Proposed Action. It is carried forward in this EIS as a baseline for comparison to the Action Alternatives.

2.1.2.1 ELG Upgrades

The KIF Plant utilizes a series of environmental control devices and systems to reduce various air emissions. One such system is the wet flue gas desulfurization (WFGD) system, often referred to as a "scrubber." The scrubber removes sulfur dioxide (SO_2) from flue gas by allowing it to react with limestone in a slurry. This process generates gypsum, which is discharged from the scrubber and is conveyed to an on-site gypsum dewatering facility owned by TVA, the Bottom Ash Dewatering (BADW) system. The dewatered gypsum has historically been sold for use in cement. TVA is currently marketing some gypsum from KIF to be used for wallboard manufacturing (or other approved uses). Water from the gypsum dewatering process is treated in clarifiers and then conveyed to an existing on-site process water basin where it receives additional treatment and is discharged from the site via a NPDES permitted outfall. KIF's NPDES permit requires discharged waters meet specific limitations, in accordance with USEPA ELGs.

In 2015, the USEPA published a final rule revising the existing Steam Electric ELGs. The ELGs updated existing technology-based water discharge limitations for power plants. In 2017, the USEPA published a rule postponing certain compliance/applicability dates to provide the USEPA with time to review and revise, as necessary, the 2015 ELGs for WFGD wastewater and Bottom Ash Transport Water (BATW). However, low volume wastes, and non-chemical metal cleaning wastewater, regulated under USEPA's 2015 ELGs (80 FR 67837 (Nov. 3, 2015)) remain unchanged. On October 13, 2020, the USEPA published revisions to the Steam Electric ELGs in 40 CFR Part 423. The revised rule modifies technology-based effluent limitations for FGD wastewater and BATW, which must be implemented by facilities as soon as possible but no later than Dec. 31, 2025. The rule also establishes several new subcategories that provide separate compliance pathways based on unit operation and asset operating plans. In early 2023, the USEPA came out with a newly proposed draft ELG supplemental rule that proposes to provide more stringent discharge standards for FGD, BATW, and combustion residual leachate. To comply with the final 2020 ELGs, it is estimated that approximately $665 Million dollars' worth of upgrades would be required, with more to be assessed to comply with this updated supplemental rule.

To comply, TVA would need to construct a new WFGD wastewater treatment (WWT) system to ensure total suspended solids (TSS), selenium, nitrate-nitrite, and trace metals, such as mercury and arsenic, meet ELGs prior to mixing (i.e., at end-of-pipe). Upgrades would also be required for the current on-site BATW system to comply with the 2020 ELG regulations. These BATW upgrades were previously covered under the Kingston Fossil Plant Bottom Ash Dewatering Facility, Environmental Assessment (TVA 2015). ELG required plant upgrades are not further addressed in this EIS.

2.1.2.2 WFGD ELG Compliance Requirements

Under the No Action Alternative, TVA would plan to construct and operate a new WFGD WWT facility and modify existing processes at KIF to achieve compliance with the October 2020 ELGs general applicability category. This action would enhance the wastewater quality to meet regulatory limits established by USEPA's ELGs and would improve the marketability of gypsum produced in the WFGD process. TVA's KIF NPDES permit is currently being modified to reflect the new 2020 ELG requirements. Additionally, these regulatory requirements may be further updated through anticipated changes to the ELG guidelines by USEPA, which are anticipated by spring 2024. In addition to a new WFGD WWT system, a basin or basins for stormwater and WFGD process water and secondary gypsum dewatering hydro cyclones would also be included.

2.1.3 Alternative A – Retirement of KIF, Demolition of the Units and Construction and Operation of a CC/Aero CT Gas Plant and Switchyard, a Solar Site, and Battery Energy Storage System on the Kingston Reservation

2.1.3.1 Retire and Demolish KIF

Following construction of the proposed CC/Aero CT Plant, all nine KIF units would be retired and decommissioned by the end of 2027. The retired coal facilities would transition to the Decommissioning, Deactivation, Decontamination, and Demolition (D4) process as described in Table 2.1-1. Routine KIF Plant deliveries would also be discontinued. The existing switchyard would be maintained for use in future operations associated with the proposed CC/Aero CT facility. Employment at the plant would be reduced. All previously studied CCR projects would continue to be implemented. The anticipated KIF D4 project area (hereafter "demolition boundary") under Alternative A is shown in Figure 2.1-2.

Table 2.1-1. Key D4 Activities

Decommissioning	Deactivation	Decontamination	Demolition
Tagging out all unit or plant equipment except service water, lighting, etc.	Performing electrical and mechanical isolation of systems,	Removal and proper disposal of regulated materials as practical	Demolition of all buildings and structures within the proposed demolition boundary (Figure 2.1-2) to three feet below final grade via mechanical

Decommissioning	Deactivation	Decontamination	Demolition
	components and areas		deconstruction and/or explosives
Emptying and cleaning hoppers, bins, bunkers, etc.	Installing bulkheads and/or fill tunnels	Periodic materials condition monitoring	Backfill all buildings and structures with below grade features using concrete and masonry from the demolished facilities in addition to fill
Opening all equipment electrical breakers not in use	Providing alternate power and services for sump pumps, Federal Aviation Administration stack lighting, etc.	Periodic waste removal as materials deteriorate over time	Cut and cap all buried utilities within the project boundary and abandon in place if they do not interfere with other ongoing projects that overlap the project footprint
Draining and disposing of oil and fluids			Decommission and seal all hollow pipe utilities with a mechanical cap or plug
Salvaging and storing all useable equipment, components, materials, spare parts, office products, etc. and relocating them, as practical.			Restore site to grade to provide proper drainage
Salvaging and storing all key plant records			

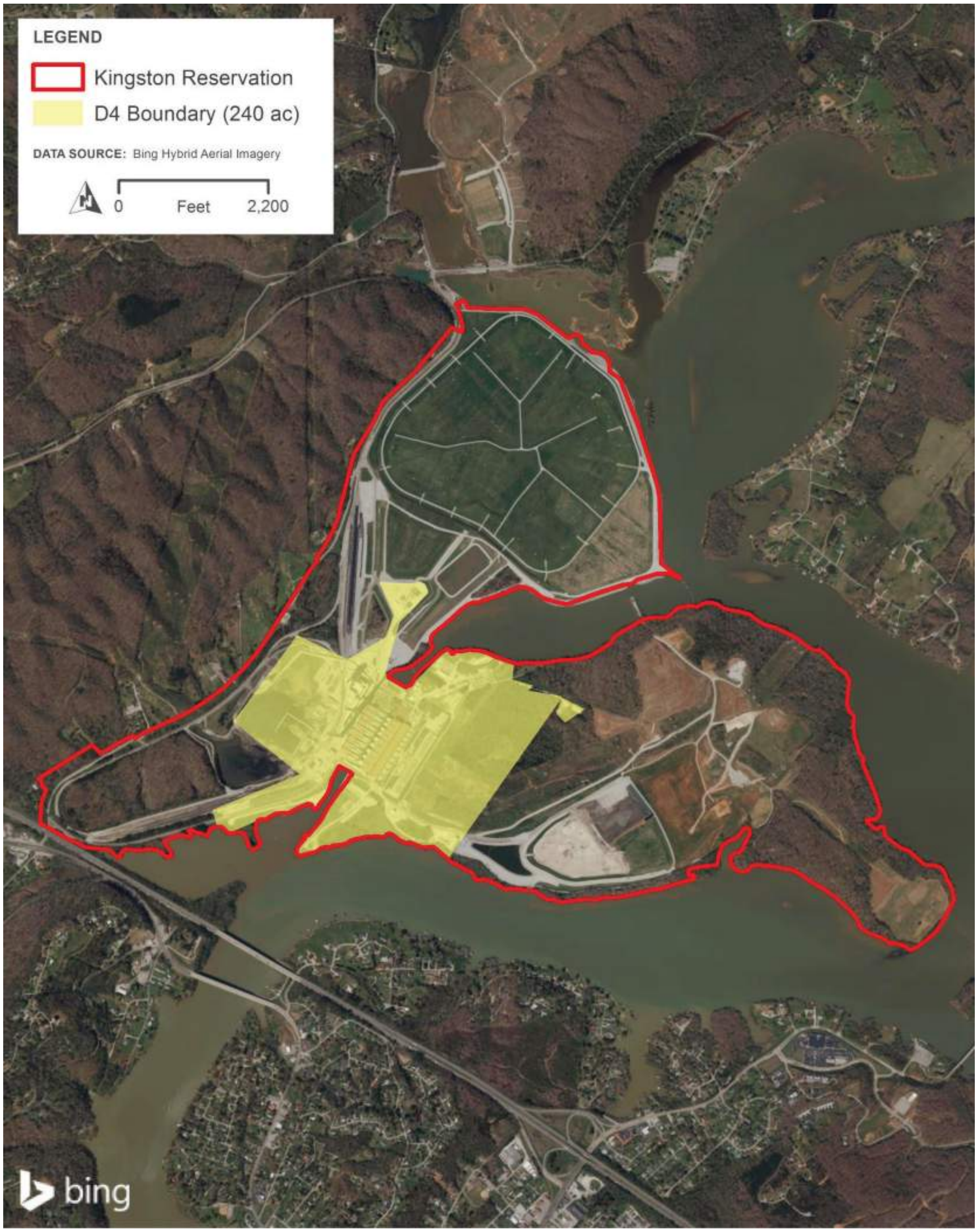

Figure 2.1-2. Kingston Fossil Plant Retirement Demolition Boundary

Virtually all coal unit operational activities would be discontinued, and the coal facilities would be retired and would transition to the D4 process as detailed in Table 2.1-1. All buildings, structures, conveyers, and silos associated with plant operations would be decontaminated and demolished to three feet below final grade. All below-grade building areas would be backfilled, and the site would be restored to grade while providing proper drainage.

The following buildings and structures are proposed for demolition:

- Powerhouse units 1 to 9
- Smokestacks/chimneys
- Boiler bays
- Turbine bays
- Aboveground coal conveyors and conveyor tunnels to 3 feet below final grade
- Conveyor control and crusher building
- Steam lines
- Coal lab
- Demineralization building
- Precipitators
- Maintenance shop
- Fuel unloading facility
- Tank farms
- Electrical control buildings
- Hopper buildings 1 and 2
- GUBMK Constructors office buildings
- Electric Power Research Institute (EPRI) Office
- Fly ash handling facility
- Wash pads
- Office wing
- Service bay
- Utility building
- Fuel/chemical storage and associated piping
- Railroad and crossties
- Silos
- Light towers
- Selective Catalytic Reduction (SCR)/FGD scrubber facility and support buildings
- Water treatment plant
- Hydrogen ports
- Warehouses
- Oil water separators
- Security portal/ guard building
- Electrical shops
- Car/equipment wash
- Booster fan building
- Draft Sys XFMR YD transformer
- Transformer yard
- Precipitator building
- Coal unloading area, transfer stations, and conveyors
- Waste storage building
- Reverse osmosis system
- Bottom ash dewatering facility
- Weather enclosures
- Other unnamed structures within the D4 boundary

The following features are also included for consideration for deconstruction/demolition:

- Select plant roads and parking lots,
- Street lighting,
- Intake condenser circulating water tunnels,
- Discharge condenser circulating water tunnels,
- Water treatment building and reverse osmosis trailers,
- Gypsum plant,
- Plant perimeter fencing,

- All decommissioned piping from the tank farm (that may contain residuals) to the utility building, and the coal pile, coal conveyor tunnels and transfer pits to three feet below final grade (facilities below three feet would be abandoned in place),
- Rotary car dumper (and associated railroad track, ties, and ballast), and
- Sanitary sewer connections from demolished facilities.

The following buildings and facilities located within the deconstruction/demolition project area (D4 footprint) would remain in place and operational at KIF:

- Intake pump station,
- Diesel fire pump house,
- Switchyards and all associated insulating oil piping and pits,
- Electrical control building associated with the switchyards, and
- Emergency storage tank associated with the leachate system.

Primary operational measures that would be discontinued include daily coal rail operations, coal pile management, pumping and use of water from the Clinch and Emory River for the coal plant, and thermal discharges into the Clinch River. The combustion of coal for the production of power would cease, as would generation of wastes associated with such power production.

2.1.3.2 Construction and Operation of a CC/Aero CT Plant and New Switchyard on the Kingston Reservation

Replacement generation would be a single gas-fired CC plant with 16 dual-fuel Aeroderivative CTs. A CC power plant uses a natural gas CT and a steam turbine together to produce up to 50 percent more electricity from the same fuel than a traditional simple-cycle (i.e., without a steam turbine) CT plant. The waste heat from the gas turbine is routed to the heat recovery steam generator (HRSG). The steam from the HRSG then goes to the nearby steam turbine, which generates extra electricity. A typical CC plant configuration is illustrated in Figure 2.1-3. Typical Aero CT units consist of similar configuration but lack the HRSG component.

A review of potential replacement generation configurations for KIF indicated that at least 1,500 MW would be required, with at least 500 MW of that capacity being dual-fuel capable. TVA selected the 16 Aeroderivative approach as it was assumed that TVA would want to install an even number of simple-cycle CT’s and the 16 Aeroderivative CT design met the target generation and dual-fuel capacity needs. Aeroderivative CT’s also provide additional benefits, which include:

- They offer synchronous condensing, which would greatly enhance the flexibility of the site, particularly as the percentage of renewable resources on the system grow;
- They are highly fuel-efficient for simple-cycle gas CTs;
- They offer flexible generation output, with the ability to ramp quickly and start and stop multiple times per day;
- They can be set up to provide additional black-start capability for the region; and

- The Aeroderivative CT's would be most impactful to reliability, resiliency, and flexibility at a regional and system level.

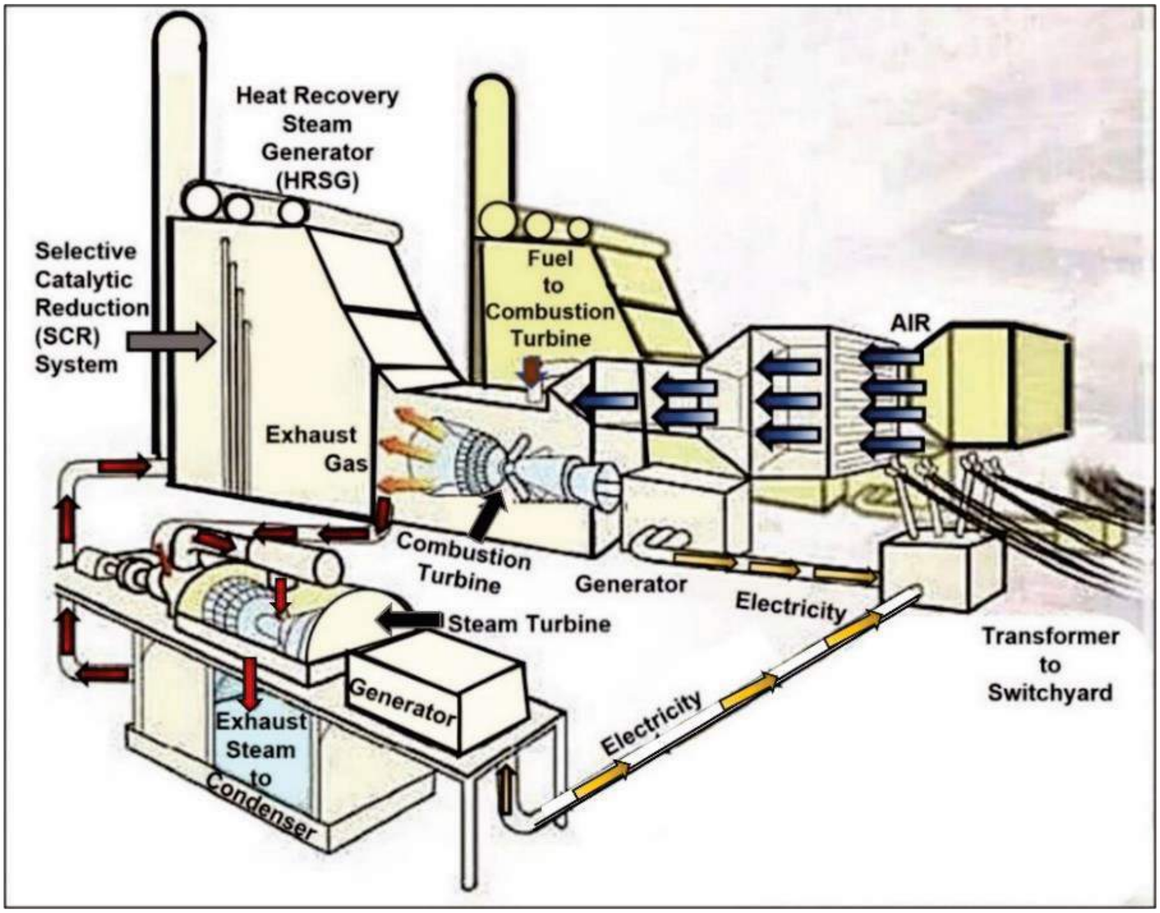

Figure 2.1-3. Typical Components of a Combined Cycle Power Plant

2.1.3.2.1 Site Evaluation for New CC and Dual Fuel-Aero CT Resources

TVA identified candidate sites for the proposed location of a new CC/Aero CT Plant based on a desktop review of land parcels located near existing transmission access and existing natural gas supply. Initial site screening resulted in several potential locations for a new CC plant, including other facility reservations within the TVA system. These sites were further evaluated using criteria summarized in Table 2.1-2.

Based on evaluation of the screening criteria, TVA proposes to construct a new CC/dual-fuel Aero CT Plant of approximately 1,500 MW generating capacity on the 2,254-acre Kingston Reservation. This location offers several benefits:

- The construction footprint for the new CC and dual-fuel Aero CT units would be located on land within existing TVA property as opposed to purchasing property.
- The Kingston Reservation currently includes transmission interconnection to the TVA system, which can largely be repurposed for the new facilities.

- With the planned retirement of the Bull Run Fossil Plant,[6] providing replacement power generation capacity on the Kingston Reservation will play an increasingly important role in maintaining system reliability and stability and meeting local load demand in the Knoxville service area. Locating generation at the Kingston Reservation would help reduce the extensive costs associated with additional transmission upgrades potentially required following coal plant retirement.
- The new gas pipeline would be installed primarily within an existing ETNG ROW and would require approximately 7.3 miles of new pipeline lateral to connect to the Kingston Reservation, thus minimizing project impacts on greenfield (or previously undeveloped property) and reducing the length of required pipeline, which further reduces the potential for associated environmental effects.

The Kingston Reservation has favorable air permitting prospects for a new CC paired with dual-fuel Aero CT units, since it would be replacing the existing higher GHG emitting coal units.

Table 2.1-2. Summary of Criteria Evaluated to Determine the Location of the CC/Aero CT Plant

Transmission	Site Considerations	Operational Considerations
• System upgrades needed • Locational value	• TVA vs non-TVA owned sites • Site availability (available for purchase) • Land cost	• Supply chain considerations • Staffing
Fuel Supply	**Environmental Considerations**	**Financial and Planning Considerations**
• Cost • Availability • Reliability • Operational considerations	• Environmental regulations • Sensitive environmental/cultural resources present • Water discharge considerations and potential regulations	• TVA's Long Range Financial Plan • TVA's Integrated Resource Plan

Based on this initial screening, TVA selected three sites on the Kingston Reservation as potential sites for the construction of a CC/Aero CT facility (Figure 2.1-4). After further site evaluations, Option A (38.78 acres) and Option B (26.32) were eliminated due to insufficient acreage. The 47.92-acre Option C was identified as the preferred location for the proposed CC/Aero CT facility on the Kingston Reservation as the site was large enough to provide the acreage needed to accommodate the proposed CC/Aero CT Plant.

[6] Bull Run Fossil Plant is located on Bull Run Creek near Oak Ridge, Tennessee, and approximately 20 miles to the northeast of the Kingston Reservation. The plant has a summer net capability of 865 megawatts and generates approximately 6 billion kilowatt-hours of electricity a year, enough to supply 400,000 homes. After a detailed review of fuel, transmission, economic and environmental impacts, as well as reviewing public input, the TVA Board of Directors approved, on Feb. 14, 2019, the retirement of Bull Run Fossil Plant by December 2023.

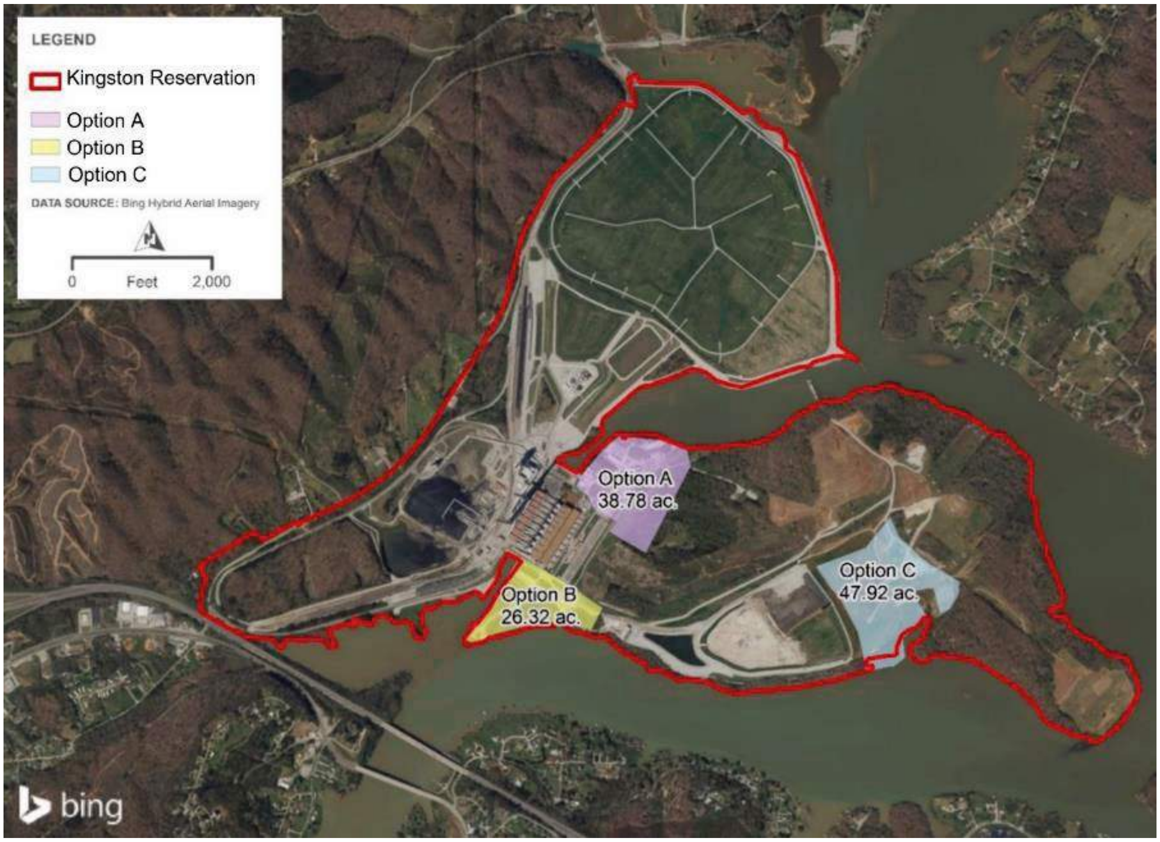

Figure 2.1-4. Alternative Siting Options Considered for the Combined Cycle/Aero Combustion Turbine Plant Proposed on the Kingston Reservation Under Alternative A

2.1.3.2.2 Components of the New CC with Dual-Fueled Aero CT Gas Plant

Conceptual plans for the proposed CC and dual-fuel CT generating plant with a generating capacity of at least 1,500 MW and associated transmission lines have been developed at the location of the Option C footprint (Figure 2.1-5). Major components of the proposed CC/Aero CT Plant are as follows:

- A gas-fired CC plant (including a single HRSG) paired with 16 dual-fuel Aeroderivative CTs and air-cooled condensers,
- Auxiliary boilers to provide start-up steam,
- Selective catalytic reduction (SCR) system,
- Aqueous ammonia systems for the SCR,
- New natural gas-fired dew point heaters may be required depending on requirements of the selected CTs,
- Electric and diesel emergency firewater pumps, and
- Gas compressors.

An CC/Aero CT Plant configuration at the Kingston Reservation would include:

- Gas system upgrades to the existing infrastructure to enable connection of the CC/Aero CT Plant to an approximately 122-mile-long proposed natural gas pipeline proposed to be constructed and operated by ETNG.
- Pond(s) for holding and treating process and storm water flow; size of pond(s) to be determined after further engineering.
- Construction of new 161-kV and 69-kV transmission lines from the proposed natural gas-fired facilities to the existing 161-kV transmission line and a new 8.5-acre switchyard (in addition to the existing switchyard which will remain on site and be reused under the proposed Alternative A).
- Preliminary estimates indicate that approximately 300,000,000 cubic feet per day (cf/d) of natural gas would be required for the CC/Aero CT Plant. This demand would require gas pressure of up to 750 pounds per square inch, requiring TVA to construct and operate an on-site electric motor drive gas compression system to increase the pressure of the gas delivered to the plant.
- Two, one-million-gallon storage tanks for fuel oil on-site.

In addition to the major equipment systems, the proposed CC/Aero CT facility includes plant equipment and systems such as natural gas metering and handling systems, instrumentation and control systems, transformers, and administration and warehouse/maintenance buildings.

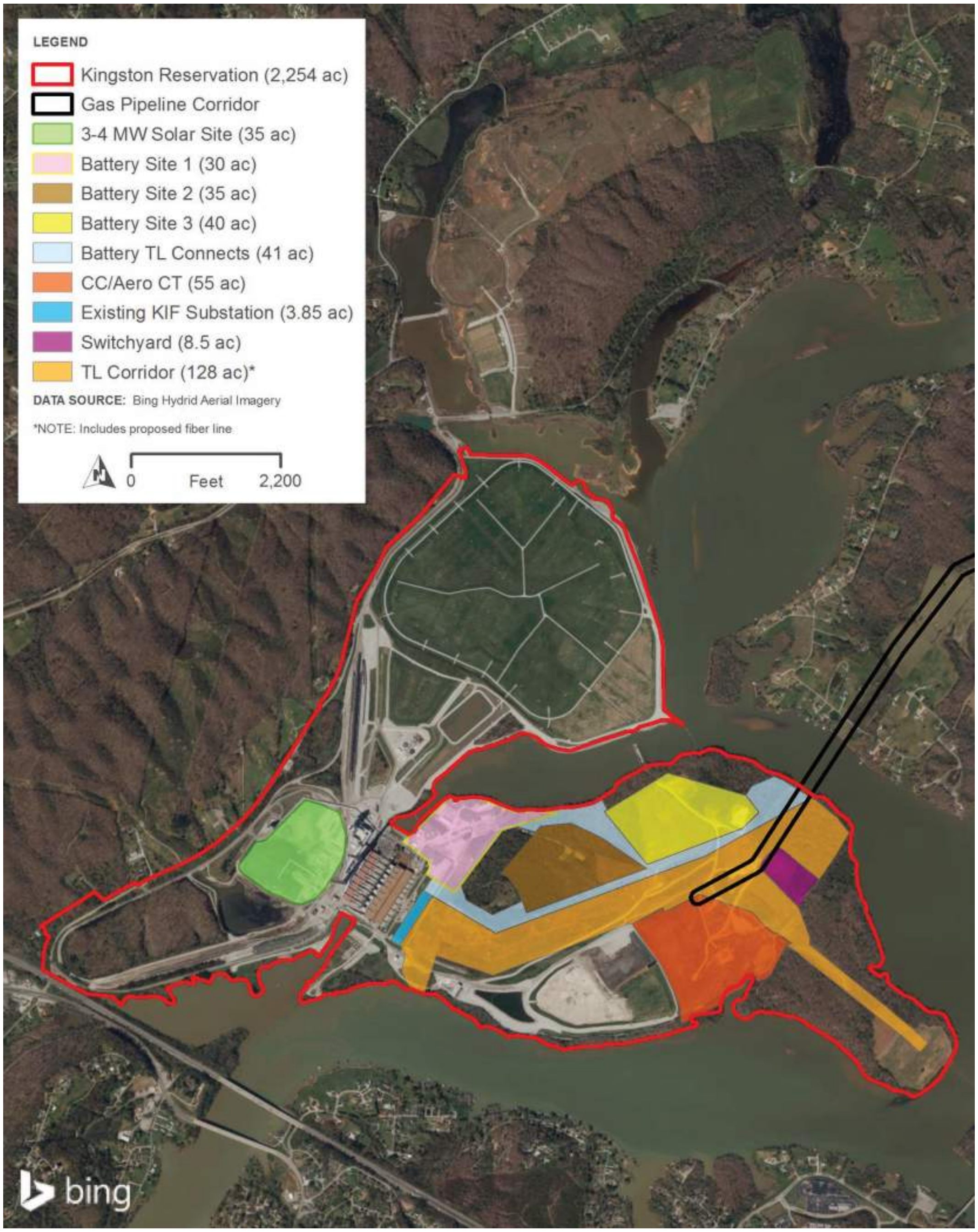

Figure 2.1-5. Proposed Alternative A Components on the Kingston Reservation

2.1.3.2.2.1 Water Requirements

The existing KIF Plant withdraws raw water for non-contact cooling, withdrawing between 800 and 1,360 million gallons per day (MGD). This water is primarily returned to the Clinch River after once-through cooling. TVA proposes to use air-cooling instead of water-cooling for the new CC/Aero CT Plant, which would eliminate the need for water withdrawal from the Clinch River or groundwater wells. To prevent concentration of minerals in the steam cycle, the HRSG would require a demineralized water feed and boiler blowdown to remove accumulating minerals. CT compressor washing also requires demineralized water. Wash effluent would be collected in tanks and, after analysis, disposed of at an approved wastewater treatment facility off-site.

Potable water would be obtained from the existing public supply at the Kingston Reservation (Harriman Utility Board), and demineralized water would be made on-site and stored on-site in newly constructed tanks within the overall project footprint. Some water treatment would be required to support the CC steam cycle and would be integrated into plant design.

2.1.3.2.2.2 Emission Monitoring and Controls

Operating the plant would require emission monitoring and controls for both the CC and aeroderivative Aero CT units. Reduction of emissions of nitrogen oxides (NO_x) from all CC and CT units would be achieved through dry low-NO_x and/or dry low emissions combustion systems. Additional NO_X control for all CC (excluding CC bypass stack) and CT units would be achieved via an SCR system located in the exhaust path. The SCR system would use 19.5 percent aqueous ammonia that would require installation of an independent storage/receiving system.

Reduction of carbon monoxide (CO) and volatile organic compounds (VOC) would be achieved using an oxidation catalyst. The exhaust stacks would be equipped with continuous emissions monitoring systems.

2.1.3.2.2.3 Fuel Oil

Alternative A would include consideration of utilizing Ultra Low Sulphur Diesel (ULSD) as an emergency backup fuel for the Aero CT units. This fuel would be permitted to be used for a limited number of hours each year. Based on preliminary calculations, the annual runtime on this back-up fuel source would be approximately 42 hours at 500 MW. Two, one-million-gallon storage tanks would be constructed to accommodate this need.

Consideration of “dual-fuel” for the Aero CT portion of the proposed gas plant on the Kingston Reservation relates directly to issues of fuel security and resiliency. Resiliency, as applied to the power system when faced with a trigger event (e.g., natural, intentional, physical, or digital/cyberterrorism events), should consider two concepts:

1) Response: Flexibility of a system to respond quickly to a trigger event; and
2) Recovery: Ability to recover to normal operating levels quickly and efficiently.

The combination of quick response and recovery addresses the concept of resiliency. Reliability reflects ongoing and continuous operations.

Natural gas-fueled electricity generation is an important source of energy for the U.S. power sector in general, as well as for TVA. The natural gas fuel supply and delivery system proposed to serve Alternative A is robust, interconnected, redundant (i.e., extra capacity to support resiliency against unforeseeable operational impacts), and geographically diversified. Most of the pipeline system is buried underground, offering protection against storms, natural events, and physical attack. The redundancy of natural gas networks, as well as access to the diverse sources of natural gas supply for the generation facilities they would or already serve, provides a highly reliable and highly resilient fuel source for power generation.

Petroleum fuels also play an important role in TVA's generation mix in both the CC and CT facility as a back-up/alternative option in dual-fuel units. The petroleum delivery system is robust, complex, redundant, diversified, and resilient, providing a multi-modal network that utilizes pipelines, trucks, and storage tanks. When combining the network benefit of natural gas with the network benefits of petroleum delivery, dual-fuel generation plants using ULSD fuel as a back-up fuel further strengthens TVA's resiliency and provides one of the most robust forms of generation on the system. Natural gas units with dual-fuel capability can switch to an alternative fuel before line-pack is lost and then recover rapidly after the trigger event has subsided.[7]

TVA notes that the 2019 IRP (Chapter 5) accounts for the resiliency of TVA's power system, detailing the annual outage rate assumptions for all selectable resources including CC, CT, solar and battery (Alternatives considered in the final EIS). For plans between IRPs, TVA regularly updates outage rates based on actual performance, and current planning assumptions remain largely consistent with those discussed in the IRP. Appendix D of the 2019 IRP explains how the reserve margin study approach and analysis captures uncertainty that arises due to weather, load forecast error, and plant outages. The decision evaluated in the Cumberland EIS falls within the parameters of the broader, comprehensive asset strategy established by the 2019 IRP, which considers the resiliency of TVA's entire power system. Similarly, the IRP's evaluation of risk and the required planning reserve constraints are appropriate to account for risks that are inherently part of the broader asset strategy with which this decision evaluation and analysis is aligned.

2.1.3.2.3 CC/Aero CT Plant Construction Activities

Construction activities associated with the CC/Aero CT facility plant other than the connecting natural gas pipeline would occur on the TVA Kingston Reservation at the Option C site identified in Figure 2.1-4. The CC/Aero CT Plant would occupy approximately 30 acres, and an additional 10 to 25 acres on-site would be used for equipment laydown and mobilization, for a total CC/Aero CT Plant footprint of 55 acres (Figure 2.1-5). Subsurface piles or other deep foundation system would be installed to support foundations for plant components, as required.

Larger project equipment could be delivered to the site by rail or barge, and smaller items by truck. Improvements to the current barge unloading facilities would consist of grading and construction of a dirt/rock ramp to the nose of the barge. Should in-water work be necessary for completion of the upgrades to the barge unloading facilities, TVA would pursue permit authorizations, as needed. Most delivered items would be placed in project laydown areas to await installation. Roads within the Kingston Reservation would be maintained during construction. Any temporary access roads for construction off-site would be designed in accordance with USDOT and relevant local requirements.

Site preparation work for the proposed CC/Aero CT Plant and associated equipment would begin in 2024. Actual plant construction would begin in fall of 2024 and the plant would begin commercial operation as early as winter 2027. A maximum of 600 workers would be employed on-site during peak construction activity.

[7] Line-pack refers to the amount of gas stored in a pipeline at a given moment, which is used to meet fluctuations in demand and balance short-term imbalances between supply and demand.

2.1.3.3 Construction of a 3- to 4-MW Solar Facility on Kingston Reservation

To offset a portion of energy usage for station service from facilities on the Kingston Reservation, TVA, or a third-party developer, would construct and operate a 3- to 4-MW distribution solar facility on an approximately 35-acre existing coal yard used for the KIF Plant, as shown on Figure 2.1-5. Site development would include the installation of solar panels on piles and associated infrastructure, which may include inverters, access roads, stormwater management, vegetation seeding, and a perimeter safety/security chain-link fence. Once operational, the solar facility would produce little noise, emit no odors or byproducts, and would not introduce traffic. The solar facility would also have a low profile with total height at less than 10 feet above ground.

Site preparation work and construction for the proposed solar site and associated equipment would begin in 2024. Construction and commissioning of the solar site would be completed in 2027, with a target in-service date of January 2028.

2.1.3.4 Construction of a 100-MW Battery Storage Facility (BESS) on Kingston Reservation

Construction of a 100-MW lithium-ion BESS would be at one of three potential sites (Battery Sites 1, 2, or 3, each between 30 and 40 acres in extent) located on the Kingston Reservation, just to the north of the proposed CC/Aero CT Plant footprint. At a need of 10-15 acres per 40 MW, the three potential sites identified by TVA meet the maximum limit of land use need (25 to 38 acres) for a 100-MW BESS.

The on-site battery would either be built by TVA, or a power purchase agreement (PPA) would be utilized for a developer to construct this portion of Alternative A. The proposed location of the three BESS site options for placement of the BESS are illustrated in Figure 2.1-5. TVA's preferred site is Battery Site 1.

TVA would install a small switchyard at the BESS location consisting of breakers, switchgear, and one or more transformers with a 161-kV high side winding voltage. The new BESS switchyard would be connected back to the existing KIF switchyard located near the proposed solar location (Figure 2.1-5) or to the new 161-kV switchyard proposed for the CC/Aero CT Plant.

Site preparation work and construction for the proposed BESS and associated equipment would begin in 2024. Construction and commissioning of the BESS would be completed in 2027, with a target in-service date of January 2028.

2.1.3.5 Transmission and Electrical System Components

2.1.3.5.1 On-site Transmission Upgrades

TVA would construct a new double-breaker 161-kV switchyard for the interconnection of the proposed CC/Aero CT Plant on the 8.5-acre location identified in Figure 2.1-5 and reroute all existing transmission lines from the existing coal plant on the Kingston Reservation and re-terminate them into the new switchyard. The new switchyard would consist of thirteen 161-kV breakers and a half bay. All unit substation transformers would be oil-filled; therefore, concrete foundations and an oil containment system would be included. TVA would install a 161-kV switch house (potentially including water and septic systems) and station service. TVA would install an approximately 1-mile-long OPGW originating within the existing Line 5108 corridor at the existing substation and terminating at the new 161-kV switchyard, as well as relaying, digital fault recorders, and redundant metering for the proposed CC/Aero CT Plant. Additionally, the OPGW installation at L5108 will include two new poles and the replacement of guy/anchors at the existing location on Structure 92.

Final engineering of the transmission routing for the proposed solar and BESS sites has not been completed at this time; however, TVA has identified a preliminary transmission routing footprint (identified as "Battery Transmission Corridor" on Figure 2.1-5) based on the three options identified as potential BESS sites located on the Kingston Reservation. TVA is considering routing the transmission lines, wholly within the Kingston Reservation, from the proposed solar site to the existing KIF switchyard. The routing studies and decision on final transmission routing for the solar system would be completed after the D4 removal of the existing KIF Plant is complete. Therefore, impact analysis of any transmission routing applies only to Alternative A, TVA's Preferred Alternative

2.1.3.5.2 Off-site Upgrades to Existing Transmission Lines and Substations

Multiple off-site transmission infrastructure would need to be upgraded if the proposed Kingston CC/Aero CT Plant is constructed. Upgrades would include uprating, reconductoring, or rebuilding transmission lines within existing ROW, as well as replacing terminal equipment, bus work, or jumpers. The off-site transmission lines and switchyard, including an on-site portion of L5108, L5302, and L5116, would require upgrades. An analysis was performed using desktop-based geospatial data (for L5116, L5280, and L5381; to be field surveyed in June 2023) and site-specific field survey data collected in 2022 (for L5383, L5302, and L5108) and provided in this EIS. L5108, L5116, L5280, L5302, and L5381 originate on or just to the east of the Kingston Reservation and are collectively referred to as the Eastern Transmission Corridor, as illustrated on Figure 2.1-6a through Figure 2.1-6d. L5383 is located west of the Kingston Reservation and is referenced as the Western Transmission Corridor, as illustrated in Figure 2.1-7.

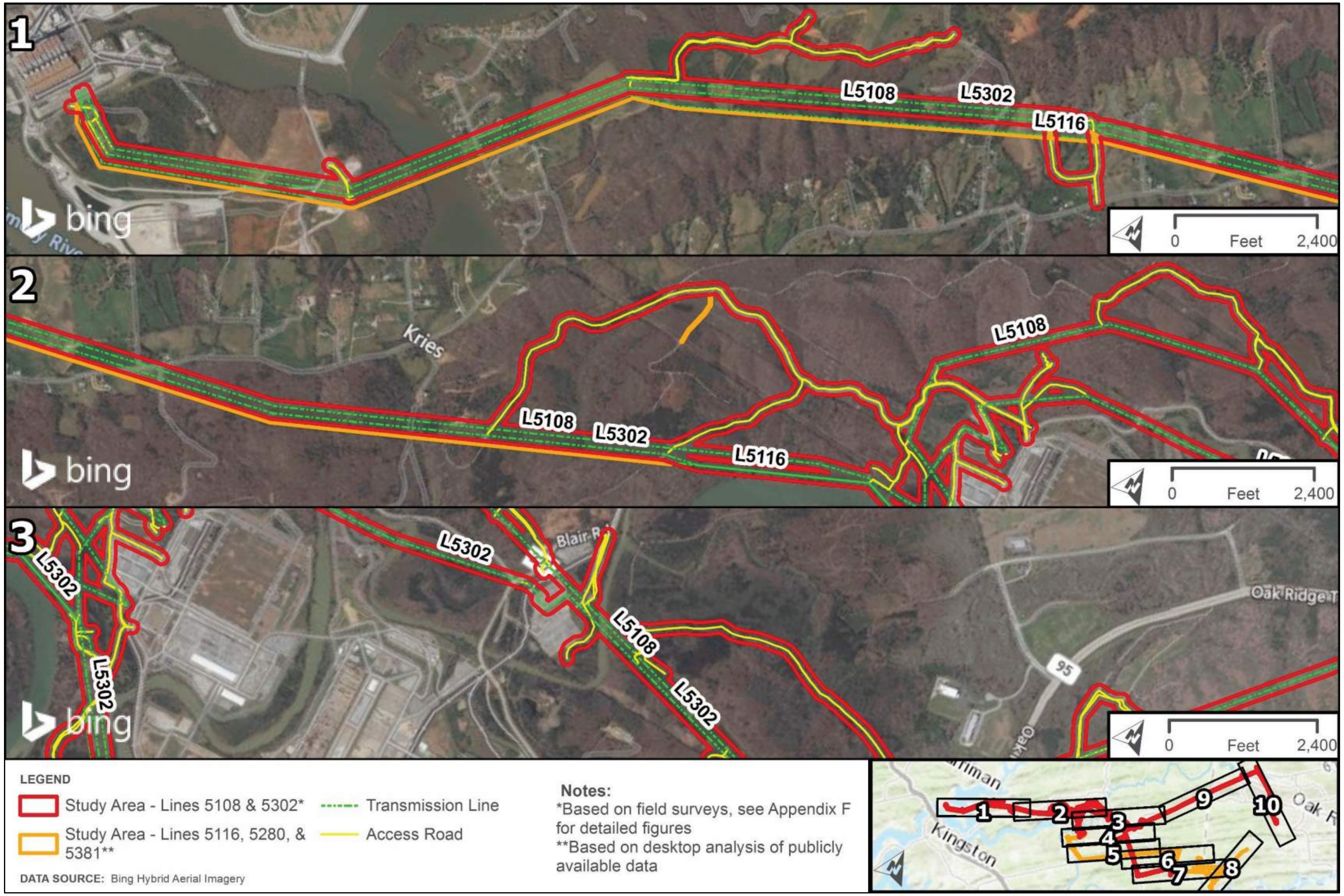

Figure 2.1-6a. Off-site Existing Transmission Line Rights-of-Way of the Eastern Transmission Corridor Proposed for Upgrades Under Alternative A

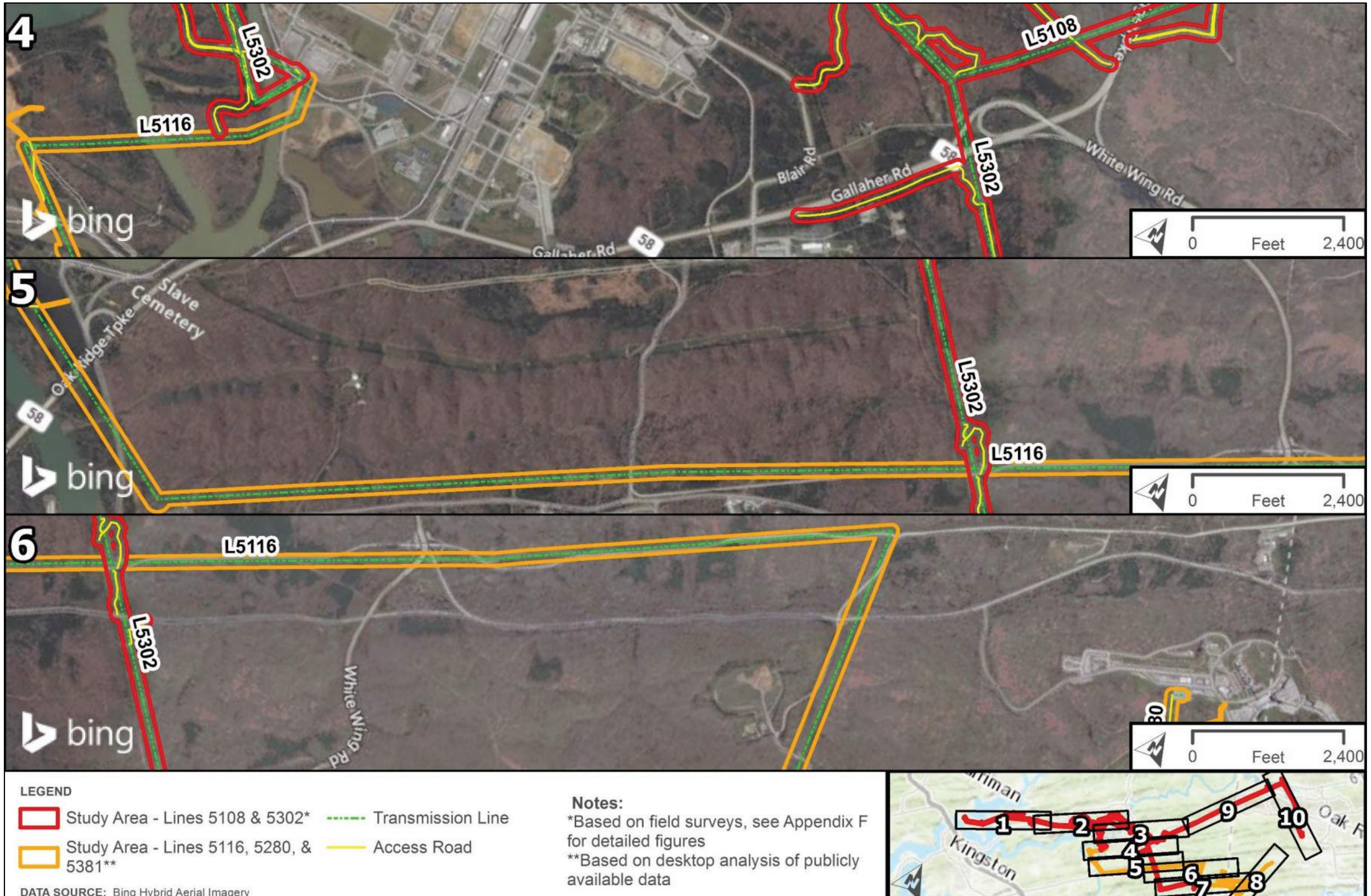

Figure 2.1-6b. Existing Transmission Line Rights-of-Way of the Eastern Transmission Corridor Proposed for Upgrades Under Alternative A

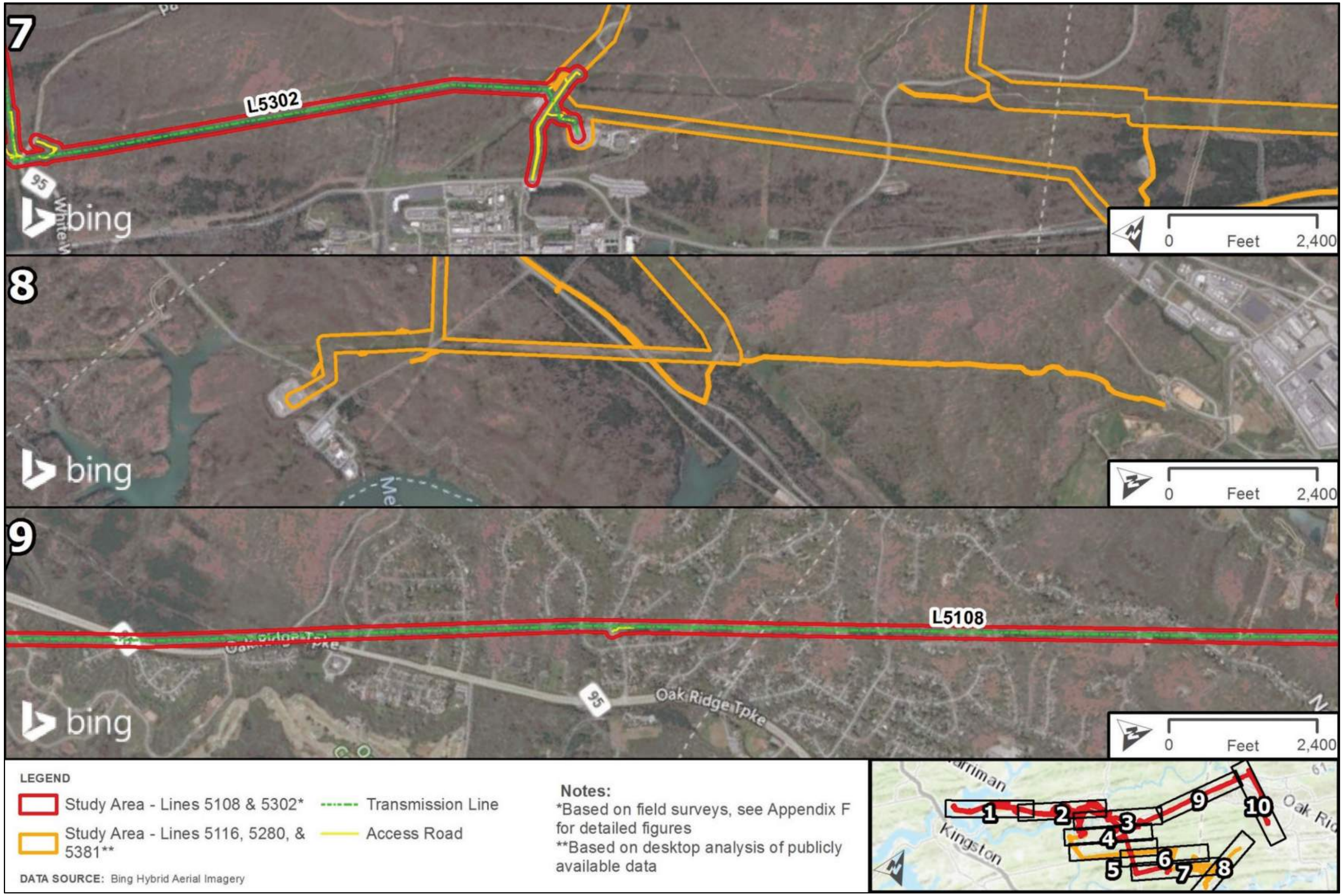

Figure 2.1-6c. Existing Transmission Line Rights-of-Way of the Eastern Transmission Corridor Proposed for Upgrades Under Alternative A

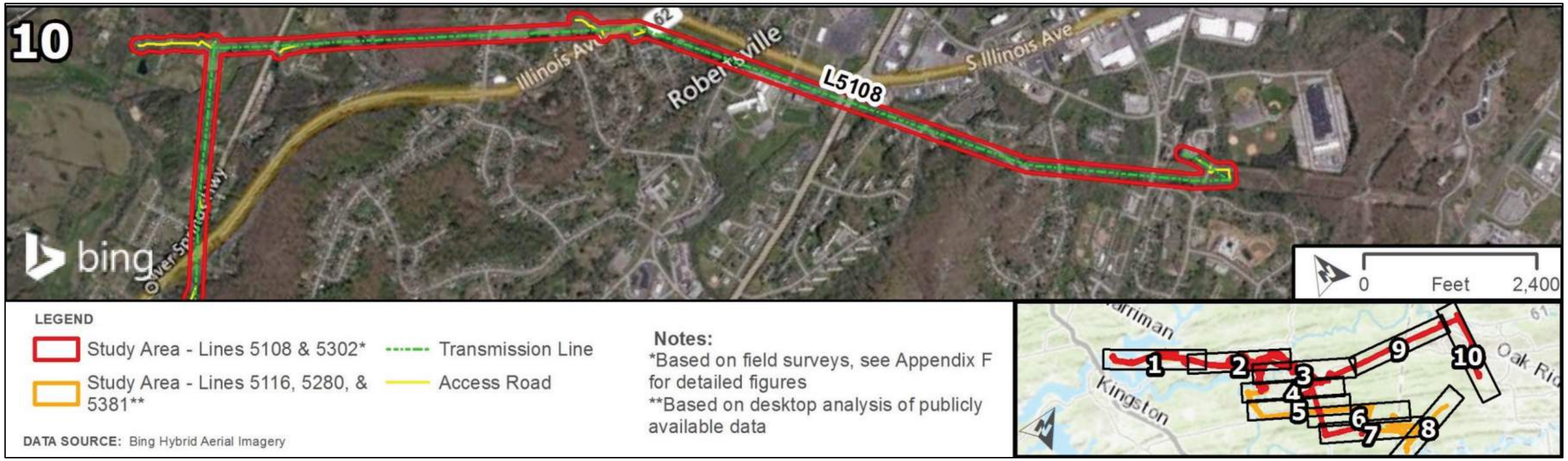

Figure 2.1-6d. Existing Transmission Line Rights-of-Way of the Eastern Transmission Corridor Proposed for Upgrades Under Alternative A

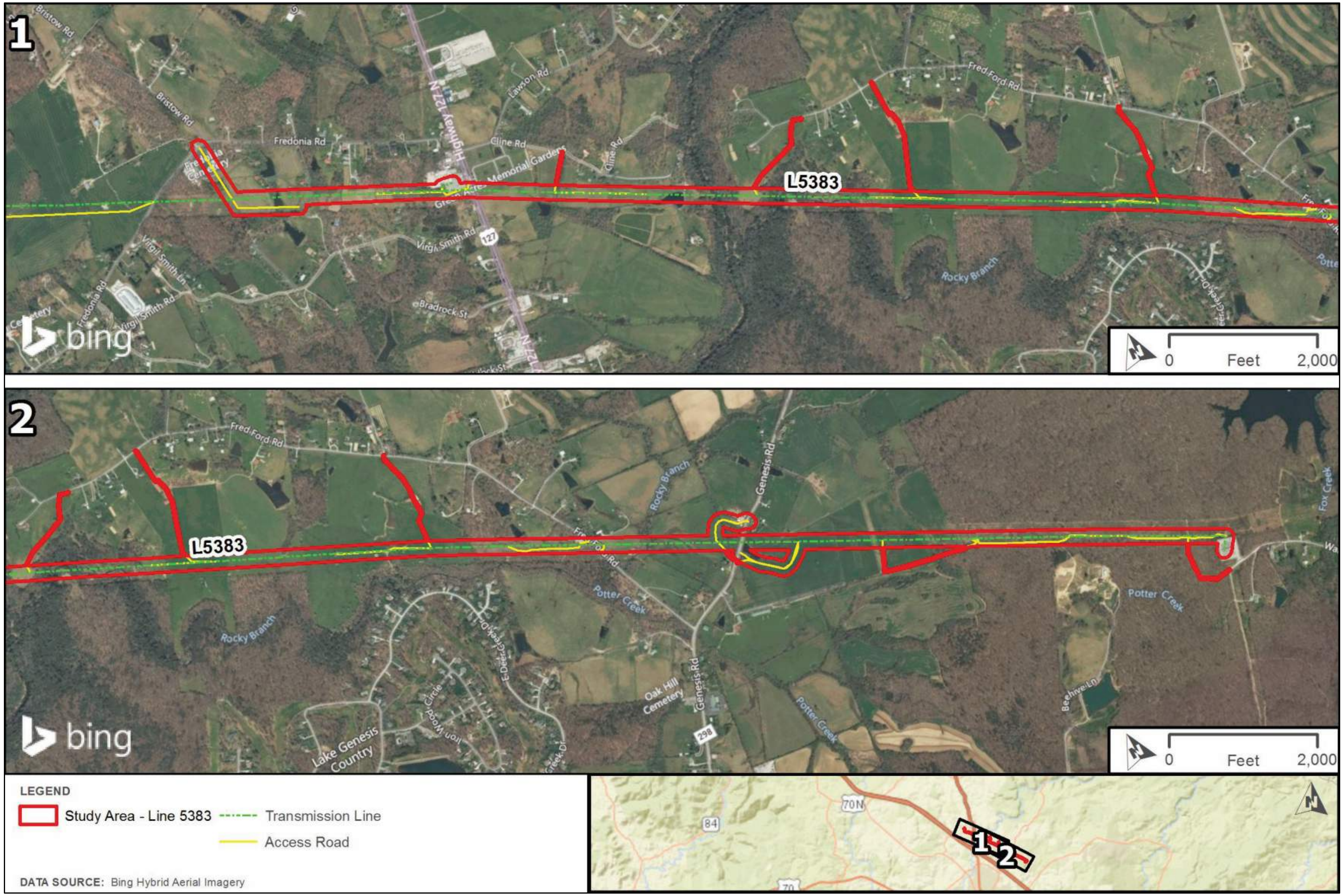

Figure 2.1-7. Existing Transmission Line Rights-of-Way of the Western Transmission Corridors (Line 5383) Proposed for Upgrades Under Alternative A

- Brief descriptions of each line are provided below:
    - Eastern Transmission Corridor
        - Kingston–Bethel Valley (No. 1)161-kV (L5302)
        - Oak Ridge TN–Kingston 161-kV (L5108)
        - ORNL TN–Bethel Valley 161-kV (L5381)
        - ORNL TN–Spallation Neutron Source 161-kV (L5280)
        - Kingston–Bethel Valley (No. 2)161-kV (L5116)
    - Western Transmission Corridor
        - Fredonia–Campbell Junction 161-kV (L5383)
        - Fredonia–Peavine TN 161-kV (L5383)
- Other off-site transmission upgrades may also be required for Alternative A, and depending on results of future evaluations, may include the following existing transmission lines:
- Rockwood TN–Peavine TN 161-kV (L5205)
- Kingston–Roane (No. 2)161-kV (L5169)
- Kingston–Roane (No. 3) 161-kV (L5764)
- Pine Ridge–Spallation Neutron Source 161-kV (L5235)
- Ft. Loudoun–Watt Road TN 161-kV (L5234)
- Alcoa–Profit Springs 161-kV (L5023)
- Nixon Rd TN–Stock Creek TN 161-kV (L5023)
- Douglas HP–Newport TN 161-kV (L5957)

If future studies indicate improvements are required to the regional transmission system to maintain system stability and integrity, additional site-specific NEPA reviews would be completed for those additional transmission system needs.

Upgrades to the transmission system are typically performed to increase the electrical capacity of the existing transmission lines and would include the following:

- *Moving Features that Interfere with Clearance.* As more electricity is transmitted through the transmission line, the temperature of the conductor (the cable that carries the current) rises and the transmission line may sag. Features such as sheds or storage buildings that may be located within the ROW could interfere with the ability to operate the transmission line safely and would need to be removed.
- *Replacement or Modification of Existing Transmission Line Structures or Installation of Intermediate Transmission Line Structure.* Typical transmission line structure replacement, extension, or installation of intermediate transmission line structures would be performed with standard transmission line equipment such as bulldozers, bucket trucks, boom trucks, and forklifts. The result of this work would be that the existing conductor would be raised higher to provide the proper ground clearance.

Disturbance would usually be limited to an approximately 100-foot-wide circumference around the work structure.

- *Conductor Modification.* Conductor modifications include conductor slides, cuts, or floating dead-ends to increase ground clearance. A cut involves removing a small amount of conductor and splicing the ends back together. A slide involves relocating the conductor clamp on the adjacent structure a certain distance toward the area of concern (i.e., “sliding” the clamp). No conductor would be removed. A floating dead-end shortens the suspension insulator string of a structure to gain elevation at the attachment point of the conductor, increasing a span’s clearance. These improvements would require the use of a bucket truck; disturbance would be minor and confined to the immediate area of the clearance issue.
- *Conductor Replacement.* If the existing conductor size cannot support the transmission line’s electrical load, the conductor must be replaced. Bucket trucks or other light-duty equipment would be utilized for access and stringing equipment. Reels of conductor would be delivered to various staging areas along the ROW, and temporary clearance poles would be installed at road crossings to reduce interference with traffic. The new conductor would be connected to the old conductor and pulled down the transmission line through pulleys suspended from the insulators. A bulldozer and specialized tensioning equipment would be used to pull conductors to the proper tension. Crews would then clamp the wires to the insulators and remove the pulleys. Wire pulls vary in length but are limited to a maximum of five-mile pulls. Pull point locations depend on the type of structures supporting the conductor as well as the length of conductor being installed and are typically located along the most accessible path on the ROW (adjacent to road crossings or existing access roads). The area of disturbance at each pull point typically ranges from 200 to 300 feet along the ROW.
- *Adding Surcharge.* Adding rock or dirt (surcharge) to structure footing would sometimes be required when height and/or loading modifications are made to a structure. These changes can create uplift on the existing tower footings or grillage, therefore requiring a stone base settlement to be placed around the existing footings. The additional burden prevents the tower from rising under certain conditions (i.e., weather conditions or conductor loading). Typical installation of surcharge would be performed with tracked equipment with minor ground disturbance. The stone would be piled around the footings as required and the depth would vary depending on the uplift on the affected structures.
- *Modification of Local Power Company Distribution Lines*. Local utilities’ distribution lines can intersect TVA transmission lines. If the local utility crossing does not have adequate clearance, TVA requests that the local utility lower or re-route the crossing.
- *Fiber Optic Ground Wire (OPGW) Installation*. A new OPGW line can be installed with the help of a helicopter. Designated pull points along the transmission line corridor are used to set up cable reels of optic ground wire for installation. Pull point locations are typically located along the most accessible path on the ROW (adjacent to road crossings or existing access roads). Modifications to the existing transmission line are typically required along the length of the transmission line. Existing access roads would be used for the pull point locations.

Development of new temporary or permanent access roads to support upgrades to the existing transmission lines may be needed. Depending on access needs, existing access roads may require modifications such as brush clearing or tree trimming to allow for passage of equipment and bucket trucks. Tree removal is not anticipated and if required would be a negligible amount. Modifications would generally be limited to the existing 20-foot-wide access road area, and, if needed, tree trimming to allow a vertical clearance of up to 12 feet. Minor ground disturbance is expected in these areas, but, if the ground is disturbed, the access road area would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed (TVA 2022a). Areas such as pasture, agricultural fields, or lawns would be returned to their former condition.

2.1.3.6 Construction and Operation of a Natural Gas Pipeline and Associated Structures

The construction and operation of the new CC/Aero CT Plant would require expanding portions of ETNG's existing pipeline system's line number 3100 and constructing a new pipeline lateral to the Kingston Reservation. ETNG's proposed new pipeline project, referred to as the Ridgeline Expansion Project (ETNG 2022m), would consist of the construction of approximately 111 miles of new 30-inch natural gas pipeline largely adjacent to an existing natural gas pipeline ROW, 4 miles of 30-inch diameter header pipeline (mainline), 7 miles of 24-inch diameter pipeline lateral to connect to the proposed CC/Aero CT Plant (lateral), a 12,000-horsepower electric motor drive compressor station, and other gas system infrastructure to connect the plant to the new gas pipeline (ETNG 2022b). The approximate route of the proposed new natural gas line that would be built largely within or adjacent to the existing ETNG 3100 pipeline ROW (identified as East Tennessee Natural Gas in figure below) is illustrated on Figure 2.1-8.

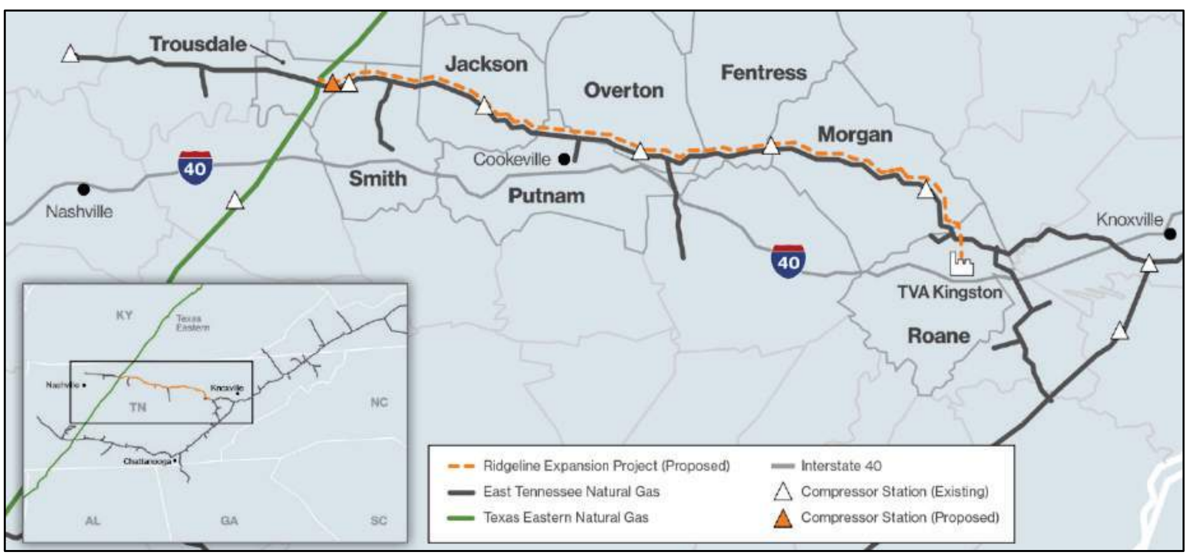

Figure 2.1-8. Alternative A – Proposed Natural Gas Pipeline Route

The CC/Aero CT Plant would be fueled by a reliable supply of natural gas. Preliminary estimates indicate that approximately 300,000,000 standard cubic feet per day of natural gas would be required for the CC/Aero CT Plant. Natural gas would be delivered to the site at a pressure up to 750 pounds per square inch, requiring an on-site gas compression system to increase the pressure of gas supplied to the CC/Aero CT Plant. Gas compressors with electric motors would be incorporated during the design phase.

The Ridgeline Expansion Project requires approval by FERC through issuance of a Certificate of Public Convenience and Necessity under Section 7 of the Natural Gas Act. An application must be submitted by ETNG to FERC for approval, which is evaluated by FERC's engineering, environmental, legal, and economic staff in an EA or EIS issued for public comment before a decision is made by FERC. ETNG submitted draft Resource Reports to FERC under Docket No. PF22 in June 2022 followed by revised Resource Reports in December 2022. ETNG is planning to file their application with FERC in July 2023. In addition to the approximately 111 miles of 30-inch-diameter pipeline and an approximately 4-mile, 30-inch-diameter header pipeline (collectively referred to as the Mainline), the pipeline project includes an approximately 7-mile, 24-inch-diameter pipeline lateral (referred to as the Lateral) to connect to the proposed CC/Aero CT Plant, and one 12,000-horsepower electric-powered compressor station and associated solar farm (in Trousdale County) to power the compressor station, and removal of some portions of the existing 3100 pipeline that are no longer in use (ETNG 2022b).

To further support and advance ETNG's Environmental Sustainability Goals of reducing greenhouse gas emissions from its operations, ETNG would develop and construct an 8.0-megawatt solar farm that would be directly connected to a 12,000 horsepower (HP) electric-powered compressor station, to provide a source of on-site, zero emission electricity to partially power the EMD station (ETNG 2022b). The solar farm and compressor station would be located in Trousdale County, Tennessee, on approximately 200 acres and would include the installation of solar panels supported on piles, associated infrastructure including inverters, access roads, stormwater management, and a perimeter safety/security chain-link fence. The new compressor station would consist of two new approximately 6,000 HP dual drive compressor units constructed inside of a compressor building with an associated combined office/warehouse/garage building (ETNG 2022b). Other necessary power for the compressor station would come from a 161-kV transmission line delivery point, which would require additional coordination with TVA for an existing, nearby tap point to be determined. These lines can then be used to feed ETNG's new 161-kV/13.8-kV substation that would be sited adjacent to the compressor station.

ETNG has initiated coordination with potentially affected stakeholders and landowners and has commenced civil, environmental, and cultural studies for the proposed pipeline route. Detailed analysis of the proposed pipeline will be provided by ETNG as part of the pre-filing process with FERC. ETNG's revised draft Environmental Resource Reports were submitted to FERC on December 9, 2022.

ETNG is currently evaluating for their FERC license the construction and proposed environmental effects of a natural gas pipeline and compressor station. The proposed gas pipeline system overview map is shown on Figure 2.1-5 and identifies the approximate route of a new natural gas line that would be up to 30 inches in diameter and built largely within or adjacent to existing pipeline ROW. The project will include a permanent pipeline easement and adjacent temporary construction workspace with additional temporary workspaces (ATWS) in some locations.

The information related to pipeline impacts provided in this draft EIS was developed based primarily on TVA's analysis of ETNG's determinations made in their draft Resource Reports provided to FERC in December 2022. Where gaps in data were noted, TVA provided additional evaluation via desktop review of resources to provide an appropriate effects determination using information available at the time of TVA's assessment. This evaluation was then further refined for resources where more detailed field survey data were provided by ETNG to TVA (i.e., results of wetland and stream surveys completed within the proposed area of effect for ETNG's gas pipeline project). The information presented in this EIS regarding ETNG's Ridgeline Expansion Project is based on conditions and information existing at the time ETNG's draft Resource Reports were filed with FERC on December 9, 2022, and does not take into account any project changes initiated after this date. Nor does this preliminary analysis account for discussions and consultations with relevant state and federal agencies or the results of extensive public involvement that would occur before any federal action would be taken. The information in ETNG's draft Resource Reports remains current as of the date of publication of this draft EIS. Information from ETNG's final Resource Reports will be incorporated when they are received. As described in ETNG's Resource Report 1 (ETNG 2022b), the Ridgeline Expansion Project includes the following:

> Construction of the Project pipelines will require a Construction ROW made up of permanent and temporary easements ranging from 75 to 150 feet in width (Construction ROW). Where collocated with the existing 3100 Line ROW, approximately 50 feet of the width of the Construction ROW will consist of existing maintained permanent pipeline ROW (Permanent ROW). In upland areas, the Construction ROW width will typically be 105 feet wide. The construction working side of the ROW will be 65 feet wide from the center of the ditch to accommodate trench excavation, trench bank sloping, topsoil segregation and safe equipment mobility. The non-working or spoil side of the Construction ROW will be 40 feet wide from the center of the ditch and will be used to store spoil and rock generated from trench excavation.
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> …
>
> Additional temporary workspace (ATWS) of varying sizes will be required adjacent to the Construction ROW in certain locations such as horizontal directional drill (HDD) locations; wetland, waterbody, road, railroad, and foreign line crossing locations; and for spoil storage, topsoil segregation, and material/equipment staging. The use of ATWS will be limited to the duration of construction and as necessary to conduct additional post-construction restoration or corrective actions that may be required. Following construction, the temporary construction ROW and ATWS will be restored and allowed to return to previous use.
>
> …
>
> Construction of the proposed Hartsville Compressor Station will require approximately 68 acres of temporary workspace. Approximately 16 acres of this area will be fenced and maintained for operation of the compressor station. The temporary workspace outside the fenced area will be restored to preconstruction conditions, to the extent practicable, following construction. …
>
> [ETNG] proposes to use existing public and private roads to the extent practicable to access the Project during construction, restoration, and operation. Existing private roads proposed as temporary access roads may require modifications including the use of mats, as needed, to support heavy equipment and protect the road surface during construction; or improvements such as widening or, adding gravel, or stabilization.

> Seventeen new permanent and seventy-seven temporary access roads are planned for the Project. All temporary access roads used during construction will be restored to pre-construction conditions or better, unless otherwise requested by landowners. … [ETNG] proposes to begin construction in August 2025 for a projected in-service date of November 1, 2026. Construction will generally take place Monday through Saturday during daylight hours, from 7 a.m. to 7 p.m.; however, certain activities may extend beyond normal construction hours and into Sunday, as necessary. The HDDs are proposed to operate 24 hours a day, seven days a week. Other discrete activities may require 24 hours of activity for limited periods of time (e.g., from one to three days)… [ETNG] anticipates that the Project will be constructed using 4 construction spreads with 550 to 850 workers per pipeline spread, and 175 workers for aboveground facility construction.

ETNG's Ridgeline Expansion Project encompasses the Construction ROW (including Permanent ROW), temporary workspace (TWS), and ATWS, and includes the compressor station and other aboveground project structures. However, for the purposes of this draft EIS, the project study area for the Ridgeline Expansion Project is referred to as the ETNG Construction ROW. Resource areas where site-specific study results were not yet available from ETNG were evaluated by TVA using desktop analyses of an expanded, 200-foot-wide study area boundary, centered on the natural gas pipeline centerline and hereafter referred to as the TVA Expanded Construction ROW.

2.1.4 Alternative B – Retirement of KIF, Demolition of the Units, and Construction and Operation of Solar and Storage Facilities, Primarily at Alternate Locations.

2.1.4.1 Retire and Demolish KIF

The actions to retire and demolish KIF are the same as those described for Alternative A in Section 2.1.3.1.

2.1.4.2 Solar Plus Storage Approach and Reliability Analysis

Under Alternative B, solar and BESS facilities would be constructed primarily at alternative locations to replace the generation of the nine units at KIF plus demand load growth, which would be retired by the end of 2027. TVA would replace the power generated and dependable capacity provided by the KIF units through the construction and operation of utility-scale solar and BESS facilities. To sustain low costs and high reliability, TVA anticipates that a portion of these new facilities would be located in East Tennessee, where they can help support regional transmission grid stability following the retirement of the KIF units. BESS are devices that store energy from the grid and renewable sources, typically during periods of surplus power or low demand, and then release that energy when customers need power. Mechanical or chemical battery options could be utilized for storage. The following section describes TVA's proposed approach to combining solar and storage to replace the KIF units and meet the capacity and energy needs of the TVA system.

Solar resource additions would be needed to provide replacement energy for the TVA system. TVA is a dual-peaking utility, meaning that it could experience the highest annual peak days in the summer or in the winter. During the winter, the peak typically occurs around 7:00 a.m., when solar resources are not generating. As such, battery storage additions would be needed to provide year-round replacement capacity, especially in winter.

While solar resources generate energy during daylight hours, this energy is both intermittent in nature and non-dispatchable. Recent proposals for utility-scale single-axis tracking solar resources to be located in the Tennessee Valley indicate an average capacity factor of approximately 20 to 25 percent. Therefore, in order to provide dependable peak capacity needs for the TVA system, solar generation must be paired with dispatchable resources, such as gas and/or storage.

> A generating facility's "**capacity factor**" is the ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period.

Additionally, new storage facilities would be required to provide dispatchable capacity to meet peak loads and to store a portion of solar generation for use at other times. These facilities typically do not exceed a few hours, when needed. In both summer and winter peak seasons, the KIF units provide dependable capacity and energy for extended time periods. That capability would need to be replaced. Oftentimes, high loads caused by warm or cold weather events can last for several days in a row, leading to difficulty in sufficiently re-charging storage resources. As a result, storage resources would need to have a nameplate capacity that is higher than the 1,500-MW minimum resource requirement for a fully dispatchable resource in order to dependably meet system needs following the retirement of the KIF units.

TVA performed a reliability analysis to determine an appropriate combination of solar and storage resources to maintain year-round system reliability for Alternative B. TVA began this evaluation by determining the appropriate level of solar resources needed to replace the energy needs resulting from the retirement of the KIF units. Multiple years of historical operating information were used to determine an average annual capacity factor and resulting average annual energy output. Recent proposals for in-Valley, utility-scale single-axis tracking solar resources, as well as the experience in operating the solar facilities currently providing power to TVA, indicate an average annual capacity factor of approximately 20 to 25 percent. Using a 25 percent capacity factor, TVA calculated the nameplate capacity of solar resources required to supply the same annual capacity factor and average energy output[8]. The resulting calculations indicated a need for approximately 1,500 MW of nameplate solar and approximately 10,950 acres of available land to replace system energy needs from the unit retirements at KIF. This 1,500 MW would be in addition to the approximately 10,000 MW of solar additions by the mid-2030s that are forecasted in TVA's current plans.

The next step was to determine what amount of battery storage should be paired with this additional 1,500 MW of solar. TVA assumed that battery storage additions would be four hours in duration, as is typical for utility scale lithium-ion battery energy storage systems. To ensure year-round reliability, TVA performed a reliability analysis utilizing the SERVM model from Astrapé, which is the same model TVA utilizes when updating its Reserve Margin Study every few years. The objective function of the study was to determine the level of storage, paired with 1,500 MW of additional solar, needed to maintain an industry best practice level of reliability of one loss of load event (LOLE) every 10 years (or 0.1

[8] A solar capacity factor of 25 percent was selected based on the NREL Annual Technology Baseline.

LOLE), with this risk balanced evenly between summer and winter. The SERVM model accounts for uncertainties related to weather, load forecasts, and system performance. Modeling the retirement of the KIF units indicated that approximately 2,200 MW of four-hour BESS, requiring an additional 550 to 825 acres of land, paired with 1,500 MW of additional solar would maintain a 0.1 LOLE with balanced seasonal risk. Based on this analysis, this EIS evaluates additions of 1,500 MW of solar paired with 2,200 MW of battery storage for Alternative B.

Battery storage is a new resource for TVA, with multiple projects either planned or under contract to come online in the next few years. The operating experience gained from these early projects would provide insight on how battery storage is utilized in the TVA system. When short-duration battery storage systems are added and become a larger part of the total system, as experienced by other utilities, the capacity credit incremental battery additions would receive toward reserve margin would decrease. Initial experience with battery storage would further inform how battery storage is valued in future planning.

2.1.4.2.1 Resource Procurement and Site Evaluation

Historically, TVA has been unable to directly benefit from tax credits available for the deployment of solar facilities and associated storage, as TVA typically utilizes PPAs with third-party developers for its solar facilities. With the passage of the 2022 IRA, TVA is now able to take advantage of tax credits authorized under the IRA. While TVA also has the option to construct and own ("self-build") these facilities, TVA's practice has been to utilize PPAs. Solar and storage facilities constructed under Alternative B could be a combination of PPAs and self-built facilities. Modeling performed for Alternative B also assumes that TVA continues its practice of soliciting competitive bids for new solar and storage PPAs to meet the need determined in this analysis for these generation resources under this alternative, in addition to self-built facilities. While site locations remain unknown at this time, TVA anticipates that a portion of these facilities will need to be physically located within portions of the East Tennessee portion of TVA's service territory to maintain grid reliability and stability. Power from these facilities would typically be delivered by direct connection to TVA's transmission system or via interconnections with local power companies that distribute TVA power to customers.

2.1.4.2.2 Components of Solar and Storage Facilities

Solar facilities convert sunlight into direct current (DC) electrical energy within photovoltaic (PV) panels (modules) (Figure 2.1-9). PV power generation is the direct conversion of light into electricity at the atomic level. Some materials exhibit a property known as the photoelectric effect that causes them to absorb photons of light and release electrons. When these free electrons are captured, an electric current is produced, which can be used as electricity (TVA 2014; 2021d).

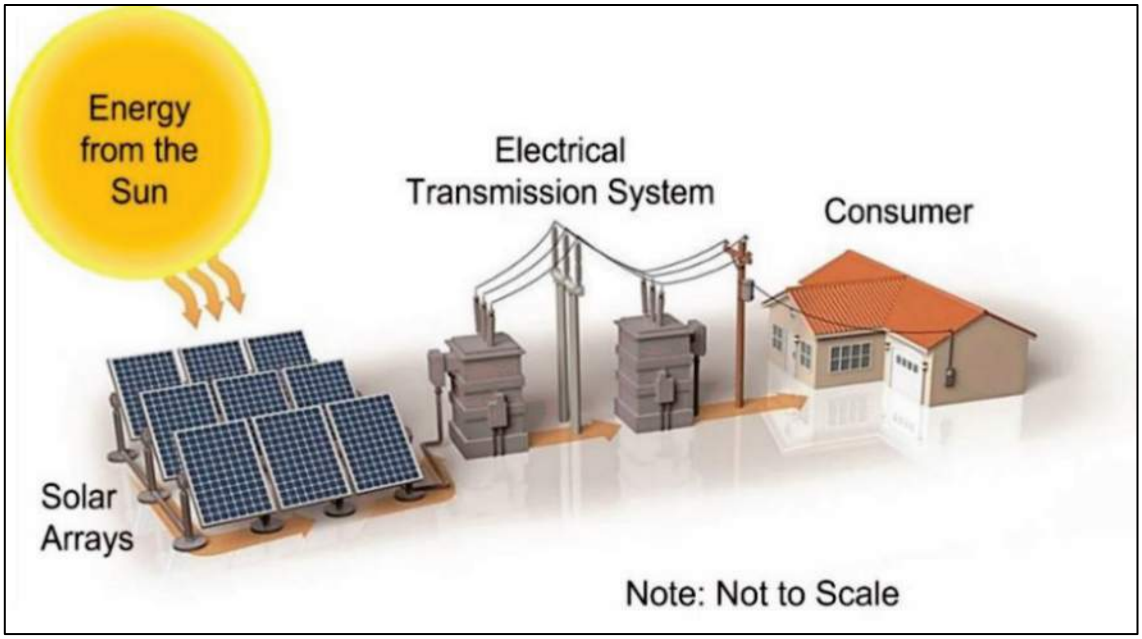

Figure 2.1-9. General Energy Flow Diagram of Photovoltaic Solar System

Solar facilities would be composed of PV modules mounted together in arrays. Groups of panels would be connected electrically in series to form “strings” of panels, with the maximum string size chosen to ensure that the maximum inverter input voltage is not exceeded by the string voltage at the project’s high design temperature. The panels, estimated to be 6.5 feet by 3.5 feet, would be in individual blocks consisting of the PV arrays and an inverter station on a concrete pad or steel piles, to convert the DC electricity generated by the solar panels into alternating current (AC) electricity. The solar facility would be enclosed by chain-link security fencing. Apart from access roads, the portions of the project outside the fenced-in area are typically not developed.

The modules would be attached to single-axis trackers that follow the path of the sun from the east to the west across the sky (Figure 2.1-10). The inverter specification would fully comply with the applicable requirements of the National Electrical Code and Institute of Electrical and Electronics Engineers standards. Each inverter would be collocated with a medium voltage transformer, which would step-up the AC voltage to minimize the AC cabling electrical losses between the central inverters and the proposed on-site project substation. Underground AC power cables would connect all medium voltage transformers to the main power transformer, located within the substation.

Other temporary or permanent project components would include construction laydown areas and security and communications equipment. Compacted gravel or native fill access roads would provide access to each inverter block and the proposed substation. Also, if determined necessary, the project would include project water wells, a septic system or pump-out septic holding tank, and an operations and maintenance building. Vegetation on individual solar facilities could be managed using intermittent mowing or grazing sheep.

Lithium-ion technology is the most common BESS. Storage facilities are typically small sites and sited near existing substations, transmission lines, or solar facilities. Construction would consist of grading the site and installing a foundation to place the battery containers, inverters, electrical and communications connections for the BESS and heating, ventilation, and air conditioning system monitoring and control. The battery containers are modular steel construction similar to intermodal shipping containers in which the modular lithium-ion battery cells are mounted on racks and connected by cabling. The battery containers are equipped with air conditioning and fire protection systems, auxiliary distribution board, and lighting.

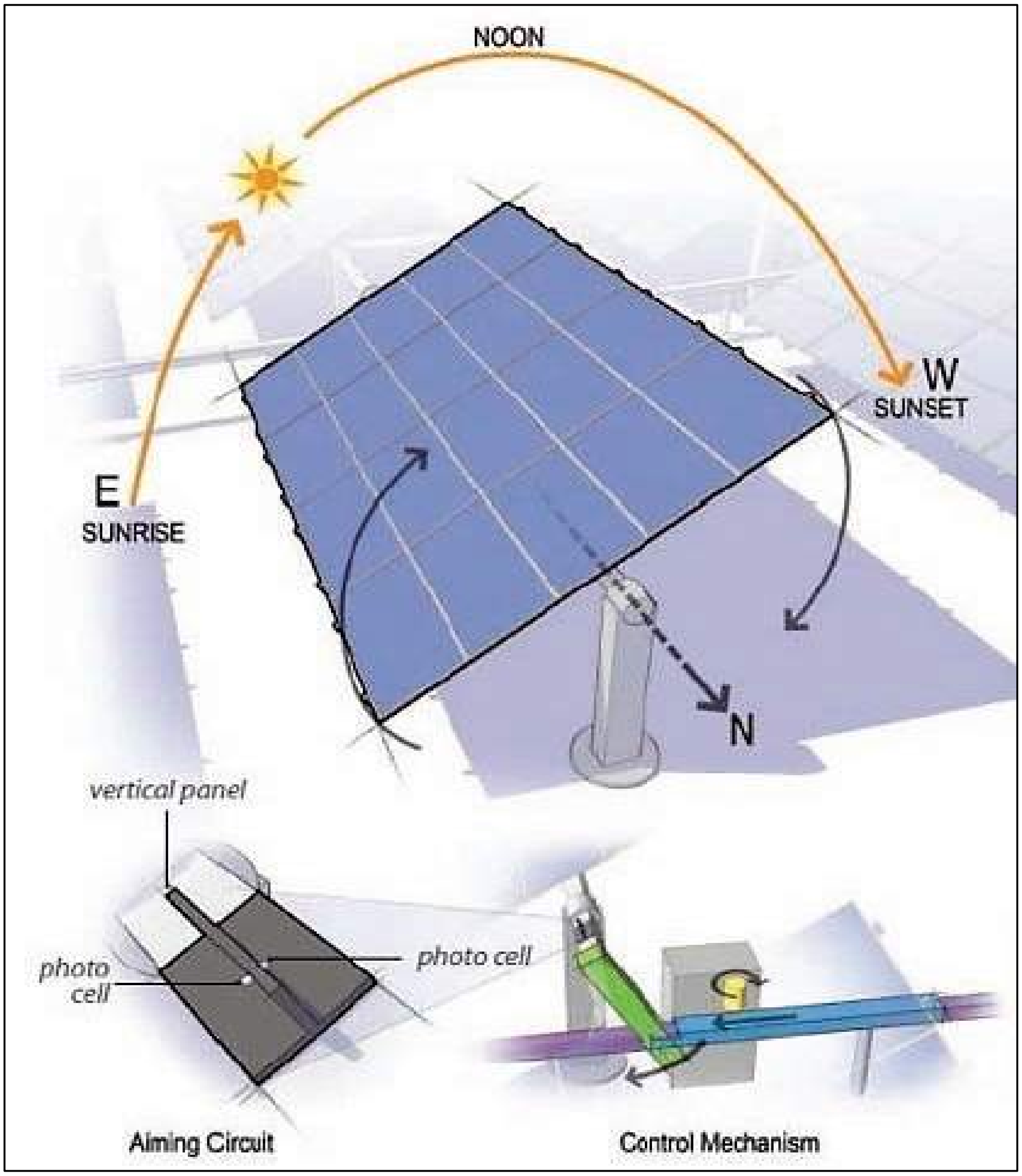

Figure 2.1-10. Diagram of Single-axis Tracking System (not to scale)

2.1.4.2.3 Transmission and Electrical System Components

Over the past several years, TVA has connected multiple solar facilities to TVA's transmission system. Most of these projects include transmission interconnection as well as network upgrades elsewhere on TVA's system. These network upgrades could include the construction of new transmission lines or upgrades to existing transmission lines to increase electrical capacity. TVA looked at 31 solar projects of various MW size from 2014 to 2021 and determined that the average length of new transmission lines for solar facility interconnection is 1.71 miles. The lengths ranged from 0 to 16 miles, with the majority being between 0 and 2 miles. The average number of acres impacted due to transmission and electrical system components ranged from 0 to 225 acres, with the average being 17.73 acres. Upgrades are typically performed to increase the electrical capacity of the existing transmission lines and new access roads may also be necessary, as discussed in Section 2.1.3.2.3.

The anticipated amount of construction of new or upgraded transmission facilities would vary amongst each solar and/or storage project. All new generating and storage facilities would require connections to the transmission system, either directly or through an interconnection with an LPC. The length of connecting transmission lines and the need for new substations and switching stations would depend on the location and capacity of the facilities. Depending on the solar and BESS site locations, transmission line upgrades may be required to increase the capacity of the lines. An OPGW may also need to be installed on transmission lines to facilitate the needed relay protection.

Since exact locations for solar and storage facilities are unknown at this time, detailed transmission impacts are undetermined. Significant transmission network upgrades to facilitate the delivery of power to the Knoxville area would likely be required, possibly including new 500-kV facilities. Furthermore, the loss of large synchronous generation (i.e., the nine KIF units) near the Knoxville area (a high load region) will increase the risk of instability events (including fault-induced delayed voltage recovery events), jeopardizing the reliability of associated power transmission systems. These events will not be effectively mitigated with inverter-based resources alone and could require multiple dynamic reactive compensation devices installed in the Nashville area to provide fast acting reactive power/grid support.

The above information was compiled to provide an estimate of the potential effects associated with the construction of transmission and electrical system components to support solar and storage facilities to provide a comparison to other action alternatives being considered. Since exact site locations for solar and storage facilities are not known at this time, additional site-specific NEPA analysis would need to be completed as the exact locations of projects are identified and the scope is further defined.

2.1.5 Alternatives Considered but Eliminated from Further Discussion

TVA considered various resource types for replacement of generation lost as a result of retiring the nine units at KIF. The replacement generation must be capable of providing year-round peak capacity as well as serving energy needs. Resources considered were required to be mature, proven technologies, capable of being constructed and operating by the end of 2027. An additional factor considered was that Kingston Fossil Plant’s (KIF) location on the transmission system, specifically on the 161 kV system near the Knoxville load center, makes KIF an integral part of the systems power flows and stability. The retirement of KIF would create a large gap in the power system in the Knoxville area and decreases the system stability for Watts Bar and Sequoyah nuclear plants. Significant transmission system upgrades in the local area would be needed if replacement generation was not provided and located on the 161 kV system near Knoxville. Retirement of Kingston Fossil without replacement generation in the area or appropriate transmission upgrades would, significantly impact the ability to add additional load in the area, degrade the stability of Watts Bar and Sequoyah nuclear plants to a point where generation would need to be curtailed, and potentially violate NERC Transmission Planning (TPL-001) standard criteria.

TVA's evaluation of the proposed retirement of KIF tiers from the 2019 IRP EIS and aligns with the 2019 IRP findings and target supply mix. In addition to the proposed replacement generation at KIF, TVA expects to add 10,000 MW of solar generation by 2035 to meet customer demands and system needs. Integrating this significant number of intermittent resources requires a generation fleet that is highly flexible and capable of ramping up and down quickly to cover gaps in renewable generation.

TVA continuously monitors a variety of market signals to inform its planning, including forecasts for loads, commodities, and resource costs. Higher demand expectations for residential and supporting services, such as data centers, is being driven by an observed shift in interstate migration patterns into the Tennessee Valley that is expected to continue. Incorporating these trends, TVA's current load forecasts indicate slightly increasing peak loads over the next 20 years. With the approved retirement of Bull Run Fossil Plant in 2023 (located approximately 22 miles west southwest of the Kingston Reservation), TVA will be at minimum reserve capacity targets and must therefore replace any retiring capacity with dependable capacity to maintain summer and winter load targets in the Knoxville region. TVA considered the resource options detailed in Table 2.1-3 to replace the nine units at KIF.

Table 2.1-3. Resource Alternatives Considered

Resource Option	Selected (Y/N)	Reasoning
Natural Gas-Fired CC	Y (Alternative A)	High fuel efficiency with large energy potential and ability to provide grid support and follow load; relatively low construction cost; and fully dispatchable year-round with the ability to ramp up and down throughout the day to meet changes in demand and fluctuations in output from renewable resources.
Natural Gas-Fired Frame CT	N	Ability to start and ramp quickly on short notice as well as provide grid support and follow load; fully dispatchable year-round with the ability to meet capacity needs during short periods; lowest installed capital cost per MW and offers flexibility to assist in the integration of renewable resources. Not selected because of inability to operate on alternative fuels like hydrogen.
Natural Gas-Fired Simple Cycle Aeroderivative (CT)	Y (Alternative A)	Can operate either on natural gas or ULSD. Highly efficient peaking units with very fast startup, offer higher cycling capacity, no start-up costs, speed provides excellent control response for better grid support, emergency Black Start to aid in system restoration following disturbance to bulk electric system, run in synchronous condensing mode.
BESS	Y (Alternative A and B)	Provides dispatchable complement to intermittent nature of solar and wind resources; represents one of the lowest cost storage options; customizable output rating.
Utility- and/or Distributed-Scale PV Solar	Y (Alternative B)	Relatively inexpensive on a cost per MWh basis but are not dispatchable and generation is intermittent; therefore, must be paired with dispatchable resources, such as storage or gas.

Resource Option	Selected (Y/N)	Reasoning
Hydro Pumped Storage	N	Long-duration storage that is currently being studied by TVA for further evaluation and potential deployment in the early 2030s. Longer timelines to meet environmental requirements and for construction are incompatible with time frame proposed for the unit retirements at KIF.
Small Modular Reactors	N	Potential to serve cost-effective baseload or load following needs in the future with low fuel costs, carbon-free generation, advanced passive safety systems, and anticipated cost reductions achieved by assembling components in a factory setting; however, longer timeline and First of a Kind deployment risks are incompatible with the needs of this project.
In- and/or Out-of-Valley Wind	N	Can provide dependable capacity in both summer and winter, though intermittent. Was not selected due to low wind speeds in Tennessee Valley and higher transmission costs for out-of-Valley wind, both of which increase relative costs.
Energy Efficiency	N	Well-positioned to play a role in absorbing load growth resulting from increased electrification of the economy; however, energy efficiency programs take time to scale and market, increasing costs at the high penetration levels required to meet the needs of this project.
Demand Response	N	Well-positioned to play a role in absorbing load growth resulting from increased electrification of the economy and allows TVA to offset physical capacity needs; however, they are limited in the number of calls available and would not meet the needs of this project.
Coal to Gas Unit Conversions	N	Can be beneficial by repurposing existing equipment but benefits can be offset by reduced generating efficiency and shorter duration for equipment lifespan.
Distributed Energy Resources (DER)	N	Cost for distributed generation is generally higher than utility-scale generation for the same type of resource. TVA has therefore determined that the combination solution of utility-scale solar paired with utility-scale storage as presented in Alternative B provides a feasible lower-cost solution.

The conversion of the existing coal units to natural gas fuel was also considered as an alternative to the retirement of the existing KIF, but this was later dismissed. Although this alternative would have utilized the existing plant boilers of the current KIF coal plant, the generating plant would have been approximately 30 percent less efficient than the proposed CC and would be expected to have shorter lifespan. This, in addition to the potential for continued material condition issues and the O&M of an older, larger plant, lead to this alternative being dismissed from consideration.

TVA's asset strategy also contemplated the blending of resources to provide the least-cost, optimal portfolio under a variety of future conditions. The preferred alternative in this EIS is a specific, discrete component of that blend reflected in TVA's asset strategy. TVA's long-term planning, specifically the 2019 IRP, accounts for the integration of renewables on a schedule that best balances economics, reliability, and environmental impacts, while staying consistent with the least-cost planning requirements of 16 U.S.C. §831m-1(b)(1).

While Alternative A does include gas, solar, and storage, a blended alternative that includes a substantial renewable component or combines a lower amount of natural gas with other technologies, such as solar and storage, would require similar transmission work and durations (i.e., eight to nine years) associated with Alternative B. Therefore, any such blended alternative would not meet the purpose and need to have 1,500 MW of firm, dispatchable power in commercial operation by 2027. Therefore, TVA has determined that blended alternatives would not meet the project purpose and need.

Distributed generation, such as distributed solar, storage, and wind, was also considered. Distributed Energy Resources (DER) are generally smaller in size and can be aggregated together in a program or agreement for planning purposes. TVA's flexibility option, available to LPC Long-term Partners, provides an avenue for additional levels of DER by allowing LPCs to self-generate up to 5 percent of their annual load. TVA's IRP (TVA 2019a) includes assumptions for DER adoption, including DER added by LPCs on the distribution system. In general, the cost to TVA for distributed generation is higher than utility-scale generation for the same type of resource. TVA has therefore determined that the combination solution of utility-scale solar paired with utility-scale storage as presented in Alternative B provides a feasible lower-cost solution for replacement generation and capacity utilizing renewable energy.

2.1.5.1 Natural Gas Pipeline Alternatives Considered but Eliminated

TVA has taken into consideration an alternatives analysis conducted by ETNG for the natural gas pipeline component of Alternative A. In this alternatives analysis, the options in Table 2.1-4 were considered as alternatives to the proposed 111-mile, 30-inch diameter pipeline. Additional details about these potential alternatives are presented in ETNG's Resource Report 10, Alternatives (ETNG 2022k).

Table 2.1-4. Potential Alternatives to the Proposed Pipeline Route

ETNG Options	Selected (Y/N)	Reasoning
No Action	N	ETNG would not be able to meet TVA's stated need to provide up to 300,000 Dth/d (300,000,000 cf/d) of natural gas transportation capacity to serve Alternative A.
Energy Conservation	N	The implementation and success of energy conservation in curtailing energy use is a long-term goal, extending well beyond the timeframe of the proposed pipeline. Further, energy conservation would not allow ETNG to provide up to 300,000 Dth/d (300,000,000 cf/d) of firm transportation service to the Kingston CC/Aero CT Plant as would be needed under Alternative A.
Non-Gas Energy Alternatives	N	The pipeline's purpose is to provide 300,000 Dth/d (300,000,000 cf/d) of natural gas transportation capacity and 95,000 Dth/d (95,000,000 cf/d)of parking capability to deliver gas to Kingston CC/Aero CT Plant as would be needed under Alternative A. A non-gas energy alternative would not meet the purpose and need for the project.

ETNG Options	Selected (Y/N)	Reasoning
System Alternative A – ETNG's 3100 Line Replacement	N	ETNG evaluated replacing approximately 115 miles of its existing 22-inch-diameter 3100 Line with 36-inch-diameter pipeline primarily in the same trench as an alternative to installing 115 miles of pipeline primarily adjacent to the existing pipeline. The potential advantage of this system alternative is that more pipeline facilities could be constructed within the existing ROW, which would reduce the need for acquiring additional ROW for the proposed pipeline. However, this alternative would also require construction activities at more aboveground facilities. ETNG does not consider replacement of the 3100 Line to be viable operationally. The replacement of the existing 3100 Line by a pick-up and relay would result in outages affecting existing customers utilizing the 3100 Line throughout the construction period because the 3100 Line is not looped for the vast majority of the 115 miles that would be replaced. Outages on the 3100 Line would impact approximately 60% of East Tennessee's customers. The installation and subsequent removal of temporary looping for almost the entire length of the 3100 Line segments to be replaced would result in significant additional environmental impacts for this alternative. In addition, sufficient natural gas trucking capability does not exist to mitigate the more than 400,000 Dth/d of existing long-term contractual entitlements on East Tennessee's 3100 Line. Even if such capability could be created, long-distance trucking would result in additional environmental impacts, including vehicle emissions and traffic impacts. Because this alternative is neither practical nor feasible, this alternative was removed from further consideration.
System Alternative B – Mountain Valley Pipeline	N	The Mountain Valley Pipeline is a 303-mile natural gas pipeline that would extend from West Virginia to southern Virginia and would intersect East Tennessee's 3100 Line at approximate MP 243 in Montgomery County, West Virginia. Due to the required length of loop pipeline necessary, this alternative would result in increased environmental and land impacts as compared to the proposed pipeline. The proposed pipeline has been designed to receive maximum supply point diversity for TVA. This system alternative would limit the supply point diversity and would not meet the pipeline objective to provide access to supply from Texas Eastern, Midwestern Gas and Columbia Gulf. This alternative would result in significantly greater land requirements, increased impacts to wetlands, including non-forest and forested wetlands, more waterbody and road crossings, more linear miles of threatened and endangered species critical habitat, and more residences would be located within 50 feet of the construction ROW. Because this alternative would result in greater impacts as compared to the proposed pipeline, System Alternative B is not environmentally preferrable to the pipeline. Accordingly, this alternative was removed from further consideration.

ETNG Options	Selected (Y/N)	Reasoning
System Alternative C – Transcontinental Gas Pipeline	N	ETNG evaluated an alternative which would receive gas from the 1,800-mile-long Transcontinental Gas Pipeline, which runs from New York to Texas and intersects East Tennessee's 3600-1 pipeline in Rockingham County, North Carolina. Due to the required length of loop pipeline necessary, this alternative would result in increased environmental and land impacts as compared to the proposed pipeline. The Transcontinental pipeline system alternative would limit the supply point diversity and would not meet TVA's need to access to supply from Texas Eastern, Midwestern Gas and Columbia Gulf. This alternative would result in significantly greater land requirements, increased impacts to wetlands, including non-forest and forested wetlands, more waterbody and road crossings, more linear miles of threatened and endangered species critical habitat, and more residences located within 50 feet of the construction ROW. Because this alternative would result in greater impacts as compared to the proposed pipeline, System Alternative C is not environmentally preferrable to the pipeline. Accordingly, this alternative was removed from further consideration.

Source: ETNG 2022k

ETNG also considered alternative sites for the compressor station (ETNG 2022k), as summarized in Table 2.1-5. Alternative sites for the compressor station were limited by the need to be within milepost (MP) 0.0 and 11.0 of the pipeline based on account system hydraulics and the availability and suitability of land for the adjacent solar array (150-200 acres). Hartsville Compressor Station was selected as the preferred site due to reduced environmental impacts as compared to other sites considered. Hartsville Compressor Station was selected as the preferred site due to reduced environmental impacts as compared to other sites considered.

Table 2.1-5. Potential Alternatives to the Preferred Alternative (Hartsville Compressor Station)

ETNG Options	Selected (Y/N)	Reasoning
Compressor Station Alternative A	N	Located at approximately MP 6.0. This parcel is located near the Hartsville Battlefield and the Averitt Herrod House, which are listed on the National Register of Historic Places. Local officials have indicated that the development of a compressor station on this site could impede future development as Hartsville expands. The adjacent site for the non-jurisdictional solar array would potentially impact cemeteries. This site would require construction of access roads near residences due to limited existing site access and would impact the viewshed of residences and the National Register of Historic Places sites. Based on these factors, Compressor Station Alternative A is not the preferred alternative.

ETNG Options	Selected (Y/N)	Reasoning
Compressor Station Alternative B	N	Compressor Station Alternative B is an approximately 225-acre parcel located at MP 8.2 (Figure 10.6-3). The site consists primarily of forested land and steep slopes. Due to its remote location, this site would draft Resource Report 10 – Alternatives 10-12 RIDGELINE EXPANSION PROJECT require construction of longer access roads and power lines as compared to the preferred alternative. Based on the site topography, required tree-clearing, and additional land impacts, this site is not suitable for development of the compressor station and adjacent non-jurisdictional solar array.
Compressor Station Alternative C	N	Compressor Station Alternative C is located at MP 10.8 adjacent to East Tennessee's existing Dixon Springs Compressor Station (Figure 10.6-4). The 100-acre parcel is primarily forested land. Because of the restricted space between the public road and the existing pipeline ROW, the station layout would include noise emitting and gas containing components close to the public road. The adjacent site proposed for the non-jurisdictional solar array has steep topography, contains waterbodies, and would require extensive tree clearing. Based on these factors, this site is less suitable for development of the solar array than the preferred alternative.

Source: ETNG 2022k

ETNG has made and continues to consider multiple minor variations to the pipeline alignment in response to engineering, environmental, and landowner concerns. This EIS addresses the potential impacts of the pipeline based on the information currently available.

2.1.5.2 Alternative Fuels and Carbon Capture and Sequestration Considered but Eliminated from Further Discussion

Combustion turbine units, used in CC or in CT operations, hold promise in further contributing to a net-zero future through the use of alternative fuels, such as hydrogen, and/or carbon capture and sequestration (CCS) technology. Most modern combustion turbine units available today have the capability to burn a blend of hydrogen in combination with fossil fuels to reduce the unit's carbon footprint. It is anticipated that this capability would continue to advance and increase the percentage of alternative fuel blending or exclusive alternative fuel use that these units would be capable of utilizing in the future. In the same vein, advancements in the development of regional hydrogen hubs and electrolyzer technology would make green hydrogen a decarbonization lever. As to CCS systems, they typically work by capturing carbon emissions before being released into the atmosphere, transporting them, and then storing them in underground geological formations. Given cost considerations, CCS technology would likely be paired with higher capacity factor units, such as those in CC configuration. At this time, however, high costs and immaturity of alternative fuels and CCS remain barriers to widespread commercial use.

TVA has committed to ensuring that the design of the Alternative A CC/Aero CT plant would enable and accommodate potential future modifications for carbon capture and the combustion of hydrogen (CC units only) as a replacement or supplemental fuel for natural gas when these technologies mature to scale. The proposed CC units under Alternative A would be designed to be 5 percent hydrogen capable at commissioning by adding balance of plant[9] equipment that includes areas for future hydrogen storage, appropriately sized piping, and a blending station during the original construction. TVA would also purchase a CC unit capable of burning at least 30 percent hydrogen, by volume, with modifications to the balance of plant once a hydrogen source is available. TVA would only consider burning hydrogen as a part of test burns or normal operations when it is commercially available at an acceptable chemical content that would reduce carbon emissions and be price competitive in the market at that time. It is important to note that once a viable option for future mitigation projects is identified, TVA would conduct additional analyses to determine proposed pipeline routes, costs, storage requirements, or other needs with hydrogen fuel incorporation. TVA would analyze the site- specific impacts associated with any future mitigation that is planned as additional details become available.

TVA has considered the USEPA's draft whitepaper on reducing GHG emissions from CTs (USEPA 2022b) and anticipates the efficiency, effectiveness, scalability, and economics of these systems to improve in the next several years, allowing for more informed decisions in the future when adequate storage locations or pipelines are identified for both the delivery of hydrogen and the storage or use of captured CO_2. TVA is exploring partnerships with federal agencies and peer utilities to advance the research and development of both alternative fuels and CCS technology, which could enable their use at existing or future TVA facilities. In addition to the current cost and maturity challenges with CCS, the potential geological features (i.e., karst instability and tendency to develop sinkholes) of the Kingston Reservation pose further challenges to the consideration of CCS at this site.

In its Fall 2022 Unified Regulatory Agenda (published in the Federal Register on February 22, 2023), the USEPA indicated that it expects to propose a rule to regulate GHG emissions from existing and new fossil fuel-fired power plants in Spring 2023 and to finalize the rule in Spring 2024. The construction and operation of the Kingston replacement project would be consistent with the requirements of rules promulgated by the USEPA under Section 111 of the CAA.

2.2 Comparison of Alternatives

Impacts evaluated may be beneficial or adverse and may apply to the full range of natural, aesthetic, historic, cultural, and socioeconomic resources within the project areas of each alternative and within the surrounding areas. Impact severity is dependent upon their relative magnitude and intensity and resource sensitivity. In this document, four descriptors are used to characterize the level of impacts in a manner that is consistent with TVA's current practice. In order of degree of impact, the descriptors are as follows:

- No Impact (or "absent") – Resource not present or, if present, not affected by project alternatives under consideration.
- Minor – Environmental effects are not detectable or are so minor that they would not noticeably alter any important attribute of the resource.

[9] The Balance of Plant is a power engineering term referring to the various supporting and auxiliary components of a power plant.

- Moderate – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
- Large – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

A comparison of the environmental consequences associated with each alternative is presented in Table 2.2-1.

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Table 2.2-1. Summary and Comparison of Alternatives by Resource Area

		Alternative A			Alternative B
Resource Area	**No Action Alternative**	**Retirement and Demolition of KIF Plant (All Action Alternatives)**	**TVA Actions on Kingston Reservation and Transmission Line Upgrades**	**Natural Gas Pipeline and Associated Structures**	
Environmental Justice	No amplified effects to EJ populations are projected.	Minor, permanent amplified effects on EJ populations possible. Due to the loss of direct and indirect employment associated with Kingston, competition for employment in other fields in the Kingston labor market area may increase, leading EJ populations and other populations to relocate for work or follow recent depopulation trends and permanently relocate. These changes may affect familial and community relations among EJ and other populations. Effects may be offset by temporary employment increases during D4 activities.	Minor to moderate amplified effects on EJ populations possible. Effects to EJ and other populations due to impact to soils, water resources, air quality, recreation, land use, transportation, socioeconomics, noise, and aesthetics (visual resources) Minor beneficial effects to EJ and other populations by reducing fish mortality from impingement and entrainment at the existing KIF plant intake, improving water quality due to reduced loading of metals in the coal plant's discharge, temporarily increasing employment as a result of construction needs, and improving air quality due to reduced air emissions.	Minor to moderate, temporary, and/or permanent amplified effects to EJ populations possible. Effects to EJ and other populations due to impact to soils, water resources, air quality, recreation, land use, transportation, socioeconomics, noise, and aesthetics (visual resources). Minor but permanent effects to EJ and other populations due to the loss and conversion of prime farmland, the chosen location of waste disposal, and local socioeconomics. Minor effects to EJ and other populations during construction due to potential indirect effects to aquatic life used for subsistence and permanent/temporary loss of forested areas.	Minor to moderate, temporary and/or permanent amplified effects on EJ populations possible. Whether effects are amplified for EJ populations would be verified through reviews for individual solar and storage facilities.
Land Use	No direct or indirect project-related effects	Minor temporary effects during demolition.	Permanent, moderate impacts to land use and conversion of land from hay/pasture, forest and open space to industrial use and maintained open space. No changes to land use for existing on- and off-site transmission corridors. Minor impacts on previously disturbed land are expected. Battery sites 2 and 3, and the Battery Transmission Corridor would have the most significant long-term impacts as they are forested.	Pipeline construction would both temporarily and permanently impact various types of land including open, agricultural, forested, residential, and wetlands areas. Impacts would range from minor to moderate.	Minor temporary effects during construction. Moderate effects in conversion of agricultural land to developed land with potential for later restoration of agricultural use.
Geology	No direct or indirect project-related effects.	Minor direct effects to geology during demolition.	Minor direct effects to geology during construction. Minor potential for seismic activity. Geologic features, such as sinkholes or karst terrain, would be avoided if possible.	Mitigation measures would be utilized in karst-prone or sloped areas to reduce the risk of geologic hazards and impacts during pipeline construction. Pipeline routing modifications and directional drilling may be used to avoid or minimize risks associated with karst prone areas.	Minor direct effects to geology during construction. Minor potential for seismic activity. Geologic features, such as sinkholes or karst terrain, would be avoided.
Soils	No direct or indirect project-related effects.	Minor temporary effects during demolition.	Construction of the CC/Aero CT plant, Battery Site, and the solar facility would have moderate permanent effects on soils due to placement of fill. Forested areas within on-site transmission corridors may have minor effects on soil stability and erosion from habitat conversion (i.e., from forested to herbaceous or scrub/shrub). Minor, temporary impacts to soils from construction activities during transmission upgrades would occur.	Effects to soils due to pipeline construction would be temporary and mitigated through BMPs.	Soil impacts would be spread across 15 or more solar sites within portions of the East Tennessee region, based on the assumption that each site is 100-MW. Approximately 10 to 15 acres per 40 MW would be required for the storage facilities. Based on this requirement, the 2,200 MW of battery storage would occupy about 550 to 825 acres. Moderate direct effects could occur that would be reduced using appropriate BMPs.
Prime Farmland	No direct or indirect project-related effects.	No direct or indirect project-related effects.	No direct or indirect project-related effects. No prime farmland exists within the Alternative A boundaries. Prime farmland along off-site transmission corridors would remain unchanged.	Minor direct effects from loss of on-site prime farmland soils within the ETNG Construction ROW.	A large portion of the approximately 10,950 acres occupied by the proposed solar facilities is likely to be prime farmland. Moderate direct effects from temporary loss of prime farmland soils if found on-site.

Resource Area	No Action Alternative	Alternative A: Retirement and Demolition of KIF Plant (All Action Alternatives)	Alternative A: TVA Actions on Kingston Reservation and Transmission Line Upgrades	Alternative A: Natural Gas Pipeline and Associated Structures	Alternative B
Floodplains	No direct or indirect project-related effects.	Minor direct effects in the 100-yr floodplain that would be minimized using appropriate BMPs.	Construction of the CC/Aero CT Plant would result in 1.0 acre-foot or less of net fill within the Clinch River 100-year floodplain and Watts Bar Flood Storage Zone. The new structures and upgrades to the existing on-site transmission corridor would cause minor temporary impacts during construction with floodplain capacity being restored after completion. Battery Site 1 option, if selected, would result in minor permanent impacts within the 100-year floodplain.	Temporary minor effects to 100-year floodplains and floodways as a result of pipeline construction.	Potential minor direct effects from solar installations in the 100-year floodplain that would be reduced using appropriate BMPs. Floodplain impacts are not anticipated for storage facilities as they are typically sited to avoid floodplains. New transmission structures and upgrades to existing transmission lines would cause minor temporary impacts during construction with floodplain capacity being restored after completion.
Water Resources	No direct or indirect project-related effects	Long-term beneficial effect from reduced cooling water withdrawals and the reduction of wastewater discharges. Temporary minor effects to surface waters during demolition. BMPs would be employed where appropriate. Minor effects to groundwater mitigated with the use of appropriate BMPs.	Indirect minor beneficial effects to groundwater and minor adverse effects to waters and wetlands from the demolition of the existing coal plant facilities. Potential permanent impacts to 1,453-2,815 linear feet (LF) of wet-weather conveyances (WWCs), 0-1 pond and 0.17 acre of wetlands on Kingston Reservation; 2.98 acre of forested wetland conversion within off-site transmission corridors during regular vegetation maintenance; and indirect temporary impacts to 16,373 LF of perennial stream, 11,426 LF of intermittent stream, 14,274 LF of WWC, and 15 waterbodies during off-site transmission corridor upgrades. Surface waters would be avoided to the maximum extent practicable, and effects would be minimized with appropriate BMPs or mitigated through purchase of mitigation credits. Minor effects to groundwater may occur but would be mitigated through the use of BMPs. Avoidance, minimization, and mitigation are expected to reduce or eliminate cumulative effects to groundwater, streams and wetlands.	Temporary impacts to a total of 549 ephemeral channels, streams, ponds, and major waterbodies, including 339 waterbodies crossed by the pipeline and 210 waterbodies within workspaces. No impacts to the 18 major waterbodies proposed to be crossed via HDD. Temporary impacts include effects to waterbody banks and water quality due to clearing. Potential permanent impacts to 1.1 ac of wetlands and temporary impacts to 26.2 ac of wetlands from natural gas pipeline construction.	Moderate adverse impacts expected to 4.5 acres and up to 150 acres of wetland, in addition to an average of 15 acres and up to 150 acres of forested wetland clearing. Minor effects to streams and groundwater from expansion of solar facilities and transmission lines, mitigated with the use of appropriate BMPs.
Biological Resources	No direct or indirect project-related effects	Long-term beneficial effect to vegetation (recolonization) and eventual benefit to wildlife with added habitat and reduced water withdrawals. Potential temporary minor adverse impacts to aquatic life due to storm water runoff associated with demolition. Likely minor adverse effect to protected bats due to forest removal, but these effects would be minimized by use of specific conservation measures established through TVA's programmatic consultation with USFWS for protected bats.	Potential long-term moderate adverse effects (habitat loss or conversion) to vegetation due to construction of all Alternative A components. There would be no permanent impacts to aquatic life associated with the CC/Aero CT Plant, solar facility, battery site, or on-site or off-site transmission line corridors. Impacts to threatened and endangered species are expected to be minor, and periodic due to habitat removal or conversion. Likely adverse effect to protected bats due to forest removal. These effects would be mitigated by use of specific conservation measures established through TVA's updated programmatic consultation with USFWS for protected bats.	Potential permanent impacts to 724 ac of vegetation due to construction and regular maintenance activities resulting in habitat conversion. Potential minor yet long-term temporary impacts to 1,879 ac of vegetation due to construction of natural gas pipeline. Approximately 30 ac of wildlife habitat removal are expected from the construction of access roads and aboveground facilities and an additional 268 ac of habitat would be impacts by habitat conversion (i.e., forested to herbaceous/scrub-shrub). No long-term impacts to surface waters or aquatic life associated with the natural gas pipeline. Temporary impacts from stream diversion during open cut natural gas pipeline installation would occur and impacts to aquatic life would be limited. Impacts to	Minor direct and indirect adverse effects to vegetation, wildlife, aquatic life, and protected species may occur due to habitat removal for solar site and transmission construction. Likely adverse effect to protected bats due to forest removal, but these effects would be minimized by use of specific conservation measures established through Section 7 Consultation with the USFWS for protected bats.

		Alternative A			Alternative B
Resource Area	**No Action Alternative**	**Retirement and Demolition of KIF Plant (All Action Alternatives)**	**TVA Actions on Kingston Reservation and Transmission Line Upgrades**	**Natural Gas Pipeline and Associated Structures**	
				protected species would be caused by clearing, resulting in reduction of summer roosting habitat, but nearby or adjacent forested areas may provide alternative habitat during the summer. No direct impacts would be felt by bat species during the winter hibernation period.	
Natural Areas, Parks, and Recreation	No direct or indirect project-related effects	Minor temporary effects during demolition. Minor permanent effects to recreation activities currently hosted on-site.	Minor but temporary adverse effects could occur to recreational uses of the Emory and Clinch rivers near the Kingston Reservation during construction. Public access to the boat launch in the Kingston Reservation could be temporarily interrupted. Effects to boat launching activities would be temporary but beneficial in the long-term. Off-site transmission upgrades would have minor and temporary impacts on outdoor recreational activities and natural areas due to construction traffic. Moderate, permanent, adverse impacts would occur due to conversion of forested area to maintained open space where the Eastern Transmission Corridors intersect natural and recreational areas.	The proposed gas pipeline is expected to temporarily disturb 21 acres of natural and recreational resources during construction, resulting in increased traffic, noise and visual disturbances.	Unlikely to affect natural areas, parks, or recreation.
Noise	No direct or indirect project-related effects	Temporary, minor effects during D4 activities.	Noise effects from construction activities and construction-related traffic are expected to be temporary and minor. Construction would not result in the generation of, or exposure of persons to excessive noise or vibration levels for lengthy periods, and noise mitigation efforts would be implemented by TVA.	Noise effects from construction activities and construction-related traffic are expected to be temporary and minor. Construction would not result in the generation of, or exposure of persons to excessive noise or vibration levels for lengthy periods, and noise mitigation efforts would be implemented by ETNG. After the construction of the pipeline, there would be little to no noise during its operation aside from occasional maintenance activities, including the periodic mowing of the pipeline ROW.	Temporary, minor effects during construction.

		Alternative A			Alternative B
Resource Area	**No Action Alternative**	**Retirement and Demolition of KIF Plant (All Action Alternatives)**	**TVA Actions on Kingston Reservation and Transmission Line Upgrades**	**Natural Gas Pipeline and Associated Structures**	
Visual	No direct or indirect project-related effects	Temporary, minor effects during demolition. Permanent beneficial effects to viewshed.	The proposed CC/Aero CT Plant would generally be absorbed by surrounding industrial components and would become visually subordinate to the overall landscape character associated with the plant site. Long-term visual effects from the conversion of forest to fields due to the off-site transmission lines. Where mitigation is necessary due to adverse visual impacts, fencing and vegetative screening would be utilized.	Permanent visual effects would occur as a result of the construction of the aboveground natural gas structures and areas along the ETNG Construction ROW where forestland is converted to maintained open space. Where mitigation is necessary due to adverse visual impacts, fencing and vegetative screening would be utilized. Overall, the buried pipeline would largely blend in with the existing environment and would not create significant visual discord once operational.	Temporary, minor effects during construction. Likely moderate effects post-construction depending on original visual character of the sites selected.
Air Quality and GHGs	No direct or indirect project-related effects.	Temporary, minor effects during demolition. Permanent, beneficial effects.	Temporary, minor effects during construction. Permanent beneficial effects.	Temporary, minor effects during construction. Permanent beneficial effects.	Temporary, minor effects during construction. Permanent beneficial effects.
Regional Climate	No direct or indirect project-related effects.	No appreciable direct or indirect project-related effects.	Increases in ambient temperatures due to climate change would have minor adverse impacts to combustion turbine efficiency. Operational effects due to flooding or drought conditions are expected to be minor. Permanent, beneficial effects on regional climate.	Increases in ambient temperatures due to climate change would have minor adverse impacts to natural gas equipment efficiency. Operational effects due to flooding or drought conditions are expected to be minor. Permanent, beneficial effects on regional climate.	Increases in ambient temperatures due to climate change would have minor negative impacts to equipment efficiency. Operational effects due to flooding or drought conditions are expected to be minor. Permanent, beneficial effects on regional climate.
Cultural Resources	No direct or indirect project-related effects.	No direct or indirect project-related effects.	No effects to archaeological resources pending SHPO concurrence with proposed site boundary results based on 2022 Phase II survey. Because the natural gas pipeline lateral would be subsurface, this installation would have no effect on any significant historic architectural resources.	There are 133 archaeological sites within the ETNG Construction ROW. A total of 44 newly and previously recorded sites are considered potentially eligible for the NRHP; additional testing investigations is recommended to evaluate their NRHP eligibility. Additionally, there are four previously recorded sites that are eligible for the NRHP; additional data recovery investigations are required if these sites cannot be avoided by construction activities. Because the natural gas pipeline lateral would be subsurface, this installation would have no effect on any significant historic architectural resources. The 17 cemeteries within or adjacent to the current natural gas pipeline would be avoided.	Impact avoidance likely if significant cultural resources can be avoided in site selection.

		Alternative A			Alternative B
Resource Area	**No Action Alternative**	**Retirement and Demolition of KIF Plant (All Action Alternatives)**	**TVA Actions on Kingston Reservation and Transmission Line Upgrades**	**Natural Gas Pipeline and Associated Structures**	
Utilities	Moderate, adverse, permanent impacts due to increasing performance challenges.	Permanent effects to buried utilities. No effects to switchyards.	Overall, long-term beneficial impacts would occur due to decreased water use for the CC/Aero CT Plant. Service disruptions associated with Alternative A construction are expected to be minimized through coordination with impacted utilities. Minor beneficial impacts from the solar facility would occur due to the increased power generation and interconnection to the TVA grid. Overall, long-term beneficial impacts would occur due to improved reliability and service costs as a result of Alternative A.	Project operations are not expected to result in adverse impacts to public or private water supplies unless operation and maintenance activities involving pipe excavation and repairs are needed. Overall, long-term beneficial impacts would occur due to improved reliability and service costs as a result of Alternative A.	Minor, temporary impacts due to potential for service disruption. Permanent beneficial effects.
Waste Management	No direct or indirect project-related effects	Temporary, minor effects due to the limited potential for hazardous waste to be discharged and/or released into the environment during demolition activities.	Temporary increase in generation of hazardous waste during construction. Permanent impacts due to increase in waste at CC/Aero CT Plant. Moderate impacts due to end-of-life disposal for potentially hazardous infrastructure due to solar component.	Temporary increase in generation of hazardous waste. Appropriate spill prevention, containment, and disposal requirements for hazardous wastes would be implemented to protect construction and plant workers, the public, and the environment. Moderate impacts due to end-of-life disposal for potentially hazardous infrastructure due to solar component.	Minor, temporary increase in generation of hazardous waste during construction. Moderate impacts due to end-of-life disposal for potentially hazardous infrastructure.
Public Health and Safety	No direct or indirect project-related effects	Temporary, minor effects during demolition. Permanent beneficial effects.	During construction, workers would have a temporary, minor increased safety risk that would be mitigated through BMPs and site-specific health and safety plans. General public health and safety would not be at risk in the event of an accidental spill on-site due to precautionary measures. Permanent beneficial impact due to atmospheric emissions reduction as a result of coal generation replacement.	During construction, workers would have a temporary, minor increased safety risk that would be mitigated through BMPs and site-specific health and safety plans. General public health and safety would not be at risk in the event of an accidental spill on-site due to precautionary measures. Permanent beneficial impact due to atmospheric emissions reduction as a result of coal generation replacement.	Temporary, minor effects during construction.
Transportation	No direct or indirect project-related effects	Temporary, minor effects during demolition.	Temporary, minor increases in traffic volume would occur as a result of construction and operation. The effect from traffic volume generated by the construction workforce and the construction-related vehicles would have a moderate, temporary impact to driver safety and roadway degradation. As added traffic due to operations would be significantly less than construction, long-term impacts would be minor.	Vehicular traffic on public roads as well as near the proposed gas pipeline would increase during construction due to construction workers and materials moving to and from the plant and pipeline construction areas. Long-term impact on traffic and transportation routes would be negligible.	Temporary, minor effects during construction.
Socioeconomics	No direct or indirect project-related effects.	Permanent, minor direct and indirect employment loss due to KIF closure. KIF employees and associated family members may also temporarily relocate for work or follow recent depopulation trends and permanently relocate elsewhere, affecting familial and community relations.	New, temporary, and permanent employment options in the KIF labor market area due to construction and operations of the new CC/Aero CT Plant, switchyard, and transmission connections on the Kingston Reservation.	New, temporary, and permanent effects due to employment in relation to construction and operations of the natural gas pipeline and associated gas system infrastructure would provide employment Construction activities would create minor, temporary adverse effects on transportation systems in the associated communities.	Anticipated temporary beneficial effects to local population numbers; temporary and permanent beneficial effects to local employment; temporary indirect beneficial effects to the local economy; and long-term beneficial effects to the local tax base.

2.3 Identification of Mitigation Measures

TVA would employ standard practices and routine measures and other project-specific measures to avoid and minimize effects to resources from implementation of the Proposed Action Alternatives. Certain minimization and mitigation measures were provided by TDEC as recommendations regarding demolition of materials in lieu of open burning, such as beneficial reuse or transport to a recycling facility or landfill; general permitting; and BMP guidance regarding cultural, air, and water resources.

TVA's siting processes for generation and transmission facilities, as well as practices for modifying these facilities, are designed to avoid and/or minimize potential adverse environmental effects. Potential effects are also reduced through standard pollution prevention measures and environmental controls, such as air pollution control systems and wastewater treatment systems. Other potentially adverse effects can be mitigated by measures, such as avoidance of sensitive areas; compensatory wetland mitigation; payments to in lieu stream mitigation programs and related conservation initiatives; enhanced management of other properties; documentation and recovery of cultural resources; and infrastructure improvement assistance to affected local communities.

TVA would implement minimization and mitigation measures. These have been developed with consideration of BMPs, permit requirements, and adherence to erosion and sediment control plans. TVA would utilize standard BMPs to minimize erosion during construction, operation, and maintenance activities. These BMPs are described in *A Guide for Environmental Protection and BMPs for TVA Construction and Maintenance Activities – Revision 4* (TVA 2022a) and the *Tennessee Erosion and Sediment Control Handbook* (TDEC 2012).

2.3.1 Standard Practices and Routine Measures

In association with the potential construction of an action alternative, TVA would employ standard practices and specific routine measures to avoid and minimize effects to resources. During development of the EIS, TVA has considered implementation of the following minimization and mitigation measures in relation to potentially affected resources:

Soils

- Install silt fence along the perimeter of areas cleared of vegetation.
- Implement other soil stabilization and vegetation management measures to reduce the potential for soil erosion during site operations.
- Try to balance cut-and-fill quantities to alleviate the transportation of soils off-site during construction.

Water Resources

- Perennial, intermittent, and ephemeral streams and wetlands that could be affected by the proposed construction would be protected by implementing standard BMPs as identified in the project SWPPP, TVA's BMP manual, and the Tennessee Erosion and Sediment Control Handbook. Direct, permanent effects to streams and wetlands would be permitted and mitigated under the CWA Section 404 permit and TDEC ARAP/ CWA Section 401. TVA would purchase mitigation credits within the Clinch, Emory, and Tennessee River watersheds, as appropriate and to the extent such credits are available within these watersheds. Should mitigation credits not be available within the primary or applicable secondary watersheds, TVA would pursue mitigation through in-lieu fee credit purchases or through permittee-responsible mitigation.

- Comply with the terms of the individual NPDES permit for industrial wastewater discharge(s) by ensuring any proposed process water discharge meets applicable effluent limits and water quality standards, as identified in the NPDES permit.
- Comply with the terms of the erosion and sediment control plans prepared as part of the NPDES permitting process.
- Use TVA BMP procedures for controlling soil erosion and sediment control, such as the use of 50-foot buffer zones, to the extent practicable, surrounding perennial and intermittent streams and wetlands; impaired or high-quality designated water features may require larger buffer zones and the installation of erosion control silt fences and sediment traps; and
- Implement other routine BMPs as necessary, including:
    - Non-mechanical tree removal within stream and wetland buffers;
    - Placement of silt fence and sediment traps along buffer edges;
    - Selective herbicide treatment to restrict application near receiving water features;
    - Proper vehicle maintenance to reduce the potential for adverse effects to surface and groundwater; and
    - Use of wetland mats for temporary crossing, dry season work across wetlands, and no soil rutting of 12 inches (depth) or more in wetlands.

Biological Resources

- Revegetate with native and/or noninvasive vegetation consistent with EO 13112 (Invasive Species), including species that attract pollinators, to reintroduce habitat, reduce erosion, and limit the spread of invasive species.
- In areas requiring chemical treatment, only USEPA-registered and TVA-approved herbicides would be used in accordance with label directions designed, in part, to restrict applications near receiving waters and to prevent unacceptable aquatic effects. TVA would apply for coverage under TDEC's NPDES General Permit for Application of Pesticides prior to use of herbicides in aquatic environments.
- Follow USFWS recommendations regarding biological resources and pollinator species:
    - Use of downward and inward facing lighting to limit attracting wildlife, particularly migratory birds and bats;
    - Instruct construction personnel on wildlife resource protection measures, including applicable federal and state laws, such as those that prohibit animal disturbance, collection, or removal; the importance of protecting wildlife resources; and avoiding unnecessary vegetation removal; and
    - Perform surveys of buildings prior to demolition to ensure they have not been colonized by bats or migratory birds. If bats are found, including those listed as threatened or endangered species, these buildings would not be demolished until one of two mitigation actions occurs: 1) bats are transitioned out of the buildings, or 2) consultation with USFWS is completed (if federally listed species are observed). If active nests of migratory birds are present and demolition activities

must occur within the nesting season, TVA would coordinate as appropriate with USFWS or US Department of Agriculture's Wildlife Services, which assists with managing any potential effects to some birds, to determine best options for carrying out demolition activities.

- Should actions near nesting osprey rise to levels above normal routine disturbance typically encountered on the Kingston Reservation, US Department of Agriculture's Wildlife Services would be contacted to ensure compliance under federal law.
- TVA would endeavor to remove trees between November 15 and March 31 when listed bat species are not expected to be roosting in trees and when most migratory bird species of conservation concern are not nesting in the region.
- For those activities with potential to affect listed bats, TVA would commit to implementing specific conservation measures approved by USFWS through TVA's updated[10] programmatic consultation to ensure effects would not be significant. Relevant conservation measures that would be implemented as part of the approved project are listed in the bat strategy form. The bat strategy form is in included as Appendix B.
- TVA would endeavor to sell any marketable timber generated from on-site clearing activities. Non-marketable timber may be cut and left in place in specified, non-wetland areas as a windrow BMP or may be chipped and used as sediment barriers or mulch.

Cultural Resources

- Keep access routes and construction activities outside of the 30-meter buffers surrounding any archaeological sites listed in, or eligible or potentially eligible for listing in, the National Register of Historic Places (NRHP).
- When access routes must be placed within such buffers, avoid modifications and use wetland mats and light-duty equipment when practicable.
- Locate new structures and buildings at least 0.5 mile from, and out of view of, any NRHP-listed or eligible historic architectural structures, when practicable. When avoidance is not practical, mitigation would be performed in consultation with the SHPO.
- Maintain existing vegetative screening (at least 100 feet in width) to prevent clear views from any NRHP-listed or –eligible above-ground resources to the proposed new facilities or structures surrounding the Green-Mahoney Cemetery.

Waste Management

- Develop and implement a variety of plans and programs to ensure safe handling, storage, and use of hazardous materials.

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[10] The original TVA programmatic consultation with the USFWS is in the process of being updated in response to recent changes to the species protection designation for the northern long-eared bat. The completed update is anticipated to be completed by May 2023.

Public and Occupational Health and Safety

- Implement BMPs for site safety management to minimize potential risks to workers.

Transportation

- Implement staggered work shifts during daylight hours, when feasible, and a flag person during the heavy commute periods to manage construction traffic flow near the project site(s), if needed.

Noise

- Minimize construction activities during overnight hours, where possible, and ensure that heavy equipment, machinery, and vehicles utilized at the project site meet all federal, state, and local noise requirements.

Visual

- Use of downward- and inward-facing lighting.

Air Quality and GHG Emissions

- Comply with local ordinances or burn permits if burning of vegetative debris is required and use BMPs, such as periodic watering, covering open-body trucks, and establishing a speed limit to mitigate fugitive dust.
- Remove ash from the facilities proposed for deconstruction and demolition, prior to removal of that facility and implement dust control measures during demolition to prevent the spread of dust, dirt, and debris to minimize potential fugitive dust mobilization associated with explosive demolition. These methods may include wetting equipment and demolition areas, covering waste or debris piles, using covered containers to haul waste and debris, and wetting unpaved vehicle access routes during hauling. Wet suppression can reduce fugitive dust emissions from roadways and unpaved areas.
- Maintain engines and equipment in good working order.
- Comply with TDEC Air Pollution Control Rule 1200-3-8, which requires reasonable precautions to prevent PM from becoming airborne. If necessary, emissions from open demolition areas and paved/unpaved roads could be mitigated by spraying water on the work areas and roadways to reduce fugitive dust emissions.
- Comply with the USEPA mobile source regulations in 40 CFR Part 85 for on-road engines and 40 CFR Part 1039 for non-road engines, requiring a maximum sulfur content in diesel fuel of 15 parts per million (ppm).
- Implement emissions controls for NO_x and CO, and meet emissions limitations for SO_2 and CO_2 emissions, in accordance with 40 CFR 60 Subparts KKKK and TTTT, including emissions monitoring and/or performance testing requirements, fuel and fuel sulfur monitoring requirements, maintenance, recordkeeping, and reporting requirements. Use an SCR system located in each CC/CT exhaust path for additional NO_x reduction. Reduction of CO/VOC emissions would be achieved using an oxidation catalyst. The CC/CT exhaust stacks would be equipped with continuous emissions monitoring systems.

- Reduce NO_x emissions from the CC HRSG-bypass operations through dry low- NO_x combustion systems.
- Utilize efficient operation and maintenance techniques and leak detection to minimize sulfur hexafluoride emissions associated with transmission construction and upgrades.

Blasting/Explosives

- TVA would work to minimize one-time emissions of fugitive dust from facilities expected to produce large volumes (such as demolition of the stack) by working with the demolition contractor on a site-specific plan. The plan may use mitigation methods that include the treatment of fall zones, misting, and application of tackifier inside the stacks, or cleaning and removal of ash and other materials. The fall zones may have berms to reduce the lateral extent of the dust cloud. Also, a hardened berm near the base of the stack could act as a backstop to prevent rock and debris spreading from the base of the stacks during demolition.
- TVA would develop a project specific SWPPP as required under the General Permit for Stormwater Discharges Associated with Construction Activities (TDEC 2021a) prior to beginning demolition.
- To mitigate the potential for effects to public safety, TVA would restrict or close roads in the vicinity should blasting be used to demolish the stack. No barge or boat traffic would be allowed in the area during the stack blasting activities.
- TVA would work with the demolition contractor to create a detailed site-specific plan for any public road closures that would be distributed to affected parties, including emergency personnel.
- TVA would require the demolition contractor to develop and implement a blast plan to minimize vibration effects at KIF and in the vicinity. After obtaining site specific data provided by the blasting contractor, and if deemed necessary during development of the demolition plan, TVA would work with a documentation services company to prepare a vibration model simulating the effects of discharge of the explosives or vibrations due to the stack hitting the ground. If indicated by the results, imported fill, dirt binder, and geofabric could be used for mitigation of noise and vibration.
- During the construction planning process, TVA would determine mitigation measures to minimize potential effects to on-site power transmission equipment from vibrations caused by explosive demolition of the stacks. Use of such mitigation measures would address any power disruptions.
- Explosives would be managed under the direction of a licensed blaster, 24-hour security would be provided to monitor the explosives, and detailed security plans would be developed. And provided to area emergency response agencies as part of measures that would be taken to mitigate potential effects on the safety of personnel and the public.
- If construction or operations have the potential to emit pollutants greater than acceptable thresholds in KIF's existing Title V permit, mitigation would include a request to modify the permit, which would be required for the prevention of significant deterioration of air quality.

- All pipeline blasting would be conducted during daylight hours, as feasible, and would not begin until occupants of nearby buildings, stores, residences, places of business, and farms have been notified. ETNG would comply with all federal and state regulations applying to blasting and blast vibration limits regarding structures and underground utilities (ETNG 2022b).

Floodplains

- To minimize adverse effects on natural and beneficial floodplain values, the following mitigation measures would be implemented:
    - Construction of new transmission lines would adhere to the TVA subclass review criteria for transmission line location in floodplains;
    - KIF decommissioning and deconstruction debris would be disposed of outside 100- and 500-year floodplains;
    - The natural gas pipeline would be installed through trenching or directional drilling, and any excess fill resulting from this would be disposed of outside 100-year floodplains;
    - For any access roads proposed within 100-year floodplains but not floodways, the roads would be constructed such that flood elevations would not increase more than 1.0 foot;
    - For any roads proposed within 100-year floodways, and to prevent an obstruction in the floodway, (1) any fill, gravel, or other modifications in the floodway that extend above the pre-construction road grade would be removed after completion of the project; (2) this excess material would be spoiled outside of the published floodway; and (3) the area would be returned to its pre-construction condition;
    - Any switchyard(s) located in the floodplain would be located a minimum of one foot above the 100-year flood elevation at that location for a regular action, or a minimum of the 500-year flood elevation for a critical action, as well as be consistent with local floodplain regulations;
    - The flood-damageable components of the solar panels, as well as other flood-damageable structures and facilities sited in floodplains, would be located at least one foot above the 100-year flood elevation at that location and would otherwise be consistent with local floodplain regulations;
    - Outside the KIF Reservation, in construction laydown areas, flood-damageable equipment or materials located within the 100-year floodplain would be relocated outside the floodplain during a flood; and
    - On the KIF Reservation, in construction laydown areas, flood-damageable equipment or materials located within the 100-year floodplain would be relocated by the equipment owner to an area above elevation 750 during a flood.

2.3.2 Non-routine mitigation measures

TVA has incorporated non-routine mitigation measures into Alternative A such as the construction and operation of a 3- to 4-MW distribution solar facility and 100-MW lithium-ion battery storage system on the Kingston Reservation, see Sections 2.1.3.3. and 2.1.3.4. The proposed solar facility would be located on the site of a former coal yard adjacent to the existing

KIF facility. The proposed battery location is currently under evaluation but would be located on the Kingston Reservation adjacent to the proposed natural gas-fueled CC/Aero CT Plant described in Alternative A. These non-routine mitigation measures have been incorporated into Alternative A to either offset a portion of energy usage for station service from facilities at the Kingston Reservation directly or to plan for future conditions, which may necessitate the need for future mitigation efforts.

As previously discussed in more detail in Section 2.1.5, TVA is evaluating combustion of hydrogen as potential future mitigation for Alternative A and plans to ensure that plant design would enable future modifications for the combustion of hydrogen as a replacement or supplemental fuel for natural gas as the technology matures.

TVA is also considering incorporating environmentally beneficial features, such as pollinator habitat, at the Kingston site in the future.

It is important to note that once a viable option for future mitigation projects is identified, TVA would conduct additional analyses to determine proposed pipeline routes, costs, storage requirements, or other needs with hydrogen fuel incorporation. TVA would analyze the site-specific impacts associated with any future mitigation that is planned as additional details become available. Additional equipment could be located in the area of the current coal plant after that area is closed and remediated.

2.4 The Preferred Alternative

TVA completed an alternatives analysis for the proposed retirement of KIF (Appendix C) and has identified Alternative A as its Preferred Alternative. Under the Preferred Alternative, TVA would demolish the nine existing KIF coal units, construct a new 1,500-MW natural gas dual-fuel capable CC/Aero CT Plant, a 3- to 4-MW solar array, a 100-MW BESS, and new transmission systems on Kingston Reservation. Offsite transmission system upgrades are also proposed along six existing transmission lines located in East Tennessee. The Preferred Alternative would replace the capacity lost as a result of retiring all nine existing KIF coal units and provide additional sufficient capacity to support anticipated demand growth in the TVA PSA. This replacement aligns with the 2019 IRP near term actions to evaluate engineering end-of-life dates for aging generation units to inform long-term planning and to enhance system flexibility to integrate renewables and distributed resources. This alternative is consistent with the need set forth in the 2019 IRP to establish new capacity in the TVA region and increase reliability and flexibility, as well as meet near-term TVA energy production goals. Replacement of generation with a CC/Aero CT Plant is the best overall solution to provide low-cost, reliable, and cleaner energy to the TVA power system. TVA has also selected Alternative A as its Preferred Alternative because the proposed CC/Aero CT Plant at Kingston provides the operational flexibility needed to reliably integrate 10,000 MW of solar into the system by 2035 and enables the KIF coal-fired units to be retired by the projected end-of-life estimates for those units and before significant water treatment investments become necessary under recent and anticipated new regulations such as the Effluent Limitation Guidelines (ELGs).. Further, the proposed CC/Aero CT Plant could be built and made operational by the end of 2027, as required to meet the project purpose and need and reduce economic, reliability, and environmental risks.

In contrast, although Alternative B would provide the necessary replacement power, it would require substantial transmission upgrades and lengthy timeframes for the transmission work such that Alternative B would not meet the need to provide replacement generation by the end of 2027 when the KIF units would be retired. Moreover, Alternative B would not provide the firm, dispatchable generation needed to meet year-round generation.

TVA's primary analysis for GHG impacts is based on the use of "proxy emissions." TVA supplemented the proxy analysis with an analysis based on the social cost of greenhouse gases. As detailed in Section 3.7.2.5.2, although Alternatives A and B are generally within a similar range of social costs of greenhouse gases (SC-GHG) savings when compared to the No Action Alternative, Alternative B would result in fewer GHG emissions and more SC-GHG emissions savings than Alternative A. The TVA system-wide Life Cycle Analysis reflects about $1.99 billion of SC-GHG savings for Alternative B relative to the No Action Alternative. Alternative A reflects about $1.75 billion of SC-GHG savings relative to the No Action Alternative, and about $245 million less savings than Alternative B. As shown in the evaluation of alternatives in Appendix C, however, Alternative B costs approximately $1.2 billion more than Alternative A in project costs which includes capital, fuel, transmission, and production costs. After giving due weight to the supplemental GHG analysis that projected greater SC-GHG emissions savings for Alternative B than for Alternative A, TVA has determined that Alternative A is still the Preferred Alternative based on its ability to meet the purpose and need of providing firm, dispatchable power by the end of 2027, while still significantly reducing carbon emissions as compared to the No Action Alternative.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter begins with a description of other actions that are considered in the analyses and the methods used to analyze solar and storage facilities and transmission corridors. It continues with the existing environmental conditions of the project area, as defined for each resource area, and the potential environmental effects that could result from implementing the No Action or Proposed Action Alternatives. This DEIS utilizes analyses of geospatial data and site-specific survey data available at the time of EIS development.

3.1 Identification of Other Actions

In addition to the action alternatives identified in Chapter 2, this DEIS also considers the impacts of past, present, and reasonably foreseeable future actions (RFFAs) listed in Table 3.1-1. These other actions were identified within the overall 10-mile geographic area of analysis surrounding the No Action Alternative and Alternative A, and included all East Tennessee counties for Alternative B, as having the potential to, in aggregate, result in larger and potentially adverse effects to the resources of concern. The RFFAs assessed here are based on project information that is publicly available online and does not include private developments or projects that have not yet been announced. Potential cumulative effects for resources in which adverse effects from the proposed Project are anticipated are discussed in each resource section in this chapter.

Table 3.1-1. Summary of other past, present, or reasonably foreseeable future actions within a 10-mile radius of the Action Alternatives

Action	Description	Project Type
Kingston Reservation		
Borrow site #3	Described in Kingston Fossil Plant Borrow Site #3 Final EA (TVA 2020a).	Past/Present
Clinch River Nuclear Site Development	Site preparation for one or more small modular reactors with a combined generation capacity up to 800Mwe.	Present/Future
KIF WWTF	Construction of WFGD WWTF subject to USEPA ELGs.	Future
Bottom ash dewatering facility	Described in Kingston Fossil Plant Bottom Ash Dewatering Facility Final EA (TVA 2016b)	Past/Present
Landfill expansion	Described in Final EA for Installation of Flue Gas Desulfurization System at Kingston Fossil Plant (TVA 2006) and Flue Gas Desulfurization System at Kingston Fossil Plant Final Supplemental EA (TVA 2019c)	Past/Present
Heritage Center Industrial Park	A 1,200-acre industrial park with rail and barge access adjacent to State Route (SR) 58 in Oak Ridge, approximately six miles northeast of the Kingston Reservation. There are over 20 existing private sector businesses and several vacant sites (Roane ECD 2022a).	Past/Present
Roane County Industrial Park	A 1,100+ acre industrial park with three vacant sites (79 acres) on Cardiff Valley Road in Rockwood, approximately six miles west of	Past/Present

Action	Description	Project Type
	Kingston Reservation. There are more than a dozen existing industries (Roane ECD 2022b).	
Roane Regional Business and Technology Park	A 655-acre industrial park with four vacant sites, totaling 139 acres adjacent to Interstate 40 (I-40) in Lenoir City, approximately eight miles east of the **Kingston** Reservation. There are more than a dozen existing industries, anchored by H.T. Hackney, a wholesale food distributor, and a Volkswagen parts distribution center (Roane ECD 2022c).	Past/Present
Oak Ridge Airport	A proposed general aviation airport with a 5,000-foot runway adjacent to the Heritage Center Industrial Park, approximately six miles northeast of the Kingston Reservation (City of Oak Ridge 2022).	RFFA
Horizon Center Industrial Park	A proposed 110-acre industrial park adjacent to SR-58 in Oak Ridge, approximately eight miles northeast of the Kingston Reservation (Roane ECD 2022d).	RFFA
Alternative A: Natural Gas Pipeline		
Ridgeline Hartsville Solar Array	Construction of an approximate 80-acre solar array on primarily agricultural land 0.5 mile east of Hartsville Compressor Station. Would be constructed concurrently with the Alternative A Natural Gas Pipeline.	RFFA
Hartsville Compressor Station Substation	Construction of an electric substation; would impact 1.3 acres of agricultural land adjacent to the Hartsville Compressor Station. Would be constructed concurrently with the Alternative A Natural Gas Pipeline.	RFFA
Hartsville Compressor Station Communications Tower	Construction of a 300-foot-tall communications tower 985 feet west of Hartsville Compressor Station. Would be constructed concurrently with the Alternative A Natural Gas Pipeline.	RFFA
Hartsville Compressor Station Other Non-jurisdictional Facilities	Construction of telephone and internet connections and a municipal water supply connection adjacent to Hartsville Compressor Station; lengths and locations to be determined.	RFFA
West Main Street Sidewalk Replacement – Hartsville, TN	Improvements to sidewalks on both sides of West Main Street between the Broadway/Church Street and Littleton Street intersections, 5,000 feet north of milepost (MP) 5.2, to meet Americans with Disabilities Act (ADA) standards.	RFFA
Hartsville Parks Master Plan	Construction of ADA upgrades including replacement of sidewalks, installing ADA parking spaces and ramps, and installing ADA playground equipment.	Present and RFFA
Rockwood, TN Road Improvements – Multiple	The milling and resurfacing of various roads 20.5 miles west of MP 122; exact roads unknown at this time.	RFFA

Action	Description	Project Type
Projects		
Bridge Replacement – Livingston City, TN	Bridge replacement in Overton County, Tennessee; exact location and scope unknown at this time.	RFFA
Cookeville, TN – Pedestrian Infrastructure	Construction of sidewalks, storm water drainage improvements, guardrails, curb ramps, and signal poles along SR-24/East Spring Street, from Raider Drive to Old Kentucky Road/Neal Street and Raider Drive, from SR-24 to the school parking lot (approximately 2,800 feet). Located 5 miles south of MP 50.	RFFA
Highlands Business Park	A 304-acre business park with 224 available acres adjacent to I-40 in Cookeville, approximately nine miles south of the natural gas pipeline (Highlands Business Park 2022).	Past/Present
US-127/SR-28 Improvement Project	A widening of US-127/SR-28 from a two-lane roadway to a five-lane roadway from Lowe Road to Little Road in Clarkrange, which crosses the natural gas pipeline. This project also includes improvements to the intersection of SR-28 and SR-62, approximately 1,500 feet north of the natural gas pipeline, and the construction of a new 1,425-foot bridge over Clear Creek, approximately 4,000 feet south of the natural gas pipeline (TDOT 2022).	Present
PowerCom Industrial Center	A proposed 500-acre industrial park on the former TVA Hartsville Nuclear site adjacent to the Cumberland River, approximately 400 feet south of the natural gas pipeline (Tennessee Central Economic Authority 2022).	RFFA
Alternative B: Solar and Storage Facilities		
Expansion of solar facilities under the 2019 IRP	TVA is proposing to add 10,000 MW of solar by 2035 throughout the TVA power service area. While projects have not yet been identified, they would require individual NEPA reviews once identified as a potential TVA project or under a power purchase agreement. Extension transmission system work would also be required to maintain system safety and reliability.	RFFA

3.2 Methodology for Assessing Impacts of Solar and Storage Facilities in Alternative B

As noted in the 2019 IRP (TVA 2019a), TVA currently operates a few small solar PV installations and purchases power from numerous small and large (utility scale) PV facilities. In response to the IRP, as well as customer driven demand, TVA has assessed the potential environmental effects of solar PV facilities in multiple Eas conducted over the past several years and in the North Alabama Utility-scale Solar Facility EIS completed in May 2022. Since the exact project locations for solar and/or storage projects described under alternative B are not known at this time, TVA has compiled a list of typical effects associated with the construction and operation of PV facilities within the TVA region (Table 3.2-1). While the number of sites is dependent upon the generating capacity, TVA has assumed that generating at least 1,500 MW of solar would require at least fifteen 100-MW sites. This list was compiled by reviewing the Eas and the EIS for community to utility-scale PV projects issued from 2014 through 2022. A total of 31 projects were included in the review.

Table 3.2-1. Typical Effects of Solar Facility Construction Activities Determined from a Review of Project Planning Documents of 31 Solar Construction Projects, 2014-2022

Effect Type	Average and Range of Typical Effects
Land Use Effects	
Land Requirements (Acres of Solar Installation within the Site)	Average of 7.3 Acres per MW[1] Range: 2 – 9.6 acres per MW
Solar Facility Effects	
Floodplain Fill (Acres) per MW	Average of 0.02 acre per MW affected Range: 0 to 1.8 acres per MW
Prime Farmland Converted	81% of solar projects resulted in prime farmland conversion.
Forest Cleared (Acres)	Average of 64 acres Range 0 to 434 acres Average of 1.2 acres per MW Range of 0 to 15 acres per MW
Parks and Public Lands	7% of solar projects affected parks and public lands
Historic Properties	3% of Solar Projects affected Historic Properties
Water Resource Effects	
Wetland Area Affected	Average of 0.14 acres Range 0 to 0.73 acres Average of 0.003 acres per MW Range of 0 to 0.1 acres per MW
Forested Wetland Area Cleared	Average of 0.34 acres Range: 0 to 4.26 acres Average of 0.01 acres per MW Range of 0 to 0.1 acres per MW
Stream Effects	Average of 367 (LF) Range: 0 – 6,900 LF Average of 8.7 LF per MW Range of 0 to 41 acres per MW
Biological Effects	
Endangered and Threatened Species	48% of solar projects affected federally listed endangered or threatened species or species proposed or candidates for listing
Migratory Bird Effects	9% of solar projects resulted in migratory bird effects
Bald and Golden Eagle Effects	None
Visual Effects	99% of solar projects resulted in visual effects

Effect Type	Average and Range of Typical Effects
Environmental Justice	May vary based on location, but typically, none with amplified adverse effects

[1]All MW are reported in Alternating Current (AC).

BESSs are a new resource and technology for TVA; therefore, TVA does not have experience of multiple projects to assess typical effects as it does for solar facilities. For the purposes of analyzing Alternative B in this EIS, TVA used the anticipated effects associated with a BESS pilot study project that is capable of generating 20 megavolt amperes (MVA) with a storage capacity of 40 MW in Vonore, Monroe County (TVA 2022d). The Vonore BESS and Associated Substation Final EA and FONSI were issued by TVA on January 18, 2022. Approximately 10 to 15 acres of land would be required for the BESS pilot project, including an associated new 161-kV substation consisting of a transformer, breakers, power quality meters, a Supervisory Control and Data Acquisition Remote Terminal Unit, relays, alarms, a capacitive coupled voltage transformer, switch house, and other equipment. The battery site would be approximately four acres at completion. Construction would consist of grading the site and installing a foundation to place the battery containers, inverters, electrical and communications connections for the BESS and heating, ventilation, and air conditioning system monitoring and control. The battery containers would be of modular steel construction similar to intermodal shipping containers in which the modular lithium-ion battery cells are mounted on racks and connected by cabling. The battery containers would be equipped with air conditioning and fire protection systems, auxiliary distribution board, and lighting. There would be twelve 40 ft. Battery Containers, 12 (2.5 MVA) transformers, 24 Inverter Cabinets, and a 13.8-kV Switchgear for the Vonore Project. A new communication cabinet and a 1.5-MVA transformer would also be needed. Additionally, a loop connection point would be installed on the existing Loudon-Tellico Reservoir Development Agency 69-kV transmission line. Direct transfer trip and transfer trip work would occur at the Vonore 161-kV Substation.

3.3 Methodology for Assessing Impacts of Transmission and Electrical System Components

The analyses of environmental consequences for the proposed transmission upgrades anticipated to support solar and storage facilities in Alternative A and Alternative B reference the typical effects from construction activities related to transmission projects, as compiled in the 2019 IRP EIS. A total of 298 projects were included in the review (Table 3.3-1).

Table 3.3-1. Typical Effects of Transmission System Construction Activities Determined from a Review of Project Planning Documents of 298 Transmission Construction Projects*, 2005-2018

Effects by Use Type	Transmission Lines	Substations/Switching Stations
Land Use Effects		
Land requirements	Average of 13.1 acres/line mile, range 3.5 – 39	Average of 10.8 acres, range 1 – 73 median for 500 kV: 49.5 acres
		Median for <500 kV: 5.5 acres
Floodplain fill	De minimis	Average of 0.1 acres, range 0 – 4 5% affected floodplains
Prime farmland converted	None	Average of 6.9 acres, range 0 – 29.1 64% affected prime farmland

Effects by Use Type	Transmission Lines	Substations/Switching Stations
Forest cleared	Average of 5.5 acres/line mile for new lines, range 0 – 30.5	Average of 4.5 acres, range 0 – 50 29% cleared forest
Parks and Public Lands	40 (16%) of 249 projects affected parks and public lands	
Historic Properties	41 (14%) of 288 projects affected historic properties	
Water Resources Effects		
Wetland area affected (new lines)	Average of 0.9 acres/line mile for new line, range 0 – 22.2 55% affected wetlands	Average of 0.1 acres, range 0 – 1.8 15% affected wetlands
Wetland area affected (existing lines)	Average of 0.9 acres/line mile of existing line, range 0 – 18.3 52% affected wetlands	
Forested Wetland Area Cleared (new lines)	Average of 0.9 acres/line mile of new line, range 0 – 18.3 52% affected wetlands	Undetermined
Forested Wetland Area Cleared (existing lines)	Average of 0.02 acres/line mile of existing line, range 0 – 0.5 17% affected forest wetlands	
Stream crossings (new lines)	Average of 2.9 per mile of new line, range 0 – 50, 76% crossed streams	Undetermined
Stream crossings (existing lines)	Average of 1.5 per mile of existing line, range 0 – 5.6, 64% crossed streams	
Forested stream crossings (new lines)	Average of 1.0 per mile of new line, range 0 – 17.6, 48% crossed forested streams	Undetermined
Forested stream crossings (existing lines)	Average of 0.1 per mile of existing line, range 0 – 2.5, 8% crossed forested streams	
Biological Effects		
Endangered and threatened species	32 (11%) of 256 projects affected federally listed endangered or threatened species, or species proposed or candidates for listing 63 (22%) of 290 projects affected state-listed endangered, threatened, or special concern species	

*Note: Because some project planning documents did not contain all of the environmental data included in this EIS, the sample sizes for the various categories differ.

The above information was compiled to provide an estimate of the potential effects associated with the construction of transmission and electrical system components for Alternative B to provide a comparison to other action alternatives. Since exact site locations for solar and storage facilities associated with Alternative B are not known at this time, additional site specific tiered NEPA analysis would need to be completed as projects are identified and the scope is further defined.

3.4 Environmental Justice

3.4.1 EJ Analysis Approach

Potentially affected Environmental Justice (EJ) populations, including minority, low-income, and limited English proficiency (LEP) populations, are identified in this section using the U.S. Census Bureau (USCB) 2010 decennial census (2010 Census), USCB 2020 decennial census, and the 2016-2020 American Community Survey (ACS) 5-year estimates (2020 ACS), depending on availability of data. State-level and, for some characteristics, county-level USCB data are included for analysis and comparison purposes. Decennial census and ACS data were obtained utilizing 2022 USCB Explore Census Data and 2022 ESRI Demographics. Where appropriate, additional data from USCB are employed. EJ populations were determined through a comparison of the above-stated USCB census data to threshold criteria selected based on guidance from the Council of Environmental Quality (CEQ), as defined below. USEPA's EJScreen: Environmental Justice Screening and Mapping Tool (Version 2.1) (USEPA 2022e) was also reviewed and compared with the compiled USCB census data.

Potential effects to identified EJ populations are analyzed in this section and subsequent sections in Chapter 3 where project effects are anticipated, in accordance with EO 12898, to identify and address disproportionately high and adverse human health or environmental effects of each alternative on minority populations and low-income populations. EJ communities have a history of experiencing environmental discrimination, social disadvantage, and cultural and economic vulnerabilities due to practices of our larger society, as well as due to the tendency for EJ communities to have differing cultural traditions and practices from the norm. USCB data from 2019 show that, across the nation, approximately 18.8 percent of African American individuals live below poverty, 15.7 percent of Hispanic individuals live below poverty, and 7.3 percent of both Asian and White (non-Hispanic) individuals live below poverty. Minority communities often experience high poverty rates, less upward mobility, and more downward mobility as a result of common practices in the United States sometimes referred to as institutionalized racism (Winship et al. 2021). Low income is associated with many disadvantages and can include less-desirable living situations, limited access to healthcare and a plethora of environmental effects that may result in higher levels of disease, disability, and other health problems. These issues are compounded when environmental indicators, such as shown in USEPA's EJScreen tool (discussed in more detail below), overlap. While not subject to EO 12898, TVA routinely considers EJ during its NEPA review processes and does so here by employing these base assumptions.

CEQ guidance for applying EO 12898 under NEPA directs the identification of minority populations when either the minority population of the affected area exceeds 50 percent, or the minority population percentage of the study area is meaningfully greater than the minority population percentage in the general population or through another appropriate unit of geographic analysis (CEQ 1997). CEQ defines minority populations as people who identify as Asian or Pacific Islander, American Indian or Alaskan Native, Black (not of Hispanic origin), or Hispanic. Those indicating two or more races are also considered minorities due to necessarily including one of these minorities.

CEQ guidance specifies that low-income populations are to be identified using the annual statistical poverty threshold from the USCB Current Population Reports Series P-60 on Income and Poverty. The current (2021) USCB-provided poverty threshold for individuals under age 65 is $14,097, and the official poverty rate for the U.S. as a whole is currently 11.6 percent (USCB 2022a). Study area income and poverty rates are compared with the county and/or state data using the 2021 USCB Small Area Income and Poverty Estimates (SAIPE), as recommended by USCB (USCB 2020b). For purposes of this analysis, the percentages of individuals with poverty rates that are less than two times the poverty level (i.e., those with poverty ratios defined in the 2020 ACS as 1.99 or lower) was calculated to define low-income populations. More encompassing than the base poverty level, this low-income threshold, also used by USEPA in its delineation of low-income populations, is an appropriate measure for EJ consideration because current poverty thresholds are often too low to capture the populations adversely affected by low-income levels, especially in high-cost areas (USEPA 2019b). According to USEPA, the effects of income on baseline health and other aspects of susceptibility are not limited to those below the poverty thresholds. For example, populations having an income level from one to two times the poverty level also have worse health overall than those with higher incomes (Centers for Disease Control and Prevention 2011).

For each study area as defined below, the census block groups or counties with minority percentages that were 10 percentage points above the study area average or higher in the 2020 ACS are identified by TVA as the areas where the chance for amplified environmental and human health effects to minority populations may be greatest (i.e., the qualifying minority EJ populations). The census block groups or counties with poverty ratios that were 20 percentage points above the study area average and/or above 50 percent based on the 2020 ACS are identified as the areas where the chance for amplified environmental and human health effects to low-income populations may be greatest (i.e., the qualifying low-income EJ populations). These approaches to defining minority and low-income populations were taken in the TVA analysis due to the socioeconomic aspects of the study areas across all alternatives, where, in comparison with the state, the populations were generally more aged and had fewer high school graduates or higher; higher unemployment rates; and lower per capita income, as detailed in Section 3.16. Therefore, TVA's approach allowed for identification of the most vulnerable portions of the mostly rural, depopulating study areas, where the chance for amplified environmental and human health effects to human populations may be greatest.

According to CEQ guidance, minority and low-income populations may be groups of people living in geographic proximity or scattered groups or individuals sharing common conditions. As such, CEQ directs the identification of groups demonstrating differential patterns of consumption of natural resources among minority and low-income populations. Specialized groups are identified, where commensurate with anticipated effects, in relation to the subsequent resource areas; these are presented in the EJ Considerations subsections throughout Chapter 3, where relevant.

The LEP population is assessed in this section, consistent with Title VI of the Civil Rights Act of 1964 (42 USC §2000d et seq.); U.S. Department of Justice (DOJ) Guidance to Federal Financial Assistance Recipients Regarding Title VI Prohibition Against National Origin Discrimination Affecting Limited English Proficient Persons [DOJ LEP guidance; Federal Register 67(117):41455-41472, June 18, 2002]; and EO 13166 [Federal Register 65(159):50121-50122, August 16, 2000]. Based on DOJ LEP guidance, LEP language groups that constitute five percent or 1,000 individuals, whichever is less, should be offered translated project materials, where relevant. Eligible LEP language groups are defined herein as those whose members self-report speaking English less than well, based on the 2020 ACS.

In addition to the desktop sources listed above, TVA used their internal Customer Analytics group to identify specific EJ-qualifying residences within three miles of the proposed CC/Aero

CT Plant (under Alternative A) location on the Kingston Reservation. TVA contacted the Highland Rim Economic Corporation, local plant personnel, and local government officials to verify that known low-income, LEP, or minority communities located near the Kingston Reservation were included in this desktop review. TVA also contacted the local school board to provide information regarding the project and requested input regarding EJ-qualifying communities. No specific EJ communities, vulnerable EJ areas, or EJ concerns were identified beyond the desktop analysis presented in this section.

TVA also considered EJ-qualifying census block groups identified in the ETNG EJ analysis for the natural gas pipeline associated with Alternative A. ETNG's analysis used a "meaningfully greater" threshold for defining EJ populations. Following FERC guidance, ETNG used the following criteria to identify EJ populations (ETNG 2022f):

- Communities where the percentage of minorities within a given census block group exceeds 50 percent or exceeds the comparative county level by 10 percent or more; and
- Communities where the low-income level within the census block group is equal to or exceeds the comparative county level.

These criteria vary slightly from the criteria used by TVA to define qualifying EJ communities. However, TVA elected to perform their analysis of potential EJ impacts from ETNG's proposed natural gas pipeline and compressor station using the same criteria TVA used to identify potential EJ impacts under the No Action and Action Alternatives to maintain consistency in TVA methodology and to facilitate TVA's comparison of potential impacts in this draft EIS. Because the ETNG EJ population criteria differed from the TVA criteria, and due to the overlap of the Kingston Reservation and natural gas pipeline EJ study areas, these additional EJ-qualifying census block groups were also incorporated into TVA's EJ analysis in this EIS in relation to Kingston Reservation retirement activities. In relation to the pipeline activities, ETNG has conducted outreach among and would continue to engage with stakeholders including landowners, public officials, and groups within the EJ communities that may be impacted by the pipeline (ETNG 2022f).

Populations determined to meet the criteria regarding minority, low-income, and/or LEP status were considered qualifying EJ populations, and additional USCB data, USEPA data, historical information, and relevant details from other sources were obtained to better understand the socioeconomic and sociocultural aspects of these populations to bolster evaluate for amplified effects on EJ populations. The additional USCB data obtained included other relevant demographic factors, as well as information regarding the rural or urban status of the area. USCB defines an urbanized area as having a population of 50,000 or more and an urban cluster as populations more than 2,500 and less than 50,000; all areas outside of urbanized areas and urban clusters are considered rural. USEPA's EJScreen tool was used to review 12 different environmental indicators for EJ-qualifying areas in comparison with the state values of those indicators to identify the potential for cumulative effects to EJ populations. The environmental indicators consist of those relevant to air quality and proximity to traffic, toxins, underground storage tanks (USTs), hazardous waste facilities, Superfund sites, and wastewater discharges.

3.4.1.1 EJ Study Area Identification

3.4.1.1.1 Alternative A

3.4.1.1.1.1 Kingston Reservation

The Kingston Reservation EJ Study Area from which potentially affected EJ populations are identified is a 10-mile radius of the Kingston Reservation boundary. This area was selected to

(1) assess the larger demographic context to allow for analysis of amplified effects on EJ populations, (2) evaluate EJ effects based on the full reach of project effects on other resource areas (such as transportation), and (3) analyze cumulative effects on EJ populations.

3.4.1.1.1.2 Off-site Transmission Corridors

The transmission Corridor EJ Study Area from which potentially affected EJ populations are identified is a one-mile radius of each transmission corridor (Eastern and Western corridors). This area was selected because the one-mile area encompasses the likely concentration of construction activities, noise, visual, and traffic impacts.

The combination of the Kingston Reservation and the transmission corridor study areas is herein collectively referred to as the TVA EJ Study Area.

3.4.1.1.1.3 ETNG Construction ROW

Based on current FERC practice[11], the ETNG-defined EJ Study Area for the Ridgeline Expansion Project includes census block groups crossed by the ETNG Construction ROW, and also includes those within one mile of the Hartsville Compressor Station (ETNG 2022f). However, TVA's analysis was expanded to include census block groups within a one-mile radius of ETNG Construction ROW, which includes the Hartsville Compressor Station (illustrated in Figure 3.4-1); therefore, the TVA Expanded EJ Study Area is slightly larger than the ETNG EJ Study Area.

The one-mile radius is sufficiently broad considering the likely concentration of construction emissions, noise, visual, and traffic impacts proximal to the pipeline construction and consistent with FERC regulations (18 CFR §380.12 Environmental reports for Natural Gas Act applications). This radius is conservative for pipeline safety, as it is much greater than the 220-yard (0.125 mile) area of consideration to define human uses (i.e., class locations and high consequence areas) used by USDOT Pipeline and Hazardous Materials Safety Administration (PHMSA). This is also conservative relative to the potential impact radius (PIR) also utilized by PHMSA in the unlikely event of pipeline failure. The PIR is used to analyze the area within which the potential failure of a pipeline could have significant impact on people or property, in accordance with 49 CFR §192.903. For a natural gas pipeline of this size and pressure, a PIR of less than 500 feet was calculated. The one-mile radius also factors in the area utilized in the analysis prepared for the pipeline as part of FERC's pre-filing process, which included the census block groups that either cross the pipeline centerline or are within one mile of proposed aboveground facilities. The TVA Expanded EJ Study Area would allow for future aboveground structures anywhere along the length of the pipeline.

3.4.1.1.2 Alternative B

For Alternative B, the EJ study area (or Alternative B EJ Study Area) is defined by the counties within the East Tennessee region of the TVA power service area (PSA) (Figure 3.4-2), as assessed by the census data associated with each county in the region. The county approach was taken since the area of analysis is large, and detailed consideration of EJ effects at the census tract or census block group level would occur during assessment of individual solar and battery storage facilities.

The census block groups are given in tables as 2020 ACS Census Tract number and Block Group number (e.g., CT 1106 BG 2). When counties overlap by less than two percent of the

[11] FERC typically identifies EJ populations in census tract block groups that are crossed by a pipeline or within one mile of aboveground facilities like the electric-powered Hartsville Compressor Station.

overall study area, the associated census block groups are not included in the analysis to avoid skewing results.

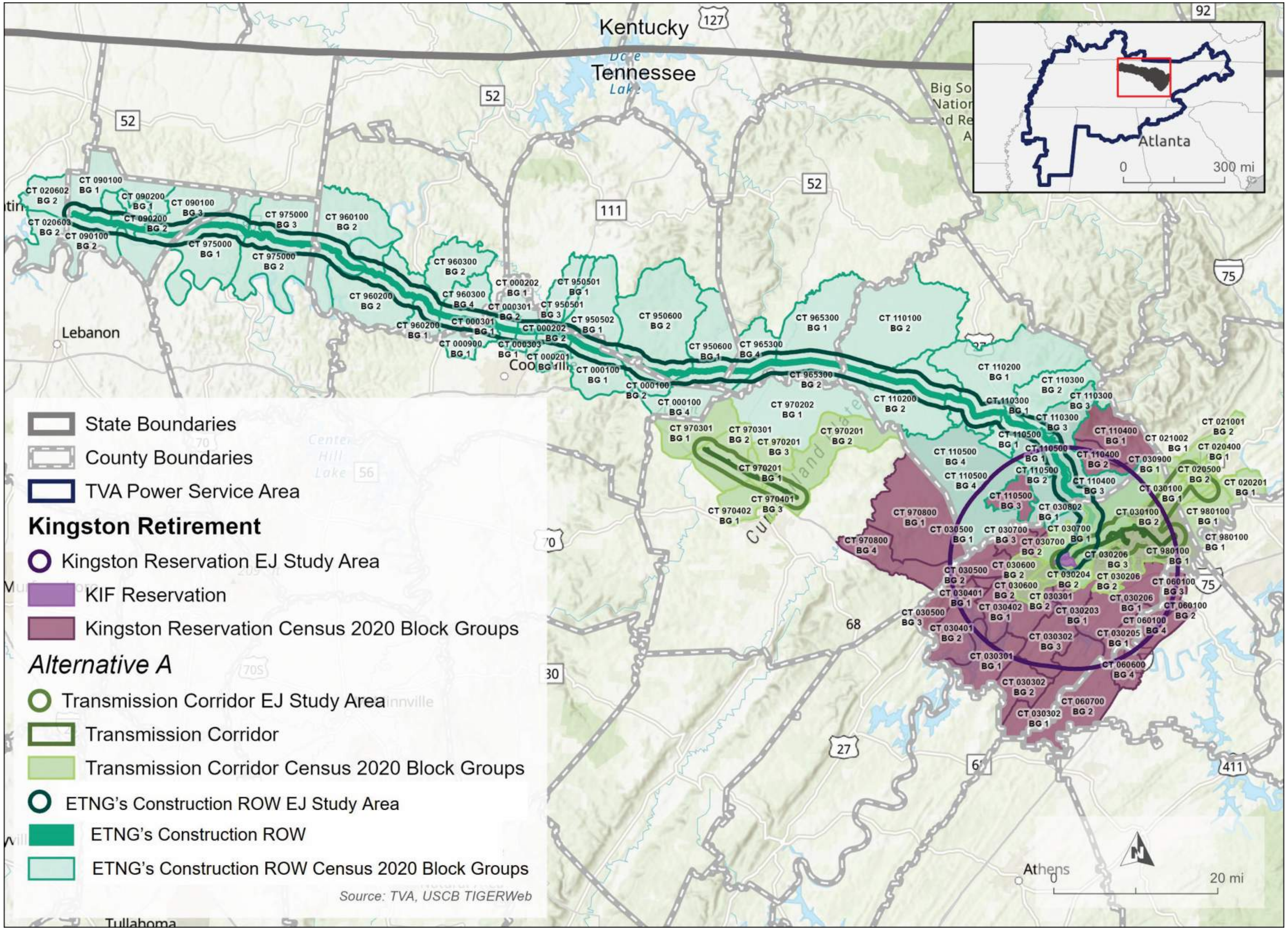

Figure 3.4-1. Environmental Justice Study Area for TVA's Expanded Environmental Justice Study Area (Kingston Reservation and Transmission Corridors EJ Study Areas) and ETNG Construction ROW under Alternative A (TVA's Environmental Justice Study Areas)

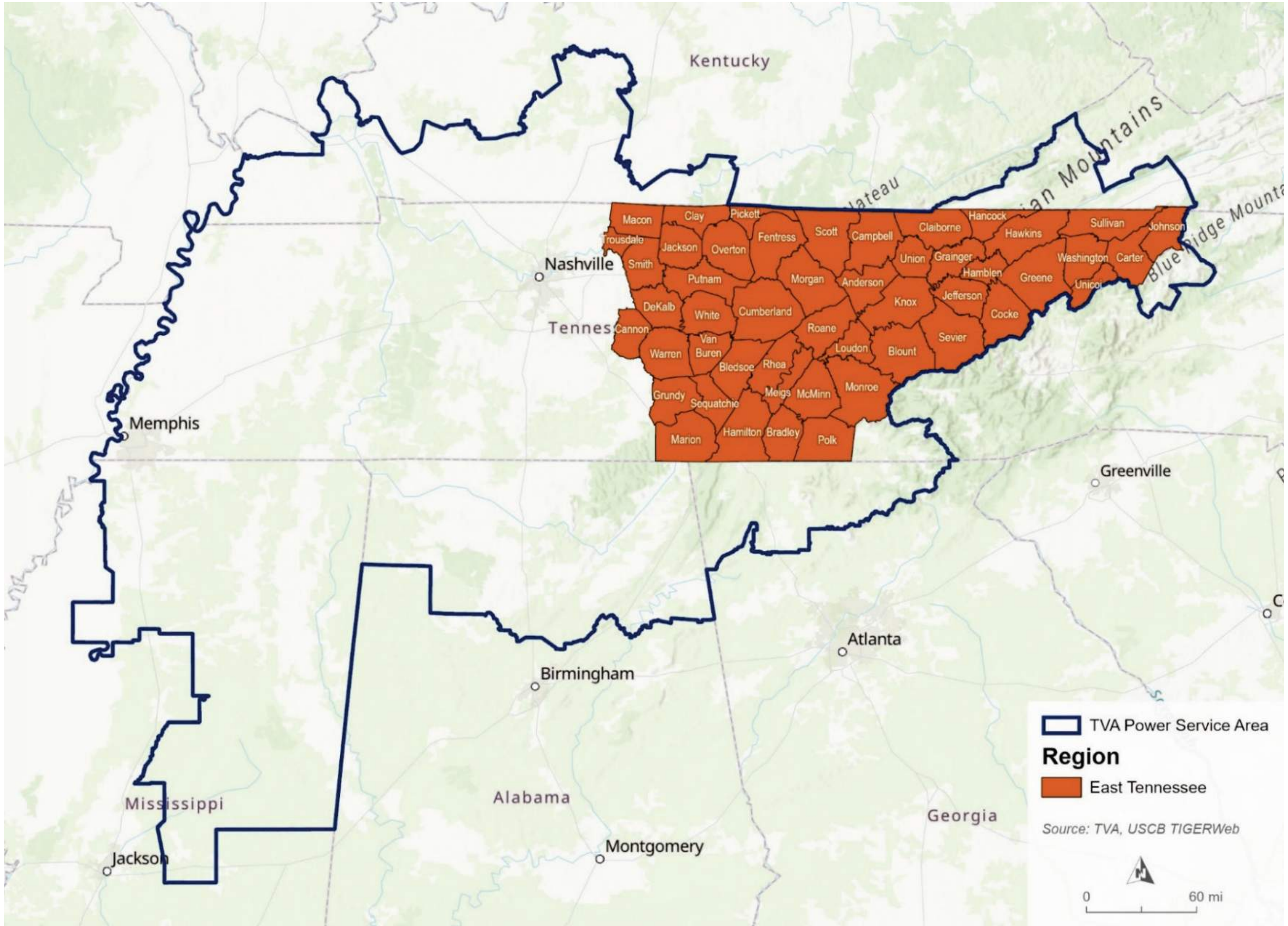

Figure 3.4-2. Environmental Justice Study Area for the East Tennessee Region of the Tennessee Valley Authority Power Service Area under Alternative B

3.4.2 Affected Environment

The EJ study areas associated with each alternative, as previously defined, have recreational areas that support subsistence activities, such as fishing and hunting (see Section 3.9 for more detail on these specific resources). These recreational areas are utilized by diverse populations, including EJ populations, and are specifically considered in relation to EJ populations in relevant EJ Consideration subsections throughout Chapter 3. As this NEPA analysis tiers from the TVA IRP EIS (TVA 2019b), this EJ analysis likewise tiers from the human context information presented in Chapter 4 of the IRP EIS. Refer to the IRP EIS for more details on the tribal populations (Chapter 4.9.3) and the sociocultural characteristics (Chapter 4.8) of the TVA PSA and the subregions within it.

Based on a review of EJ population metrics in the USEPA's EJScreen standard report for available EJ study areas, the EJ study areas described in the following sections are generally not in areas with high concentrations of EJ populations in comparison with the state and those that are present in higher concentrations are primarily low-income populations (Table 3.4-1). The Eastern Transmission Corridor EJ Study Area has low-income populations that exceed the state population levels. Minority and linguistically isolated populations generally make up relatively small percentages of the total population of the study areas.

Table 3.4-1. EJScreen Findings for EJ Study Areas

Geography	People of Color %	Low Income %	Linguistically Isolated %
State	27.0	34.0	1.0
Kingston Reservation EJ Study Area	7.0	13.0	2.0
ETNG EJ Study Area*	*No data**	*No data**	*No data**
Western Transmission Corridor EJ Study Area	24.0	10.0	5.0
Eastern Transmission Corridor EJ Study Area	0.0	7.0	3.0
Alternative B EJ Study Area*	*These data cannot be compiled until proposed sites have been identified*		

*Too large or too complex an area to generate reports in EJScreen

The review of the affected environment for the Kingston Reservation and the ETNG Construction ROW draws upon the results from the ETNG EJ analysis prepared for the project based on FERC guidance. However, as explained above, the TVA and ETNG EJ analyses used different criteria for identifying minority and low-income populations resulting in slight differences in the results of the two analyses. The ETNG analysis identified several EJ qualifying census block groups within the ETNG EJ Study Area that were not identified in the TVA analysis. Those EJ census block groups have been included in this EJ analysis.

3.4.2.1 Kingston Reservation (No Action and D4 Activities)

The Kingston Reservation EJ Study Area includes all or portions of 49 census block groups with resident populations (Figure 3.4-1). These block groups encompass portions of Roane County, where the Kingston Reservation falls within CT 307 BG 2, and Cumberland, Loudon, and Morgan counties. While the study area overlaps CT 9801 BG 1, this census block group is entirely encompassed by the Y-12 National Security Complex, which has no residential population. As all census values were zero, CT 9801 BG 1 was not included in the CT total or the analyses so not to skew results. The Kingston Reservation EJ Study Area is relevant under each of the evaluated action alternatives.

3.4.2.1.1 Minority Populations

One census block group within the Kingston Reservation EJ Study Area was identified as a minority EJ population, as shown in bold (Table 3.4-2). Based on the 2020 ACS, the minority populations in all of the affected counties were generally smaller proportionally than statewide.

Based on the 2020 ACS at the census block group level, 7.8 percent of people identified as minorities, a lower proportion than across the TVA EJ Study Area and the state. While the overall study area had a lower minority percentage than the state, 17 of the 49 census block groups within the Kingston Reservation EJ Study Area had higher percentages of minorities in comparison with the overall study area percentage. Further, one census block group in the Kingston Reservation Study Area had a minority percentage that is 10 percentage points or more above the TVA EJ Study Area average of 9.5 percent (Figure 3.4-3). This area is considered a minority EJ population area, where the chance for amplified environmental and human health effects may be the greatest. As shown in Table 3.4-2, this minority percentage is due to a high percentage of Black or African American population.

Table 3.4-2. Minority Percentages and Ethnicities in the Kingston Reservation Environmental Justice Study Area

Geography	% Minority	% White[1]	% Black/ African American	% American. Indian/ Alaska Native	% Asian	% Native Hawaiian /Pacific Islander	% Some Other Race	Two or More Races	% Hispanic / Latino[2]
TVA EJ Study Area	9.5	90.5	3.1	0.3	0.5	0.0	0.9	4.5	2.0
Kingston Reservation EJ Study Area	7.8	92.2	1.7	0.5	0.2	0.0	0.2	5.2	0.9
Tennessee	*27.8*	*72.2*	*15.8*	*0.4*	*2.0*	*0.1*	*3.6*	*6.0*	*6.9*
Cumberland County	*7.0*	*93.0*	*0.5*	*0.3*	*0.6*	*0.0*	*1.3*	*4.3*	*3.2*
CT 9708 BG 1	4.4	95.6	0.0	0.0	0.7	0.0	1.0	2.8	1.5
CT 9708 BG 4	4.6	95.4	0.1	0.2	0.2	0.0	0.5	3.8	1.3
Loudon County	*13.7*	*86.3*	*1.1*	*0.4*	*0.8*	*0.0*	*5.4*	*6.1*	*9.8*
CT 601 BG 2	7.3	92.7	0.4	0.4	0.6	0.0	2.0	3.9	3.2
CT 601 BG 3	11.3	88.7	0.7	0.2	0.7	0.1	4.2	5.4	5.8
CT 601 BG 4	11.1	88.9	1.4	0.1	0.4	0.1	4.5	4.6	8.6
CT 606 BG 4	11.8	88.2	0.6	0.1	3.2	0.0	2.2	5.7	4.7
CT 607 BG 2	6.9	93.1	0.7	0.5	0.1	0.0	0.8	4.8	2.4
Morgan County	*9.1*	*90.9*	*4.6*	*0.3*	*0.2*	*0.0*	*0.8*	*3.1*	*1.4*
CT 1103 BG 3	**33.0**	**67.0**	**30.5**	**0.2**	**0.2**	**0.0**	**1.2**	**0.9**	**1.8**
CT 1104 BG 1	4.1	95.9	0.0	0.1	0.2	0.1	0.5	3.2	2.0
CT 1104 BG 2	3.5	96.5	0.0	0.2	0.0	0.1	0.3	2.9	0.2
CT 1104 BG 3	2.5	97.5	0.0	0.1	0.0	0.0	0.1	2.4	0.2
CT 1105 BG 1	5.9	94.1	0.1	0.3	0.0	0.0	0.4	5.1	1.6
CT 1105 BG 2	5.5	94.5	0.7	0.6	0.1	0.0	0.9	3.1	1.6
CT 1105 BG 3	4.4	95.6	0.2	0.1	0.3	0.1	1.1	2.6	1.2
CT 1105 BG 4	7.7	92.3	0.3	0.4	0.3	0.0	1.8	4.9	2.3
Roane County	*9.3*	*90.7*	*2.4*	*0.4*	*0.6*	*0.0*	*0.8*	*5.0*	*1.9*
CT 301 BG 2	15.2	84.8	5.7	0.3	1.7	0.1	1.1	6.2	3.3
CT 302.03 BG 1	7.0	93.0	0.9	0.1	1.1	0.0	0.9	4.0	1.7
CT 302.03 BG 2	7.0	93.0	1.6	0.3	1.0	0.0	0.5	3.7	1.4
CT 302.04 BG 1	7.6	92.4	0.9	0.2	0.5	0.2	0.9	4.9	1.7
CT 302.04 BG 2	16.3	83.7	8.2	0.5	0.9	0.0	1.3	5.4	4.2
CT 302.04 BG 3	9.9	90.1	3.9	0.5	0.3	0.1	0.8	4.4	2.3
CT 302.05 BG 1	7.4	92.6	1.1	0.2	0.3	0.0	0.9	4.9	1.5
CT 302.05 BG 2	7.6	92.4	0.1	0.4	0.5	0.0	0.6	6.1	3.2

Geography	% Minority	% White[1]	% Black/ African American	% American. Indian/ Alaska Native	% Asian	% Native Hawaiian /Pacific Islander	% Some Other Race	Two or More Races	% Hispanic / Latino[2]
CT 302.06 BG 1	6.9	93.1	0.2	0.8	1.0	0.0	0.7	4.3	1.8
CT 302.06 BG 2	10.4	89.6	1.1	1.0	0.8	0.0	1.3	6.2	1.7
CT 302.06 BG 3	9.1	90.9	2.0	0.2	1.3	0.0	0.5	5.1	1.9
CT 303.01 BG 1	6.6	93.4	0.3	0.7	0.4	0.0	0.4	4.8	2.3
CT 303.02 BG 2	6.0	94.0	0.1	0.1	0.5	0.0	0.5	4.9	1.3
CT 303.02 BG 1	8.2	91.8	0.2	0.5	0.2	0.0	1.9	5.3	3.0
CT 303.02 BG 2	6.8	93.2	0.3	0.2	0.2	0.0	0.8	5.4	2.0
CT 303.02 BG 3	7.0	93.0	0.1	0.4	0.1	0.0	1.6	4.8	2.6
CT 304.01 BG 1	12.2	87.8	2.7	0.1	1.4	0.0	0.9	7.0	2.5
CT 304.01 BG 2	4.7	95.3	0.6	0.3	0.3	0.0	0.4	3.1	0.8
CT 304.02 BG 2	6.7	93.3	2.5	0.2	0.5	0.0	0.4	3.1	1.2
CT 304.02 BG 2	7.9	92.1	1.5	0.8	0.0	0.0	0.4	5.2	1.2
CT 304.02 BG 3	11.8	88.2	3.3	0.4	1.1	0.1	1.8	5.1	2.0
CT 305 BG 1	10.2	89.8	3.2	0.3	0.6	0.0	0.4	5.7	2.6
CT 305 BG 2	16.3	83.7	7.4	0.4	0.2	0.0	1.2	7.0	2.9
CT 305 BG 3	7.7	92.3	1.3	0.5	0.7	0.0	1.1	4.1	2.3
CT 306 BG 1	10.1	89.9	1.8	0.7	0.4	0.2	0.7	6.3	1.2
CT 306 BG 2	8.1	91.9	2.1	0.2	0.6	0.1	0.6	4.5	1.1
CT 307 BG 1	5.6	94.4	0.2	0.3	0.2	0.0	0.2	4.7	0.5
CT 307 BG 2 (Kingston Reservation)	7.8	92.2	1.7	0.5	0.2	0.0	0.2	5.2	0.9
CT 307 BG 3	11.3	88.7	3.8	0.7	0.8	0.0	0.5	5.4	2.1
CT 308.01 BG 1	13.9	86.1	5.9	0.5	0.7	0.2	0.8	5.9	2.2
CT 308.01 BG 2	18.9	81.1	9.6	0.4	1.2	0.0	0.4	7.3	1.3
CT 308.02 BG 1	13.7	86.3	7.7	0.4	0.1	0.1	0.6	4.9	1.3
CT 308.02 BG 2	7.3	92.7	3.2	0.3	0.3	0.0	0.1	3.5	1.2
CT 309 BG 2	5.8	94.2	0.7	0.4	0.4	0.0	0.4	4.1	0.8

Source: 2020 ACS

[1] Race percentages are provided for those reporting a particular race alone or in combination.

[2] This group is calculated separately from the other ethnicities and may include overlap from the other categories, as the USCB does not consider Hispanic or Latino a "race."

Note: Emboldened census block groups represent identified EJ populations as compared with the overall study area percentage.

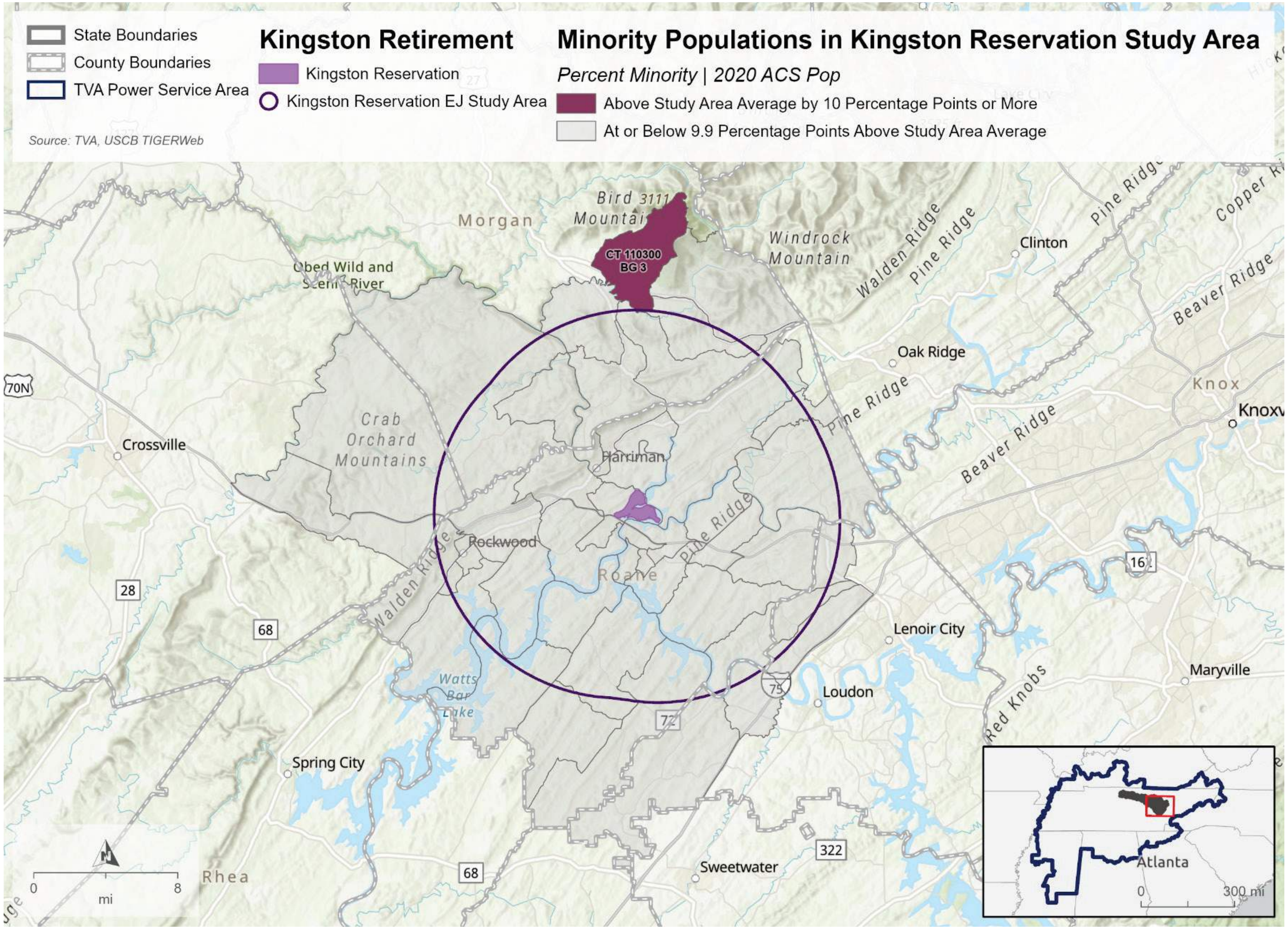

Figure 3.4-3. Minority Populations in the Kingston Reservation Environmental Justice Study Area

3.4.2.1.2 Low-Income Populations

The eight census block groups within the Kingston Reservation EJ Study Area were identified as areas with low-income EJ populations (Table 3.4-3). Based on the 2021 SAIPE, a greater proportion of the population of two of the four affected counties was living in poverty when compared with the state as a whole (USCB 2022a).

At the census block group level, based on the 2020 ACS, the immediate Kingston Reservation vicinity, i.e., the census block group encompassing the Reservation, had a higher poverty ratio than the state, but the Kingston Reservation EJ Study Area as a whole had a lower poverty ratio than the state. Twenty-six of the 49 census block groups within the Kingston Reservation EJ Study Area had higher percentages of people living in poverty than across the TVA EJ Study Area. Eight census block groups had poverty ratios that were 20 percentage points or more above the TVA EJ Study Area average of 33.1 percent and/or were at or above 50 percent (Figure 3.4-4). These census block groups are defined as the areas where the chance for amplified environmental and human health effects may be the greatest.

Table 3.4-3. Poverty Rates for the Kingston Reservation Environmental Justice Study Area

Geography	2021 SAIPE Poverty %*	2020 ACS Poverty %, Households	2020 ACS Poverty Ratio, Two Times US Threshold **
TVA EJ Study Area			33.1
Kingston Reservation EJ Study Area			41.0
Tennessee	*13.7*	*14.4*	*33.8*
Cumberland County	*14.9*	*13.1*	*39.0*
CT 9708 BG 1		5.5	11.1
CT 9708 BG 4		**12.3**	**56.0**
Loudon County	*9.6*	*12.2*	*28.0*
CT 601 BG 2		7.6	32.8
CT 601 BG 3		9.4	24.8
CT 601 BG 4		3.2	38.4
CT 606 BG 4		5.3	28.9
CT 607 BG 2		4.0	18.2
Morgan County	*18.1*	*19.7*	*45.1*
CT 1103 BG 3		20.7	43.2
CT 1104 BG 1		**24.3**	**59.3**
CT 1104 BG 2		21.7	35.4
CT 1104 BG 3		12.0	25.1
CT 1105 BG 1		13.7	41.6
CT 1105 BG 2		7.9	33.7
CT 1105 BG 3		17.8	35.4
CT 1105 BG 4		21.0	31.7
Roane County	*13.1*	*15.0*	*31.6*
CT 301 BG 2		1.1	6.1

Geography	2021 SAIPE Poverty %*	2020 ACS Poverty %, Households	2020 ACS Poverty Ratio, Two Times US Threshold **
CT 302.03 BG 1		0.0	14.2
CT 302.03 BG 2		9.2	18.3
CT 302.04 BG 1		7.8	32.2
CT 302.04 BG 2		15.8	16.8
CT 302.04 BG 3		26.6	17.2
CT 302.05 BG 1		19.0	29.9
CT 302.05 BG 2		3.5	13.7
CT 302.06 BG 1		20.1	39.3
CT 302.06 BG 2		0.0	10.2
CT 302.06 BG 3		10.4	25.6
CT 303.01 BG 1		13.0	34.6
CT 303.01 BG 2		16.3	33.5
CT 303.02 BG 1		29.8	24.7
CT 303.02 BG 2		29.0	35.9
CT 303.02 BG 3		0.0	12.9
CT 304.01 BG 1		**11.2**	**66.7**
CT 304.01 BG 2		22.2	31.6
CT 304.02 BG 1		4.6	7.3
CT 304.02 BG 2		16.0	27.3
CT 304.02 BG 3		**12.2**	**50.5**
CT 305 BG 1		**26.7**	**51.9**
CT 305 BG 2		**22.5**	**72.1**
CT 305 BG 3		**31.6**	**71.5**
CT 306 BG 1		19.0	39.7
CT 306 BG 2		10.6	38.5
CT 307 BG 1		11.2	30.7
CT 307 BG 2 (Kingston Reservation)		7.5	41.0
CT 307 BG 3		20.4	37.3
CT 308.01 BG 1		**36.3**	**56.7**
CT 308.01 BG 2		15.0	42.1
CT 308.02 BG 1		6.2	37.1
CT 308.02 BG 2		11.2	18.6
CT 309 BG 2		9.6	27.2

*For the respective county in which the block group is located
**Calculated based on percent of population with a ratio of income to poverty threshold ≤1.99
Source: 2021 SAIPE, 2020 ACS
Note: Emboldened census block groups represent identified EJ populations as compared with the overall TVA EJ Study Area percentage.

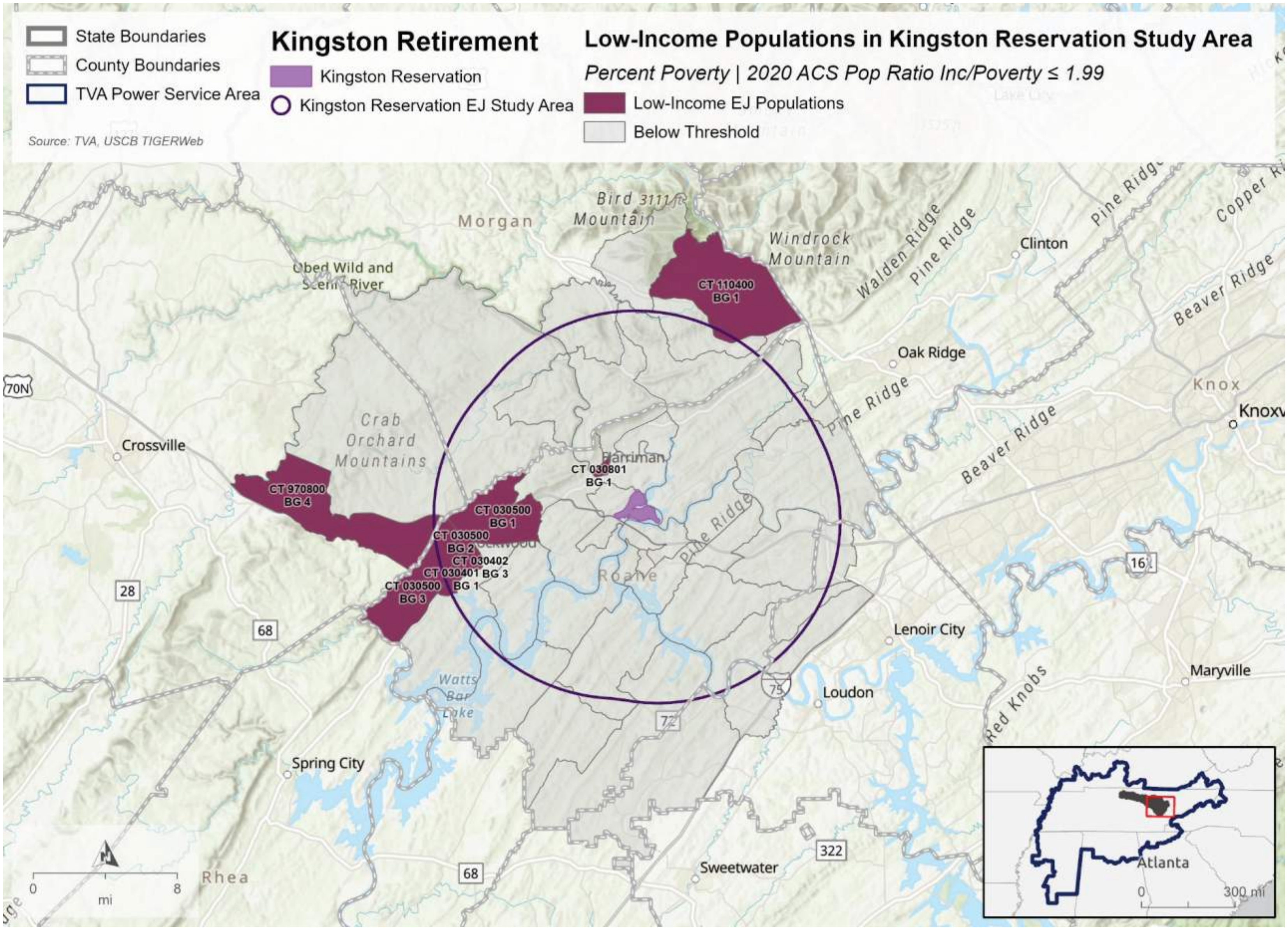

Figure 3.4-4. Low-Income Populations in the Kingston Reservation Environmental Justice Study Area

3.4.2.1.3 Limited English Proficiency Populations

Of the 49 census block groups in the Kingston Reservation EJ Study Area, 42 had zero individuals who reported speaking English less than well. However, the other seven census block groups, as shown in Table 3.4-4, had individuals who reported speaking English less than well.

Table 3.4-4. Limited English Proficiency Populations in the Kingston Reservation Environmental Justice Study Area

Geography	Total Population	# - Individuals Speaking English Less than Well	% - Individuals Speaking English Less than Well	Languages
Loudon County				
CT 601 BG 2	1,034	8	0.8	Indo-European
Morgan County				
CT 1103 BG 3	3,773	23	0.6	Indo-European
CT 1104 BG 2	1,393	10	0.7	Spanish
Roane County				
CT 302.04 BG 2	1,403	5	0.4	Spanish
CT 302.05 BG 1	1,352	49	3.6	Spanish
CT 304.01 BG 1	655	64	**9.8**	Indo-European
CT 306 BG 1	1,108	3	0.3	Asian and Pacific

Source: 2020 ACS
Note: Emboldened census block groups represent identified EJ populations based on greater than five percent of block group's population speaking English less than well.

None of these LEP populations constitute 1,000 individuals, but one census block group, CT 304.01 BG 1 in Roane County, has greater than five percent of its population aged five years or older that constitute an LEP population. (Figure 3.4-5). Therefore, the need for translation or interpreter services may be warranted for people residing in this block group. The LEP language group associated with this block group is Indo-European languages.

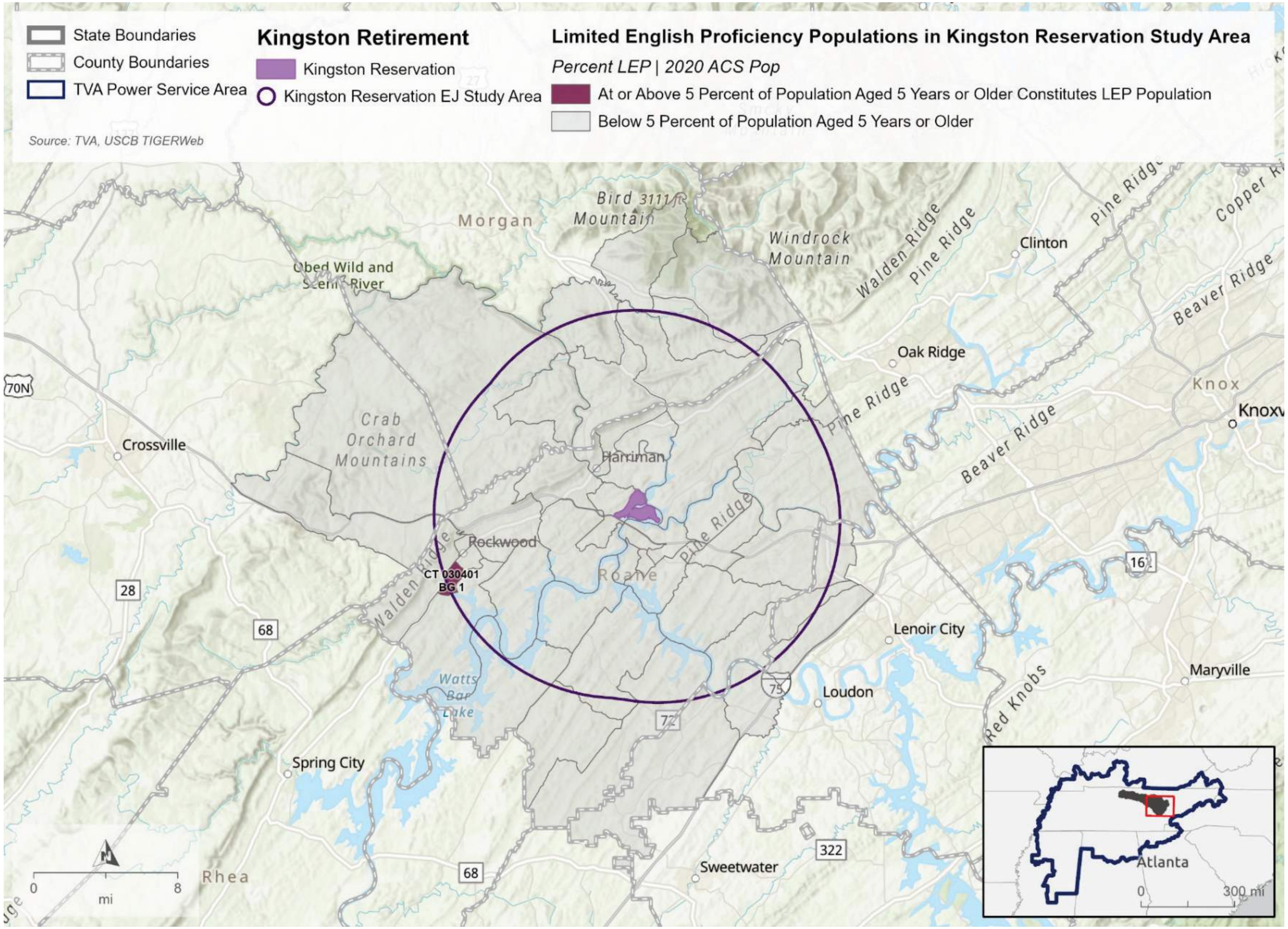

Figure 3.4-5. Limited English Proficiency Populations in the Kingston Reservation Environmental Justice Study Area

3.4.2.1.4 Qualifying Environmental Justice Populations

Additional data detail for the qualifying EJ populations, which includes nine block groups from Cumberland, Morgan, Loudon, and Roane counties (see list below), is provided in Table 3.4-5 along with comparison data for the state and respective county.

- Cumberland County CT 9708 BG 4 (Low-income)
- Morgan County CT 1103 BG 3 (Minority)
- Morgan County CT 1104 BG 1 (Low-income)
- Roane County CT 304.01 BG 1 (Low-income and LEP)
- Roane County CT 304.02 BG 3 (Low-income)
- Roane County CT 305 BG 1 (Low-income)
- Roane County CT 305 BG 2 (Low-income)
- Roane County CT 305 BG 3 (Low-income)
- Roane County CT 308.01 BG 1 (Low-income)

Morgan County CT 1103 BG 3 includes a correctional facility that sits on 65 acres of land and includes a residential recovery center, transfer station, and central office. The correctional facility may be influencing census data due to the facility capacity of 2,441 people (Tennessee Department of Correction 2023). According to USCB, prisoners at correctional facilities are counted in the general population by the rule of “usual residence,” meaning people who have spent the majority of the past year at a given correctional facility. Individuals who are at a facility short term, such as when awaiting a hearing or in the prison hospital temporarily, or under other unusual circumstances would not be counted since they may have been counted at their usual residence (Groves 2010). The data associated with Morgan County CT 1103 BG 3, which demonstrates a high minority population, small population of individuals over the age of 65, low employment rate, and low per capita income and differs from the surrounding census block groups, may be explained, in part, by the presence of the correctional facility.

Based on USCB criteria defining rural versus urban, Cumberland County is not within any portion of a metropolitan statistical area (MSA). Morgan, Loudon, and Roane counties are all part of the Knoxville, Tennessee MSA. Cumberland County contains two urban clusters: Crossville and Fairfield Glade. Within Roane County, the area surrounding the City of Kingston (excluding the Kingston Reservation), along with areas surrounding the Cities of Harriman and Rockwood, combine to form the Harriman-Kingston-Rockwood urban cluster. Loudon County contains portions of the Knoxville, Tennessee urban cluster, specifically those areas around Lenoir City and Loudon. No urban clusters or urbanized areas occur in Morgan County.

Based on the 2020 ACS, the top three areas of employment by industry for each of the qualifying BGs is as follows:

- CT 9708 BG 4 (Cumberland County) – Manufacturing (21.6 percent); Retail trade (14.9 percent); and Professional, scientific, and management, and administrative, and waste management services (19.4 percent)
- CT 1103 BG 3 (Morgan County) – Public Administration (28.2 percent); Educational services, and health care and social assistance (23.5 percent); and Retail trade (10.4 percent)

- CT 1104 BG 1 (Morgan County) – Educational services, and health care and social assistance (31.5 percent); Construction (15.7 percent); and Arts, entertainment, and recreation, and accommodation and food services (15.5 percent)
- CT 304.01 BG 1 (Roane County) – Educational services, and health care and social assistance (39.9 percent); Retail trade (32.1 percent); Other services, except public administration (22.5 percent)
- CT 304.02 BG 3 (Roane County) – Educational services, and health care and social assistance (44.1 percent); Public administration (20.1 percent); and Manufacturing (14.3 percent)
- CT 305 BG 1 (Roane County) – Educational services, and health care and social assistance (32.2 percent); Professional, scientific, and management, and administrative, and waste management services (14.7 percent); and Arts, entertainment, and recreation, and accommodation and food services (13.4 percent)
- CT 305 BG 2 (Roane County) – Educational services, and health care and social assistance (37.6 percent); Retail trade (14.4 percent); and Construction (11.0 percent)
- CT 305 BG 3 (Roane County) – Arts, entertainment, and recreation, and accommodation and food services (30.7 percent); Manufacturing (14.9 percent); and Transportation and warehousing, and utilities (12.4 percent)
- CT 308.01 BG 1 (Roane County) – Professional, scientific, and management, and administrative, and waste management services (29.0 percent); Educational services, and health care and social assistance (24.2 percent); and Manufacturing (22.2 percent)

Table 3.4-5. Additional Data for Census Block Groups (Minority, Low-income, and Limited English Proficiency) Identified in the Kingston Reservation Environmental Justice Study Area

Geography	% Minority	Poverty Ratio, Two Times US Threshold	% Speaking English Less than Well	% of Population 65 Years and Over	Median Age	% High School or Higher	% of Occupied Housing Units, Renter Occupied	Median Year Housing Units Built	% of 16+ Civilian Population in Labor Force	Unemployment Rate	Per Capita Income
Tennessee	*27.8*	*33.8*	*1.5*	*16.4*	*38.8*	*88.2*	*33.5*	*1984*	*61.1*	*5.3*	*$30,869*
Cumberland County	*7.0*	*39.0*	*0.2*	30.8	51.8	87.1	20.9	1993	45.8	6.2	*$28,255*
CT 9708 BG 4 (Low-income)	4.6	56.0	0.0	20.8	48.7	81.3	7.7	1982	32.8	3.0	$17,922
Morgan County	*9.1*	*45.1*	*0.3*	18.0	41.5	81.5	17.6	1984	43.4	7.7	$20,258
CT 1103 BG 3 (Minority)	33.0	*43.2*	0.6	6.8	35.3	70.6	19.0	1987	16.4	0.0	$8,596
CT 1104 BG 1 (Low-income)	4.1	*59.3*	0.0	20.1	39.5	84.3	30.3	1980	56.1	19.1	$15,709
Roane County	9.3	*31.6*	*0.2*	22.7	47.3	89.8	24.4	1978	54.5	6.0	$32,067
CT 304.01 BG 1 (Low-income)	12.2	66.7	9.8	15.5	51.1	67.5	9.8	1987	39.1	0.0	$13,472
CT 304.02 BG 3 (Low-income)	11.8	50.5	0.0	20.8	46.4	95.3	17.8	1959	52.3	0.0	$20,868
CT 305 BG 1 (Low-income)	10.2	51.9	0.0	37.8	60.4	82.2	30.6	1985	36.2	6.0	$23,988
CT 305 BG 2 (Low-income)	16.3	72.1	0.0	12.3	40.1	75.4	48.3	1948	57.1	6.2	$35,611
CT 305 BG 3 (Low-income)	7.7	71.5	0.0	26.9	53.5	81.8	70.4	1964	40.3	10.5	$17,591
CT 308.01 BG 1 (Low-income)	13.9	56.7	0.0	13.8	39.8	90.6	60.1	1961	52.7	0.0	$25,256

Source: 2020 ACS

EJ indices, available from USEPA's online EJScreen tool, displayed the levels of environmental pollutants present among the nine EJ-qualifying block groups associated with the Kingston Reservation. These indicators were examined in order to determine the risk of negative health impacts for residents living within these block groups. The 12 indicators that were examined included particulate matter, ozone, diesel particulate matter, air toxins resulting in cancer risk, respiratory hazard index (HI), traffic proximity, lead paint, superfund proximity, risk management plan (RMP) facilities, hazardous waste, underground storage tanks, and wastewater discharge. Indicator levels of 50 or greater were considered to have above average pollution levels (above the 50^{th} percentile as compared to the state).

The results of this examination indicated that the majority of the EJ-qualifying census block groups in the area generally contained above average levels of pollution. Therefore, these groups may be at risk for amplified and cumulative negative health impacts.

Five off the nine total EJ-qualifying populations examined scored above average pollution levels in 75 percent of environmental indicators examined. All five of these block groups are located in Roane County. Three of the EJ-qualifying census block groups had below-average pollution percentiles (below the 50^{th} percentile). Two of these are in Morgan County, and one is in Roane County. The one EJ-qualifying census block group located in Cumberland County did not indicate the presence of any adverse environmental indicators above average pollution levels~~.~~ The EJ-qualifying block groups and the environmental indicator percentiles are shown in Table 3.4-6. Those with above average pollution levels (above the 50^{th} percentile) are emboldened. The highest percentile (86^{th}) in the EJ-qualifying census block groups occurs in Roane County CT 305 BG 3 for the presence of lead paint.

Table 3.4-6. Comparison of Environmental Indicator Percentiles by Census Tract, County, and State for the Kingston Reservation Environmental Justice Study Area

Geography	% Particulate Matter	% Ozone	% Diesel Particulate Matter	% Cancer Risk	% Respiratory HI[1]	% Traffic Proximity	% Lead Paint	% Superfund Proximity	% RMP Facility[2]	% Hazardous Waste	% Underground Storage Tanks	% Wastewater Discharge
Tennessee	*46*	*57*	*56*	*39*	*50*	*51*	*39*	*23*	*59*	*60*	*56*	*53*
Cumberland County												
CT 9708 BG 4 (Low-income)	8	18	24	**57**	26	**58**	**68**	**72**	9	54	51	N/A
Morgan County												
CT 1104 BG 1 (Low-income)	28	**53**	31	**59**	**61**	10	**60**	**58**	44	22	45	19
CT 1103 BG 3 (Minority)	12	27	16	**71**	36	8	49	**80**	28	19	45	12
Roane County												
CT 304.01 BG 1 (Low-income)	20	43	**58**	**74**	**75**	**69**	**74**	**82**	31	**77**	**66**	**70**
CT 304.02 BG 3 (Low-income)	16	35	**51**	**64**	**68**	**68**	**81**	**78**	28	**74**	**65**	**65**
CT 305 BG 1 (Low-income)	25	**50**	42	**58**	**60**	38	**56**	**64**	23	42	44	41
CT 305 BG 2 (Low-income	31	**60**	**50**	**69**	**71**	**57**	**81**	**68**	21	**65**	**64**	**58**
CT 305 BG 3 (Low-income)	17	41	**63**	**74**	**75**	**65**	**86**	**82**	28	**82**	**60**	**74**
CT 308.01 BG 1 (Low-income)	16	43	**60**	**66**	**69**	**73**	**82**	**85**	**67**	48	**77**	**52**

[1] Air toxins resulting in a hazardous respiratory index
[2] Risk management plan (RMP) facilities

3.4.2.2 Alternative A

3.4.2.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The proposed CC/Aero CT Plant site and new transmission connections and corridors would be located within the Kingston Reservation. Therefore, the affected environment for environmental justice is as described as part of the Kingston Reservation EJ Study Area in Section 3.4.2.1.

3.4.2.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located within the Kingston Reservation. Therefore, the affected environment for environmental justice is as described as part of the Kingston Reservation EJ Study Area in Section 3.4.2.1.

3.4.2.2.3 Construction and Operation of a 100-MW Battery Storage Facility (BESS) on Kingston Reservation

The proposed 100-MW BESS and new transmission corridor would be located within the Kingston Reservation. Therefore, the affected environment for environmental justice is as described as part of the Kingston Reservation EJ Study Area in Section 3.4.2.1.

3.4.2.2.4 On-site Transmission Upgrades

The proposed transmission system upgrades and new transmission installations, including the one-mile OPGW line, would be on the Kingston Reservation. Therefore, the affected environment for environmental justice is as described as part of the Kingston Reservation EJ Study Area in Section 3.4.2.1.

3.4.2.2.5 Off-site Transmission Upgrades

Under Alternative A, off-site transmission system upgrades would be necessary in the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) in Anderson and Roane counties and the Western Transmission Corridor (L5383) in Cumberland County. While the Eastern Transmission Corridor overlaps CT 9801 BG 1, this census block group is entirely encompassed by the Y-12 National Security Complex, where no people reside. As all census values were zero, CT 9801 BG 1 was not included in the CT total or the analyses so not to skew results. A one-mile radius surrounding the Eastern and Western Transmission corridors was used to define the Transmission Corridor EJ Study Area, which includes all or portions of 34 census block groups with resident populations, 27 in the Eastern Transmission Corridor and 7 in the Western Transmission Corridor EJ study areas (Figure 3.4-1).

3.4.2.2.5.1 Minority Populations

Four census block groups within the Transmission Corridor EJ Study Area were identified as minority EJ populations, as shown on Table 3.4-7. At the county level, a greater proportion of the populations of the affected counties were identified as non-minority than across the associated state, based on the 2020 ACS. Correspondingly, the minority populations in these counties were generally smaller proportionally than statewide.

While the Transmission Corridor EJ Study Area had lower minority percentages than the state, with 13 of the 34 census block groups having higher minority percentages in comparison with the minority percentage of the overall TVA EJ Study Area. Four census block groups (within the Eastern Transmission Corridor EJ Study Area) had minority percentages that were 10 percentage points or more above the Eastern Transmission Corridor EJ Study Area average of 15.8 percent (L5108 and L5302) (Figure 3.4-6, Table 3.4-7). None of the census block groups within the Western Transmission Corridor EJ Study Area were identified as having minority percentages that were 10 percentage points or more above the Western Transmission Corridor EJ Study Area average. These areas are considered minority EJ population areas, where the chance for amplified environmental and human health effects may be the greatest. Depending on the census block group as shown in Table 3.4-7, these minority percentages are generally due to relatively high percentages of Latino, Black or African American, and Asian, as well as those self-identifying as some other race or two or more races.

Table 3.4-7. Minority Percentages and Ethnicities in the Alternative A Transmission Corridor Environmental Justice Study Area

Geography	% Minority	% White[1]	% Black /African American	% Am. Indian /Alaska Native	% Asian	% Native Hawaiian / Pacific Islander	% Some Other Race	Two or More Races	% Hispanic / Latino[2]
Western Transmission Corridor EJ Study Area – L3583	7.2	92.8	0.6	0.2	0.7	0.0	1.4	4.3	3.2
Eastern Transmission Corridor EJ Study Area – L5108, L5116, L5280, L5302, & L5381	15.8	84.2	5.4	0.4	1.6	0.1	1.8	6.5	4.1
Transmission Line – L3583	5.3	94.7	0.2	0.1	0.5	0.0	0.8	3.6	2.0
Transmission Lines – L5108, L5116, L5280, L5302, & L5381	17.5	82.5	7.1	0.4	1.2	0.1	1.7	6.9	3.9
Tennessee	*27.8*	*72.2*	*15.8*	*0.4*	*2.0*	*0.1*	*3.6*	*6.0*	*6.9*
L3583									
Cumberland County	*7.0*	*93.0*	*0.5*	*0.3*	*0.6*	*0.0*	*1.3*	*4.3*	*3.2*
CT 9702.01 BG 1 (TL)	4.4	95.6	0.6	0.0	0.8	0.0	0.7	2.3	1.1
CT 9702.01 BG 2 (TL)	6.5	93.5	0.2	0.2	1.0	0.0	0.9	4.2	2.5
CT 9702.01 BG 3 (TL)	4.4	95.6	0.2	0.1	0.0	0.0	0.6	3.4	1.7
CT 9703.01 BG 1	9.6	90.4	1.3	0.3	0.1	0.0	1.9	6.0	5.6
CT 9703.01 BG 2 (TL)	5.4	94.6	0.2	0.0	0.5	0.0	1.0	3.7	2.2
CT 9704.01 BG 3	14.5	85.5	1.8	0.4	1.5	0.0	4.0	6.7	9.3
CT 9704.02 BG 1	6.9	93.1	0.7	0.3	0.8	0.0	1.2	3.8	1.5
L5108 & L5302									
Anderson County	*13.3*	*86.7*	*3.7*	*0.4*	*1.3*	*0.1*	*1.6*	*6.3*	*3.7*
CT 201 BG 1 (TL)	**41.9**	58.1	27.2	0.2	2.9	0.3	1.9	9.4	3.8
CT 201 BG 2 (TL)	**34.9**	65.1	22.9	0.6	2.2	0.4	2.0	6.9	5.3
CT 202.01 BG 1	19.1	80.9	4.8	0.3	7.9	0.0	0.8	5.3	3.7
CT 202.02 BG 3	**30.4**	69.6	6.9	0.8	2.6	0.2	10.0	9.9	19.3
CT 204 BG 1 (TL)	14.9	85.1	6.0	0.5	1.3	0.0	0.6	6.5	3.9
CT 204 BG 2	20.5	79.5	7.8	0.1	0.9	0.3	3.9	7.6	5.5
CT 204 BG 3	19.6	80.4	4.8	0.2	0.7	0.3	4.4	9.2	7.9
CT 205 BG 1 (TL)	25.1	74.9	6.5	0.9	1.5	0.0	3.8	12.5	8.6
CT 205 BG 2 (TL)	**32.4**	67.6	14.4	0.3	1.1	0.0	5.0	11.6	8.8
CT 205 BG 3 (TL)	23.8	76.2	8.2	0.5	1.3	0.0	3.3	10.4	7.1
CT 206 BG 1 (TL)	14.1	85.9	4.2	0.1	1.9	0.1	1.1	6.7	4.8
CT 206 BG 2 (TL)	19.0	81.0	6.0	0.3	0.3	0.1	4.1	8.2	8.4
CT 210.01 BG 2	8.8	91.2	0.6	0.3	0.6	0.0	0.2	7.1	2.2
CT 210.02 BG 1 (TL)	8.0	92.0	1.9	0.2	0.5	0.0	0.8	4.6	2.0
CT 210.02 BG 2 (TL)	9.0	91.0	2.5	0.4	0.2	0.0	1.5	4.4	1.8
Roane County	*9.3*	*90.7*	*2.4*	*0.4*	*0.6*	*0.0*	*0.8*	*5.0*	*1.9*
CT 301 BG 1 (TL)	15.1	84.9	2.8	0.2	2.1	0.4	1.8	7.7	3.5
CT 301 BG 2 (TL)	15.2	84.8	5.7	0.3	1.7	0.1	1.1	6.2	3.3
CT 302.03 BG 2	7.0	93.0	1.6	0.3	1.0	0.0	0.5	3.7	1.4
CT 302.04 BG 2	16.3	83.7	8.2	0.5	0.9	0.0	1.3	5.4	4.2
CT 302.06 BG 2	10.4	89.6	1.1	1.0	0.8	0.0	1.3	6.2	1.7
CT 302.06 BG 3	9.1	90.9	2.0	0.2	1.3	0.0	0.5	5.1	1.9

Geography	% Minority	% White[1]	% Black /African American	% Am. Indian /Alaska Native	% Asian	% Native Hawaiian / Pacific Islander	% Some Other Race	Two or More Races	% Hispanic / Latino[2]
CT 306 BG 1	10.1	89.9	1.8	0.7	0.4	0.2	0.7	6.3	1.2
CT 306 BG 2	8.1	91.9	2.1	0.2	0.6	0.1	0.6	4.5	1.1
CT 307 BG 1	5.6	94.4	0.2	0.3	0.2	0.0	0.2	4.7	0.5
CT 307 BG 2 (TL)	7.8	92.2	1.7	0.5	0.2	0.0	0.2	5.2	0.9
CT 309 BG 1	8.6	91.4	3.2	0.3	0.2	0.0	0.4	4.5	1.7
CT 309 BG 2 (TL)	5.8	94.2	0.7	0.4	0.4	0.0	0.4	4.1	0.8

Source: 2020 ACS
[1] Race percentages are provided for those reporting a particular race alone or in combination.
[2] This group is calculated separately from the other ethnicities and may include overlap from the other categories, as the USCB does not consider Hispanic or Latino a “race.”
Note: Emboldened census block groups represent identified EJ populations as compared with the study area percentage, respective to L3583 or L5108 and L5302.

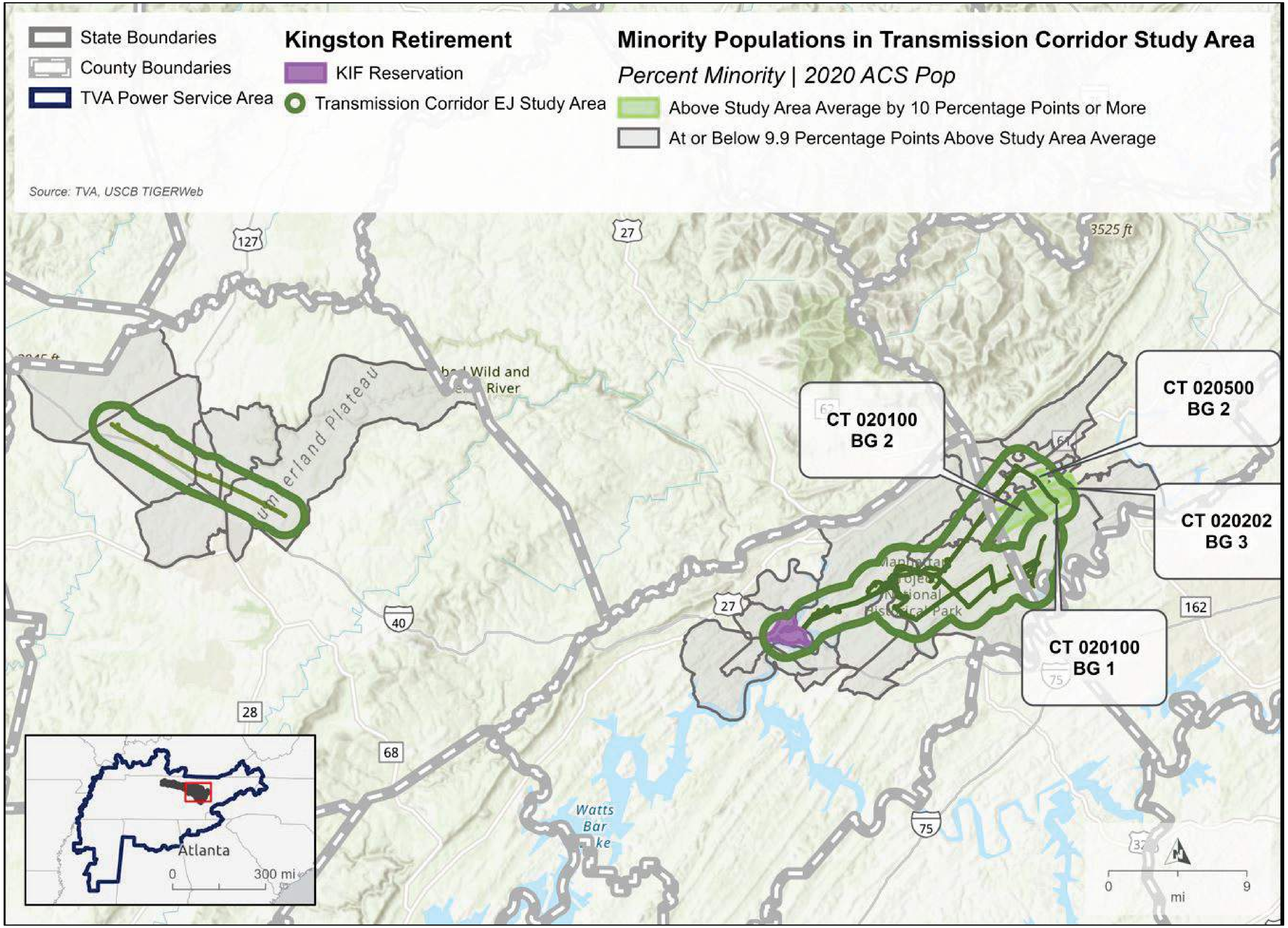

Figure 3.4-6. Minority Populations in the Alternative A Transmission Corridor Environmental Justice Study Area

3.4.2.2.5.2 Low-Income Populations

The emboldened census block groups in Table 3.4-8 are the areas with identified low-income EJ populations. Based on the 2021 SAIPE, a higher proportion of the population of two of the three affected counties was living in poverty when compared with the state as a whole.

Based on the 2020 ACS, the Western Transmission Corridor EJ Study Area that falls within Cumberland County and the eastern portion of the Eastern Transmission Corridor EJ Study Area that falls within Anderson County contain census block groups with poverty ratios higher than the state. The portion of the Eastern Transmission Corridor EJ Study Area within Roane County had a lower poverty ratio as compared to the state.

Eighteen of the 34 census block groups within the Eastern and Western Transmission Corridor EJ Study Areas likewise had higher percentages of people living in poverty than the respective study area percentage. Six census block groups had a poverty ratio that was 20 percentage points or more above the respective study area average of 42.9 percent (Western Transmission Corridor EJ Study Area - L3583) or 33.5 percent (Transmission Corridor EJ Study Area L5108 and L5302) and/or was at or above 50 percent (Figure 3.4-7). These census block groups are defined as the area where the chance for amplified environmental and human health effects may be the greatest.

Table 3.4-8. Poverty Rates for the Alternative A Transmission Corridor Environmental Justice Study Area

Geography	2021 SAIPE Poverty %*	2020 ACS Poverty %, Households	2020 ACS Poverty Ratio, Two Times US Threshold **
Western Transmission Corridor EJ Study Area – L3583			42.9
Eastern Transmission Corridor EJ Study Area – L5108, L5116, L5280, L5302, & L5381			33.5
Transmission Line – L3583			39.3
Transmission Lines – L5108, L5116, L5280, L5302, & L5381			33.9
Tennessee	*13.7*	*14.4*	*33.8*
L3583			
Cumberland County	*14.9*	*13.1*	*39.0*
CT 9702.01 BG 1 (TL)		16.8	**67.3**
CT 9702.01 BG 2 (TL)		1.2	38.7
CT 9702.01 BG 3 (TL)		13.5	27.7
CT 9703.01 BG 1		11.1	47.1
CT 9703.01 BG 2 (TL)		10.4	34.6
CT 9704.01 BG 3		17.5	**63.6**
CT 9704.02 BG 1		13.2	39.8
L5108, L5116, L5280, L5302, & L5381			
Anderson County	*14.3*	*15.2*	*35.0*
CT 201 BG 1 (TL)		14.8	43.2

	2021 SAIPE	2020 ACS	
Geography	**Poverty %***	**Poverty %, Households**	**Poverty Ratio, Two Times US Threshold ****
CT 201 BG 2 (TL)		22.1	49.8
CT 202.01 BG 1		7.9	9.1
CT 202.02 BG 3		39.2	**63.7**
CT 204 BG 1 (TL)		14.7	42.0
CT 204 BG 2		34.3	**51.0**
CT 204 BG 3		0.8	26.1
CT 205 BG 1 (TL)		22.3	**52.9**
CT 205 BG 2 (TL)		6.7	**60.8**
CT 205 BG 3 (TL)		20.5	45.1
CT 206 BG 1 (TL)		7.7	21.5
CT 206 BG 2 (TL)		14.4	34.8
CT 210.01 BG 2		19.0	38.3
CT 210.02 BG 1 (TL)		11.5	44.4
CT 210.02 BG 2 (TL)		21.1	32.0
Roane County	*13.1*	*15.0*	*31.6*
CT 301 BG 1 (TL)		1.9	9.1
CT 301 BG 2 (TL)		1.1	6.1
CT 302.03 BG 2		9.2	18.3
CT 302.04 BG 2		15.8	16.8
CT 302.06 BG 2		0.0	10.2
CT 302.06 BG 3		10.4	25.6
CT 306 BG 1		19.0	39.7
CT 306 BG 2		10.6	38.5
CT 307 BG 1		11.2	30.7
CT 307 BG 2 (TL)		7.5	41.0
CT 309 BG 1		44.8	46.2
CT 309 BG 2		9.6	27.2

*For the respective county in which the block group is located
**Calculated based on percent of population with a ratio of income to poverty threshold ≤1.99
Source: 2021 SAIPE, 2020 ACS
Note: Emboldened census block groups represent identified EJ populations as compared with the study area percentage, respective to L3583 or L5108 and L5302

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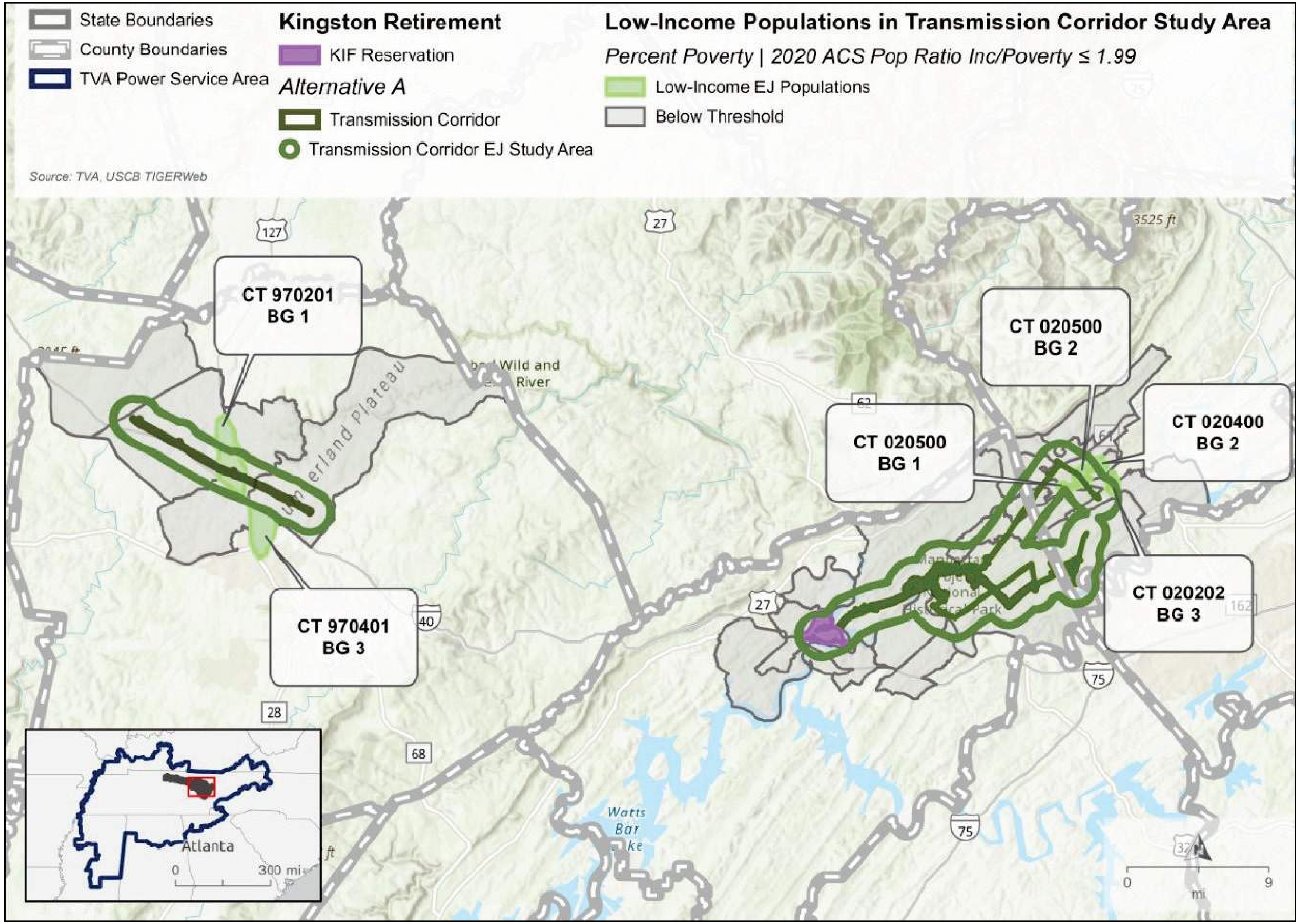

Figure 3.4-7. Low-Income Populations in the Alternative A Transmission Corridors Environmental Justice Study Area

3.4.2.2.5.3 Limited English Proficiency Populations

Of the 34 census block groups with resident populations in the Transmission Corridor EJ Study Area, 26 had zero individuals who reported speaking English less than well. However, the other eight census block groups, as shown in Table 3.4-9, had individuals who reported speaking English less than well.

Table 3.4-9. Limited English Proficiency Populations in the Alternative A Transmission Corridor Environmental Justice Study Area

Geography	Total Population	# - Individuals Speaking English Less than Well	% - Individuals Speaking English Less than Well	Languages
L5383				
Cumberland County				
CT 9703.01 BG 2	2,138	7	0.3	Spanish
CT 9704.02 BG 1	1,818	16	0.9	Indo-European
L5108, L5116, L5280, L5302, & L5381				
Anderson County				
CT 202.01 BG 1	2,762	22	0.8	Spanish
CT 202.02 BG 3	1,594	87	**5.5**	Spanish
CT 204 BG 1	677	11	1.6	Asian and Pacific
CT 204 BG 3	1,097	19	1.7	Spanish
Roane County				
CT 302.04 BG 2	1,403	5	0.4	Spanish
CT 306 BG 1	1,108	3	0.3	Asian and Pacific

Source: 2020 ACS
Note: Emboldened census block groups represent identified EJ populations based on greater than five percent of block group's population speaking English less than well.

None of these LEP populations constitute 1,000 individuals, but one census block group, CT 202.02 BG 3 in Anderson County, has greater than five percent of the population aged five years or older that constitute an LEP population, as shown in the emboldened text above (Figure 3.4-8). Therefore, the need for translation or interpreter services may be warranted for people residing in this area. The LEP language group associated with the block group is Spanish.

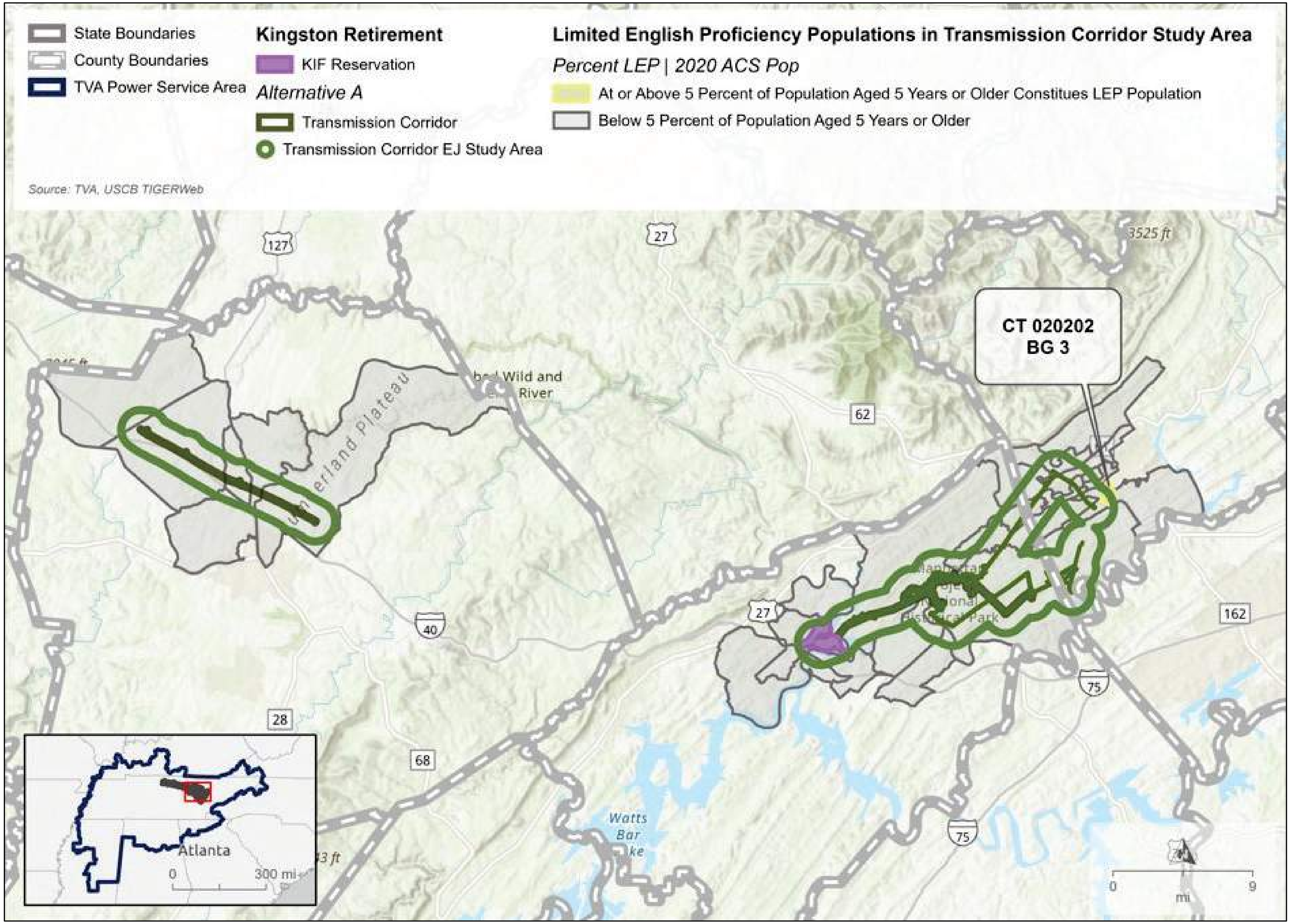

Figure 3.4-8. Limited English Proficiency Populations in the Alternative A Transmission Corridors Environmental Justice Study Area

3.4.2.2.5.4 Qualifying Environmental Justice Populations

Additional data detail for the qualifying minority EJ populations, which includes eight block groups from among those considered in Cumberland, Anderson, and Roane counties (see list below), is provided in Table 3.4-10 along with comparison data for the state and respective county.

- Cumberland County CT 9702.01 BG 1 (Low-income)
- Cumberland County CT 9704.01 BG 3 (Low-income)
- Anderson County CT 201 BG 1 (Minority)
- Anderson County CT 201 BG 2 (Minority)
- Anderson County CT 202.02 BG 3 (Minority, Low-income and LEP)
- Anderson County CT 204 BG 2 (Low-income)
- Anderson County CT 205 BG 1 (Low-income)
- Anderson County CT 205 BG 2 (Minority and Low-income)

Based on USCB criteria defining rural versus urban, Cumberland County is not within any portion of a metropolitan statistical area (MSA). Anderson and Roane counties are part of the Knoxville, Tennessee MSA. Anderson County contains portions of the La Follette and Norris urban clusters and a portion of the Knoxville urbanized area. Cumberland County contains two urban clusters: Crossville and Fairfield Glade. Within Roane County, the area surrounding the City of Kingston (excluding the Kingston Reservation), along with areas surrounding the cities of Harriman and Rockwood, combine to form the Harriman-Kingston-Rockwood urban cluster.

Based on the 2020 ACS, the top three areas of employment by industry for each of the qualifying BGs is as follows:

- CT 9702.01 BG 1 (Cumberland County) – Construction (31.5 percent); Manufacturing (24.2 percent); and Educational Services, and Health Care and Social Assistance (15.3 percent)
- CT 9704.01 BG 3 (Cumberland County) – Retail Trade (23.3 percent); Arts, Entertainment, and Recreation, and Accommodation and Food Services (17.9 percent); and; Manufacturing (17.1 percent)
- CT 201 BG 1 (Anderson County) – Educational Services, and Health Care and Social Assistance (20.6 percent); Manufacturing (17.4 percent); and Retail Trade (17.1 percent)
- CT 201 BG 2 (Anderson County) – Professional, Scientific, and Management, and Administrative, and Waste Management Services (29.1 percent); Arts, Entertainment, and Recreation, and Accommodation and Food Services (19.4 percent); and Educational Services, and Health Care and Social Assistance (19.2 percent)
- CT 202.02 BG 3 (Anderson County) – Transportation and Warehousing, and Utilities (29.5 percent); Construction (29.5 percent); and Arts, Entertainment, and Recreation, and Accommodation and Food Services (10.4 percent)
- CT 204 BG 2 (Anderson County) – Educational Services, and Health Care and Social Assistance (40.6 percent); Construction (14.7 percent); and Manufacturing (12.0 percent)

- CT 205 BG 1 (Anderson County) – Arts, entertainment, and recreation, and accommodation and food services (22.1 percent); Educational services, and health care and social assistance (21.9 percent); and Retail trade (16.6 percent)
- CT 205 BG 2 (Anderson County) – Transportation and Warehousing, and Utilities (22.3 percent); Retail Trade (20.6 percent); and Educational Services, and Health Care and Social Assistance (14.2 percent)

EJ indices, available from USEPA's online EJScreen tool, displayed the levels of environmental pollutants present among the eight EJ-qualifying block groups associated with the Alternative A Transmission Corridor. These indicators were examined to determine the risk of negative health impacts for residents living within these block groups. The 12 indicators that were examined included particulate matter, ozone, diesel particulate matter, air toxins resulting in cancer risk, respiratory HI, traffic proximity, lead paint, superfund proximity, RMP facilities, hazardous waste, underground storage tanks, and wastewater discharge. Indicator levels of 50 or greater were considered to have above average pollution levels (above 50th percentile as compared to the state), as summarized in Table 3.4-11.

The results of this examination indicated that the majority of the EJ-qualifying census block groups in the area are at increased risk of negative health impacts from one or more of the 12 risk indicators. Therefore, these EJ groups may be at risk for amplified and cumulative negative health impacts as opposed to non-EJ populations in the same area due to the greater susceptibilities and sensitivities of EJ groups.

Seven of the eight total EJ-qualifying populations examined scored above average pollution and indicated eight or more environmental indicators above the 50^{th} percentile in comparison with the state. Of these, four scored above average for all 12 of the environmental indicators. These included all six of the qualifying block groups in Anderson County, and one census tract in Cumberland County, as summarized in Table 3.4-11. Of the eight EJ-qualifying census tracts, one in Cumberland County was below average (below the 50^{th} percentile in comparison with the state) and displayed five environmental indicators above the 50^{th} percentile. The highest percentile (91^{st}) in the EJ-qualifying census block groups occurs in Anderson County CT 202.02 BG 3 for the presence of wastewater discharge.

Table 3.4-10. Additional Data for the Alternative A Transmission Corridors Identified Environmental Justice Census Block Groups (Minority, Low-income, and LEP)

Geography	% Minority	Poverty Ratio, Two Times US Threshold	% Speaking English Less than Well	% of Population 65 Years and Over	Median Age	% High School or Higher	% of Occupied Housing Units, Renter Occupied	Median Year Housing Units Built	% of 16+ Civilian Population in Labor Force	Unemployment Rate	Per Capita Income
Tennessee	*27.8*	*33.8*	*1.5*	*16.4*	*38.8*	*88.2*	*33.5*	*1984*	*61.1*	*5.3*	*$30,869*
L3583											
Cumberland County	*7.0*	*39.0*	*0.2*	*30.8*	*51.8*	*87.1*	*20.9*	*1993*	*45.8*	*6.2*	*$26,910*
CT 9702.01 BG 1 (Low-income)	3.7	67.3	0.0	24.8	38.9	74.8	11.1	1997	48.1	0.0	$18,244
CT 9704.01 BG 3 (Low-income)	8.6	63.6	0.0	15.8	30.8	78.0	69.1	1996	67.0	8.3	$22,400
L5108, L5116, L5280, L5302, & L5381											
Anderson County	*13.3*	*35.0*	*0.8*	*19.9*	*43.1*	*88.5*	*32.4*	*1976*	*55.3*	*5.5*	*$28,633*
CT 201 BG 1 (Minority)	41.9	43.2	0.0	8.9	31.0	94.9	98.8	1950	63.3	2.0	$24,508
CT 201 BG 2 (Minority)	34.9	49.8	0.0	12.0	36.5	94.8	53.2	1979	66.0	4.9	$31,942
CT 202.02 BG 3 (Minority, Low-income & LEP)	30.4	63.7	5.5	14.9	31.3	83.8	29.1	1948	45.9	0.4	$14,343
CT 204 BG 2 (Low-income)	20.5	51.0	0.0	14.0	50.5	79.3	50.5	1947	56.1	11.1	$21,739
CT 205 BG 1 (Minority)	25.1	52.9	0.0	8.5	37.4	94.4	66.6	1962	60.6	5.5	$18,359
CT 205 BG 2 (Minority & Low-income)	32.4	60.8	0.0	12.6	36.6	92.7	37.5	1949	59.5	6.1	$22,579

Sources: 2020 ACS

Table 3.4-11. Environmental Indicator Percentiles in Comparison with State in Alternative A Transmission Corridor Environmental Justice Study Area

Geography	% Particulate Matter	% Ozone	% Diesel Particulate Matter	% Cancer Risk	% Respiratory HI[1]	% Traffic Proximity	% Lead Paint	% Superfund Proximity	% RMP Facility[2]	% Hazardous Waste	% Underground Storage Tanks	% Wastewater Discharge
Tennessee	46	57	56	39	50	51	39	23	59	60	56	53
Cumberland County												
CT 9702.01 BG 1 (Low-income)	6	12	26	**65**	31	**60**	31	**65**	19	**63**	**64**	22
CT 9704.01 BG 3 (Low-income)	8	12	**56**	**66**	**69**	**71**	29	**69**	8	**74**	**78**	**61**
Anderson County												
CT 201 BG 1 (Minority)	49	**56**	**66**	**65**	**69**	**77**	**84**	**79**	**77**	**76**	**76**	**85**
CT 201 BG 2 (Minority)	**57**	**63**	**72**	**74**	**75**	**75**	**76**	**83**	**81**	**80**	**72**	**90**
CT 202.02 BG 3 (Minority, Low-income and LEP)	**66**	**68**	**74**	**76**	**77**	**81**	**89**	**83**	**84**	**83**	**87**	**91**
CT 204 BG 2 (Low-income)	**53**	**56**	**63**	**67**	**70**	40	**85**	**79**	**79**	**77**	**77**	44
CT 205 BG 1 (Low-income)	**54**	**60**	**71**	**72**	**74**	**79**	**85**	**82**	**80**	**77**	**79**	**76**
CT 205 BG 2 (Minority and Low-income)	**57**	**63**	**73**	**76**	**76**	**77**	**89**	**83**	**84**	**80**	**83**	**54**

1. Air toxins resulting in a hazardous respiratory index
2. Risk management plan (RMP) facilities

3.4.2.2.6 Construction and Operation of a Natural Gas Pipeline

The proposed natural gas pipeline and associated structures would be constructed within Fentress, Jackson, Morgan, Overton, Putnam, Roane, Smith, and Trousdale counties. The TVA Expanded EJ Study Area encompasses all or portions of 50 census block groups based on a one-mile radius surrounding the ETNG Construction ROW (Figure 3.4-1). The TVA Expanded EJ Study Area encompasses additional portions of Cumberland and Sumner counties.

3.4.2.2.6.1 Minority Populations

Four census block groups within the TVA Expanded EJ Study Area were identified as minority EJ populations, as shown in bold on Table 3.4-12. At the county level, a greater proportion of the populations of the affected counties identified as non-minority than across the associated state, based on the 2020 ACS. Correspondingly, the minority populations in these counties were generally smaller proportionally than statewide.

Based on the 2020 ACS, 10.5 percent of the population within the ETNG EJ Study Area were identified as minorities, a lower proportion than across the TVA Expanded EJ Study Area and a lower proportion than the state. While the overall TVA Expanded EJ Study Area had a substantially lower minority percentage than the state, 14 of the 50 census block groups within the ETNG EJ Study Area were at or had higher percentages of minorities in comparison with the TVA Expanded EJ Study Area percentage. Four census block groups in the ETNG EJ Study Area had minority percentages that were 10 percentage points or more above the TVA Expanded EJ Study Area average of 11.1 percent (Figure 3.4-9). These areas are considered minority EJ population areas, where the chance for amplified environmental and human health effects may be the greatest. Depending on the census block group as shown in Table 3.4-12, these minority percentages are generally due to relatively high percentages of Black or African American populations and those self-identifying as two or more races.

Table 3.4-12. Minority Percentages and Ethnicities in the TVA Expanded EJ Study Area

Geography	% Minority	% White[1]	% Black / African Am.	% Am. Indian / AK Native	% Asian	% Native Hawaiian / Pacific Islander	% Some Other Race	Two or More Races	% Hispanic / Latino[2]
TVA Expanded EJ Study Area Study Area	11.1	88.9	4.1	0.4	0.3	0.0	1.7	4.5	3.4
ETNG EJ Study Area	10.5	89.5	3.5	0.4	0.3	0.0	1.7	4.6	3.4
Tennessee	27.8	72.2	15.8	0.4	2.0	0.1	3.6	6.0	6.9
Cumberland County	7.0	93.0	0.5	0.3	0.6	0.0	1.3	4.3	3.2
CT 9702.02 BG 1	5.5	94.5	0.1	0.7	0.4	0.1	0.0	4.2	1.4
Fentress County	4.6	95.4	0.2	0.2	0.2	0.0	0.5	3.6	1.7
CT 9653 BG 1 (Pipeline)	6.5	93.5	0.1	0.2	0.3	0.0	0.2	3.1	4.0
CT 9653 BG 2 (Pipeline)	3.7	96.3	0.1	0.1	0.0	0.0	0.2	2.9	1.0
CT 9653 BG 4 (Pipeline)	5.4	94.6	0.1	0.2	0.0	0.0	0.9	3.2	1.7
Jackson County	6.5	93.5	0.4	0.3	0.1	0.0	0.7	4.9	2.1
CT 9601 BG 2 (Pipeline)	4.4	95.6	0.0	0.1	0.0	0.0	0.2	3.6	1.5
CT 9602 BG 1 (Pipeline)	6.7	93.3	0.3	0.3	0.4	0.0	0.0	4.3	1.6
CT 9602 BG 2 (Pipeline)	11.1	88.9	0.4	1.3	0.5	0.0	0.3	6.6	3.6
CT 9603 BG 2	6.1	93.9	0.5	0.3	0.0	0.0	0.5	4.3	1.3
CT 9603 BG 4 (Pipeline)	7.3	92.7	0.1	0.1	0.2	0.0	0.1	4.5	3.7
Morgan County	9.1	90.9	4.6	0.3	0.2	0.0	0.8	3.1	1.4
CT 1101 BG 2 (Pipeline)	3.8	96.2	0.3	0.3	0.1	0.1	0.4	2.2	1.1
CT 1102 BG 1 (Pipeline)	5.7	94.3	0.1	0.2	0.5	0.1	0.4	3.8	1.2
CT 1102 BG 2 (Pipeline)	6.0	94.0	0.1	0.1	0.0	0.1	0.8	4.1	1.1
CT 1103 BG 1 (Pipeline)	5.5	94.5	0.8	0.3	0.6	0.0	0.2	2.4	2.4
CT 1103 BG 2	5.7	94.3	0.5	0.3	0.3	0.0	0.2	2.9	2.1
CT 1103 BG 3	**33.0**	67.0	30.5	0.2	0.2	0.0	0.0	0.8	1.8
CT 1104 BG 3 (Pipeline)	2.5	97.5	0.0	0.1	0.0	0.0	0.0	2.3	0.2
CT 1105 BG 1 (Pipeline)	5.9	94.1	0.1	0.3	0.0	0.0	0.4	4.0	1.6
CT 1105 BG 2 (Pipeline)	5.5	94.5	0.7	0.7	0.1	0.0	0.3	3.0	1.6
CT 1105 BG 4	7.7	92.3	0.3	0.4	0.3	0.0	0.9	4.5	2.3
Overton County	9.5	94.8	0.4	0.3	0.3	0.0	0.5	3.8	1.5
CT 9505.01 BG 1	6.0	94.0	0.8	0.4	0.1	0.0	0.2	3.5	1.9
CT 9505.01 BG 3	5.5	94.5	0.5	0.2	0.4	0.0	0.1	2.8	1.9
CT 9505.02 BG 1 (Pipeline)	4.6	95.4	0.1	0.2	0.1	0.0	0.2	3.4	1.3
CT 9506 BG 1 (Pipeline)	5.6	94.4	0.2	0.1	0.2	0.0	0.0	4.0	1.5
CT 9506 BG 2 (Pipeline)	5.0	95.0	0.4	0.1	0.1	0.0	0.1	3.1	1.5
Putnam County	14.9	85.1	2.7	0.9	1.4	0.1	4.1	5.7	7.8

Geography	% Minority	% White[1]	% Black / African Am.	% Am. Indian / AK Native	% Asian	% Native Hawaiian / Pacific Islander	% Some Other Race	Two or More Races	% Hispanic / Latino[2]
CT 1 BG 1 (Pipeline)	13.9	86.1	0.6	0.0	0.3	0.0	0.3	3.1	11.6
CT 1 BG 2 (Pipeline)	21.0	79.0	0.3	0.3	0.1	0.0	0.1	3.0	22.1
CT 1 BG 4	**22.0**	78.0	1.1	0.0	0.8	0.0	0.2	5.6	19.0
CT 2.01 BG 1 (Pipeline)	8.9	91.1	1.1	0.3	1.2	0.1	0.2	3.8	3.6
CT 2.02 BG 1 (Pipeline)	8.3	91.7	0.7	0.2	0.5	0.1	0.3	3.7	3.6
CT 2.02 BG 2 (Pipeline)	14.8	85.2	3.5	0.0	0.5	0.1	0.7	4.6	6.9
CT 3.01 BG 1 (Pipeline)	12.1	87.9	0.6	0.1	0.7	0.0	0.3	6.7	4.5
CT 3.01 BG 2 (Pipeline)	7.8	92.2	0.3	0.1	0.6	0.0	0.4	3.5	3.7
CT 3.03 BG 1	12.7	87.3	1.3	0.2	0.3	0.0	0.0	2.2	9.8
CT 9 BG 1	8.3	91.7	0.9	0.0	1.0	0.0	0.1	3.0	4.7
Roane County	9.3	90.7	2.4	0.4	0.6	0.0	0.8	5.0	1.9
CT 302.03 BG 2	7.0	93.0	1.6	0.3	1.0	0.0	0.2	3.2	1.4
CT 307 BG 1	5.6	94.4	0.2	0.2	0.2	0.0	0.2	4.7	0.5
CT 307 BG 2 (Pipeline)	7.8	92.2	1.7	0.5	0.2	0.0	0.2	5.1	0.9
CT 308.02 BG 1	13.7	86.3	7.7	0.4	0.1	0.1	0.2	4.7	1.3
CT 308.02 BG 2	7.3	92.7	3.2	0.2	0.3	0.0	0.0	3.2	1.2
CT 309 BG 2 (Pipeline)	5.8	94.2	0.7	0.3	0.4	0.0	0.3	3.8	0.8
Smith County	8.6	91.4	1.8	0.5	0.4	0.0	1.0	4.9	2.6
CT 9750 BG 1 (Pipeline)	9.4	90.6	1.7	0.7	0.0	0.0	0.0	4.7	3.3
CT 9750 BG 2 (Pipeline)	6.0	94.0	0.6	0.1	0.1	0.0	0.1	3.5	2.0
CT 9750 BG 3 (Pipeline)	7.9	92.1	0.1	0.9	0.0	0.0	0.2	6.1	1.1
Sumner County	19.5	80.5	8.0	0.4	1.5	0.1	2.7	6.8	6.6
CT 206.02 BG 2	7.9	92.1	1.8	0.2	0.4	0.0	0.5	3.5	2.5
CT 206.03 BG 2	11.5	88.5	3.1	0.0	0.4	0.1	0.2	4.7	4.3
Trousdale County	23.5	76.5	16.5	0.3	0.2	0.0	1.8	4.7	3.2
CT 901 BG 1 (Pipeline)	14.4	85.6	8.0	0.2	0.1	0.0	0.1	3.9	3.0
CT 901 BG 2 (Pipeline)	10.9	89.1	4.0	0.3	0.5	0.0	0.3	4.1	2.1
CT 901 BG 3 (Pipeline)	**33.4**	66.6	28.8	0.2	0.0	0.0	0.1	1.9	3.8
CT 902 BG 1	20.8	79.2	11.7	0.2	0.4	0.0	0.1	6.2	3.3
CT 902 BG 2 (Pipeline)	**34.7**	65.3	21.5	0.2	0.4	0.0	0.3	9.4	3.9

Source: 2020 ACS
[1] Race percentages are provided for those reporting a particular race alone or in combination.
[2] This group is calculated separately from the other ethnicities and may include overlap from the other categories, as the USCB does not consider Hispanic or Latino a "race."
Note: Emboldened census block groups represent identified EJ populations as compared with the TVA Expanded EJ Study Area percentage.

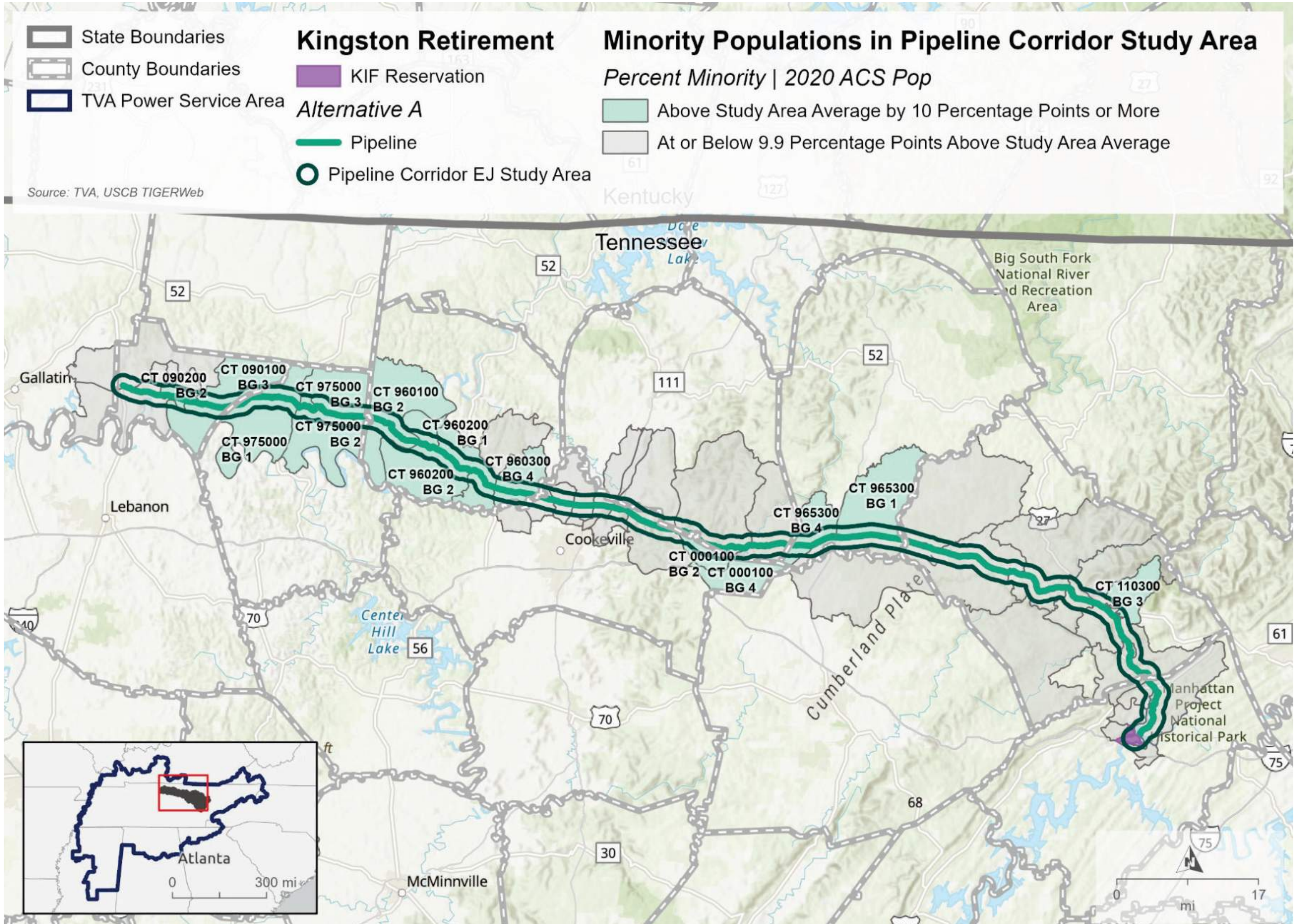

Figure 3.4-9. Minority Populations in the TVA Expanded Environmental Justice Study Area

3.4.2.2.6.2 Low-Income Populations

The 10 emboldened census block groups in Table 3.4-13 were areas with identified low-income EJ populations. Based on the 2021 SAIPE, a higher proportion of the population of seven of the ten affected counties was living in poverty when compared with the state as a whole.

At the census block group level, based on the 2020 ACS, the ETNG EJ Study Area and TVA Expanded EJ Study Area corridor had higher poverty ratios as compared to the state. In comparison with the TVA Expanded EJ Study Area, the populations within the ETNG EJ Study Area had a higher proportion of people living in poverty. Thirty of the 50 census block groups likewise had higher percentages of people living in poverty than across the TVA Expanded EJ Study Area. Ten census block groups had a poverty ratio that was 20 percentage points or more above the TVA Expanded EJ Study Area average of 36.8 percent and/or was at or above 50 percent (Figure 3.4-10). These census block groups are defined as the area where the chance for amplified environmental and human health effects may be the greatest.

Table 3.4-13. Poverty Rates for the TVA Expanded Environmental Justice Study Area

	2021 SAIPE	2020 ACS	
Geography	**Poverty %***	**Poverty %, Households**	**Poverty Ratio, Two Times US Threshold ****
TVA Expanded EJ Study Area			36.8
ETNG EJ Study Area			39.5
Tennessee	*13.7*	*14.4*	*33.8*
Cumberland County	*14.9*	*13.1*	*39.0*
CT 9702.02 BG 1		12.2	23.0
Fentress County	*19.9*	*18.7*	*45.4*
CT 9653 BG 1 (Pipeline)		11.0	43.3
CT 9653 BG 2 (Pipeline)		9.6	**55.0**
CT 9653 BG 3 (Pipeline)		7.6	49.4
Jackson County	*21.2*	*16.6*	*43.6*
CT 9601 BG 2 (Pipeline)		27.0	47.9
CT 9602 BG 1 (Pipeline)		12.4	31.5
CT 9602 BG 2 (Pipeline)		26.1	**56.8**
CT 9603 BG 2		14.6	37.7
CT 9603 BG 4 (Pipeline)		10.1	18.4
Morgan County	*18.1*	*19.7*	*45.1*
CT 1101 BG 2 (Pipeline)		31.2	**63.7**
CT 1102 BG 1 (Pipeline)		17.2	40.9
CT 1102 BG 2 (Pipeline)		25.2	**53.7**
CT 1103 BG 1 (Pipeline)		18.1	**60.8**
CT 1103 BG 2		17.2	39.7
CT 1103 BG 3		20.7	43.2
CT 1104 BG 3 (Pipeline)		12.0	25.1
CT 1105 BG 1 (Pipeline)		13.7	41.6
CT 1105 BG 2 (Pipeline)		7.9	33.7
CT 1105 BG 4		21.0	31.7

	2021 SAIPE	2020 ACS	
Geography	**Poverty %***	**Poverty %, Households**	**Poverty Ratio, Two Times US Threshold ** **
Overton County	*14.9*	*20.3*	*44.4*
CT 9505.01 BG 1		21.0	38.0
CT 9505.01 BG 3		21.6	38.8
CT 9505.02 BG 1 (Pipeline)		12.7	45.6
CT 9506 BG 1 (Pipeline)		18.7	36.6
CT 9506 BG 2 (Pipeline)		24.2	**50.8**
Putnam County	*13.7*	*17.3*	*41.0*
CT 1 BG 1 (Pipeline)		18.7	**51.0**
CT 1 BG 2 (Pipeline)		25.3	**52.5**
CT 1 BG 4		25.4	37.7
CT 2.01 BG 1 (Pipeline)		10.3	31.1
CT 2.02 BG 1 (Pipeline)		10.4	46.8
CT 2.02 BG 2 (Pipeline)		18.5	**68.4**
CT 3.01 BG 1 (Pipeline)		1.7	22.7
CT 3.01 BG 2 (Pipeline)		6.8	40.9
CT 3.03 BG 1		18.1	40.0
CT 9 BG 1		26.0	32.3
Roane County	*13.1*	*15.0*	*31.6*
CT 302.03 BG 2		9.2	18.3
CT 307 BG 1		11.2	30.7
CT 307 BG 2 (Pipeline)		7.5	41.0
CT 308.02 BG 1		6.2	37.1
CT 308.02 BG 2		11.2	18.6
CT 309 BG 2 (Pipeline)		9.6	27.2
Smith County	*11.7*	*13.9*	*36.6*
CT 9750 BG 1 (Pipeline)		13.9	15.6
CT 9750 BG 2 (Pipeline)		18.9	**56.8**
CT 9750 BG 3 (Pipeline)		25.4	48.6
Sumner County	*8.6*	*9.6*	*23.3*
CT 206.02 BG 2		6.4	11.8
CT 206.03 BG 2		11.3	23.5
Trousdale County	*17.8*	*11.0*	*27.6*
CT 901 BG 1 (Pipeline)		19.6	20.1
CT 901 BG 2 (Pipeline)		0.0	26.6
CT 901 BG 3 (Pipeline)		11.8	37.7
CT 902 BG 1		8.5	44.0
CT 902 BG 2 (Pipeline)		15.7	14.3

*For the respective county in which the block group is located
**Calculated based on percent of population with a ratio of income to poverty threshold ≤1.99
Source: 2021 SAIPE, 2020 ACS
Note: Emboldened census block groups represent identified EJ populations as compared with the TVA Expanded EJ Study Area percentage.

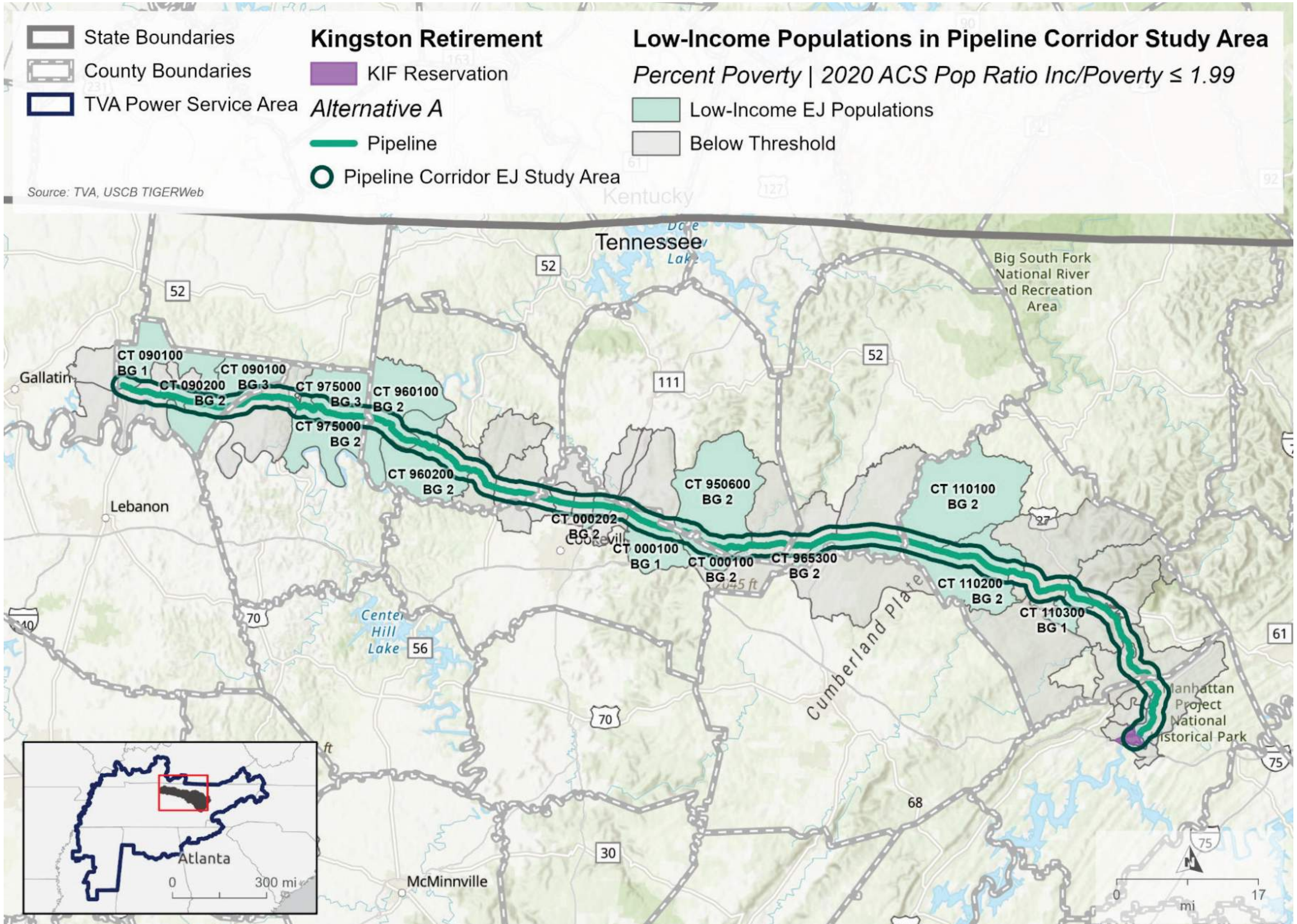

Figure 3.4-10. Low-Income Populations within the TVA Expanded Environmental Justice Study Area Under Alternative A

3.4.2.2.6.3 Limited English Proficiency Populations

Of the 50 census block groups within the TVA Expanded EJ Study Area, 37 had zero individuals who reported speaking English less than well. However, one or more individuals within each of the remaining 13 census block groups reported speaking English less than well, as indicated in Table 3.4-14.

Table 3.4-14. Limited English Proficiency Populations within the TVA Expanded Environmental Justice Study Area

Geography	Total Population	# - Individuals Speaking English Less than Well	% - Individuals Speaking English Less than Well	Languages
Jackson County				
CT 9601 BG 2 (Pipeline)	1,265	24	1.9	Spanish
		13	1.0	Indo-European
CT 9602 BG 2 (Pipeline)	806	6	0.7	Spanish
Morgan County				
CT 1101 BG 2 (Pipeline)	1,129	1	0.1	Spanish
CT 1103 BG 2	852	30	3.5	Spanish
CT 1103 BG 3	3,773	23	0.6	Indo-European
Overton County				
CT 9506 BG 2 (Pipeline)	1,171	20	1.7	Spanish
Putnam County				
CT 1 BG 1 (Pipeline)	950	13	1.4	Spanish
CT 1 BG 2 (Pipeline)	1,713	223	**13.0**	Spanish
CT 1 BG 4	1,866	72	3.9	Spanish
		19	1.0	Other Languages
CT 3.01 BG 1 (Pipeline)	1,169	2	0.2	Spanish
CT 9 BG 1	2,332	2	0.1	Spanish
Trousdale County				
CT 901 BG 3 (Pipeline)	3,051	13	0.4	Spanish
CT 902 BG 1	1,360	31	2.3	Spanish

Source: 2020 ACS
Note: Emboldened census block groups represent identified EJ populations based on greater than five percent of block group's population speaking English less than well.

None of these LEP populations constitute 1,000 individuals, but one census block group (CT 1 BG 2, Putnam County, emboldened above) has greater than five percent of its population aged five years or older that constitute an LEP population (Figure 3.4-11). Therefore, the need for translation or interpreter services may be warranted for people residing in these areas. The LEP language group associated with CT 1 BG 2, Putnam County, is Spanish.

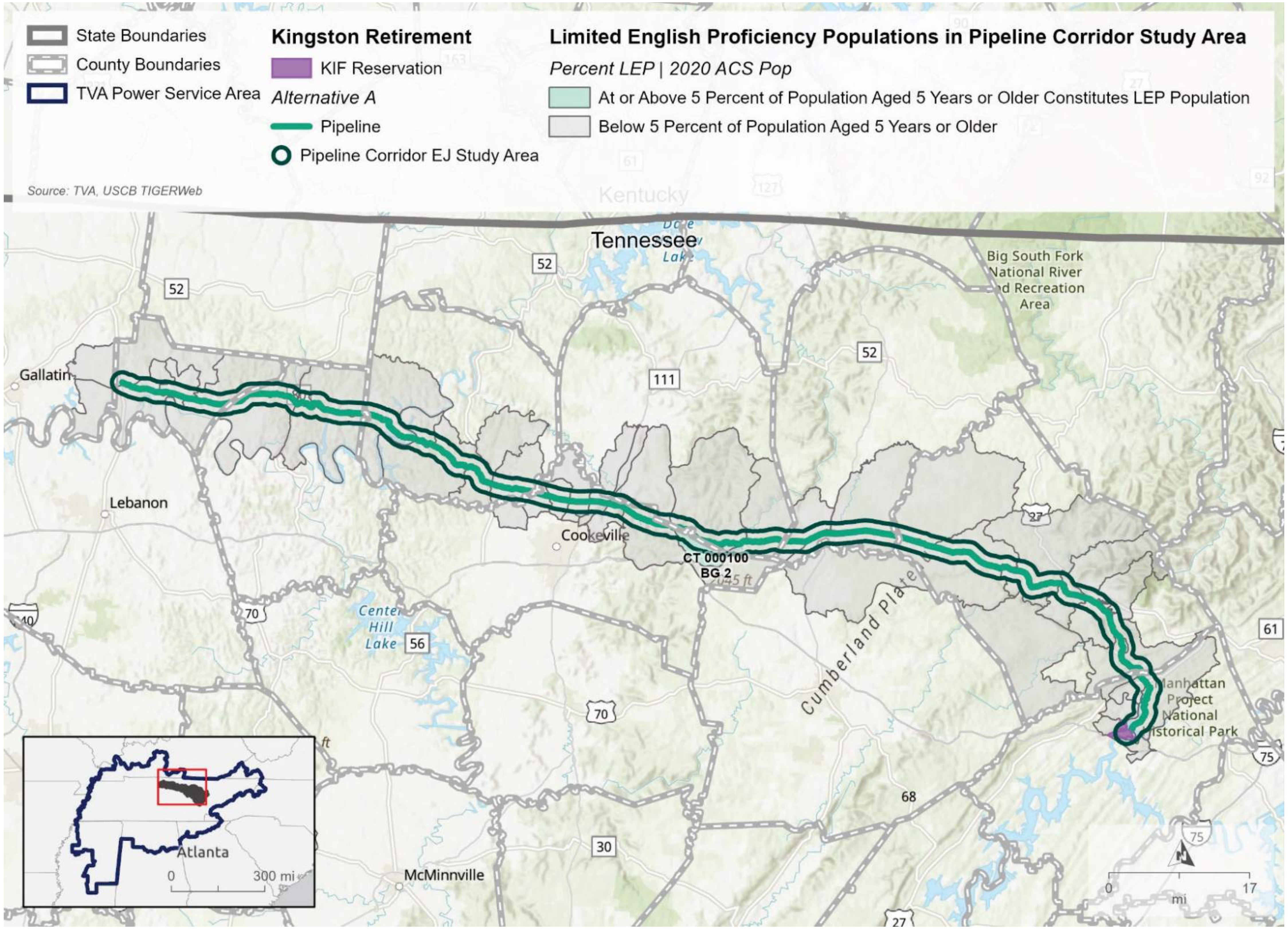

Figure 3.4-11. Limited English Proficiency Populations within the TVA Expanded Environmental Justice Study Area Under Alternative A

3.4.2.2.6.4 Qualifying Environmental Justice Populations

Additional data detail for the qualifying EJ populations, which includes 22 block groups from Fentress, Jackson, Morgan, Overton, Putnam, Smith, and Trousdale counties (see list below), is provided in Table 3.4-15 along with comparison data for the state and respective county. The table also provides comparable data for the additional census block groups that were identified as EJ-qualifying populations under the separate analysis prepared for the natural gas pipeline as part of FERC's pre-filing process described in Section 2.1.3.5. Several of the block groups identified as part of FERC's pre-filing process overlapped with those identified under TVA's analysis, resulting in a total of 22 EJ qualifying block groups[12].

- Fentress County CT 9653 BG 1 (Minority)
- Fentress County CT 9653 BG 2 (Low-income)
- Fentress County CT 9653 BG 4 (Minority)
- Jackson County CT 9601 BG 2 (Minority and Low-income)
- Jackson County CT 9602 BG 1 (Minority)
- Jackson County CT 9602 BG 2 (Minority and Low-income)
- Jackson County CT 9603 BG 4 (Minority)
- Morgan County CT 1101 BG 2 (Low-income)
- Morgan County CT 1102 BG 2 (Low-income)
- Morgan County CT 1103 BG 1 (Low-income)
- Morgan County CT 1103 BG 3 (Minority)
- Overton County CT 9506 BG 2 (Low-income)
- Putnam County CT 1 BG 1 (Low-income)
- Putnam County CT 1 BG 2 (Minority, Low-income and LEP)
- Putnam County CT 1 BG 4 (Minority)
- Putnam County CT 2.02 BG 2 (Low-income)
- Smith County CT 9750 BG 1 (Minority)
- Smith County CT 9750 BG 2 (Minority and Low-income)
- Smith County CT 9750 BG 3 (Minority and Low-income)
- Trousdale County CT 901 BG 1 (Low-income)
- Trousdale County CT 901 BG 3 (Minority and Low-income)
- Trousdale County CT 902 BG 2 (Minority and Low-income)

Based on USCB criteria, Morgan County is part of the Knoxville, Tennessee MSA, and Smith and Trousdale counties are part of the Nashville-Davidson-Murfreesboro-Franklin, Tennessee MSA. Fentress, Jackson, Overton, and Putnam counties are not within any portion of an MSA; they are rural. The following urban clusters are located within the counties crossed by the

[12] ETNG's EJ analysis provided in their draft Resource Reports identified eight BGs that the TVA analysis did not. (Conversely, TVA analysis identified four BGs that ETNG analysis did not.)

natural gas pipeline: Monterey, Tennessee (Putnam); Livingston, Tennessee (Overton); and Carthage, Tennessee (Smith). No urbanized areas are located within the counties encompassing the natural gas pipeline.

Based on the 2020 ACS, the top three areas of employment by industry for each of the qualifying BGs is as follows:

- CT 9653 BG 1 (Fentress County) – Educational services, and health care and social assistance (24.3 percent); Manufacturing (17.5 percent); and Agriculture, forestry, fishing and hunting, and mining (17.1 percent)
- CT 9653 BG 2 (Fentress County) – Retail trade (24.4 percent); Educational services, and health care and social assistance (18.8 percent); and Agriculture, forestry, fishing and hunting, and mining (16.9 percent)
- CT 9653 BG 4 (Fentress County) – Educational services, and health care and social assistance (53.8 percent); Construction (6.0 percent); and Other services, except public administration (17.7 percent)
- CT 9601 BG 2 (Jackson County) – Transportation and warehousing, and utilities (19.6 percent); Educational services, and health care and social assistance (16.6 percent); and Manufacturing (16.3 percent)
- CT 9602 BG 1 (Jackson County) – Retail (31.7 percent); Educational services, and health care and social assistance (17.6 percent); and Manufacturing (15.8 percent)
- CT 9602 BG 2 (Jackson County) – Educational services, and health care and social assistance (27.6 percent); Manufacturing (24.4 percent); and Construction (16.7 percent)
- CT 9603 BG 4 (Jackson County) – Educational services, and health care and social assistance (34.3 percent); Professional, scientific, and management and administrative and waste management services (16.1 percent); and Manufacturing (12.2 percent)
- CT 1101 BG 2 (Morgan County) – Construction (34.2 percent); Manufacturing (18.2 percent); and Educational services, and health care and social assistance (14.7 percent)
- CT 1102 BG 2 (Morgan County) – Educational services, and health care and social assistance (16.8 percent); Construction (15.4 percent); and Other services except public administration (12.8 percent)
- CT 1103 BG 1 (Morgan County) – Educational services, and health care and social assistance (24.6 percent); Public administration (17.0 percent); and Retail trade (11.4 percent)
- CT 1103 BG 3 (Morgan County) – Public administration (28.2 percent); Educational services, and health care and social assistance (23.5 percent); and Retail trade (10.4 percent)
- CT 9506 BG 2 (Overton County) – Transportation and warehousing, and utilities (13.8 percent); Manufacturing (13.8 percent); and Professional, scientific, and management and administrative and waste management services (13.1 percent)
- CT 1 BG 1 (Putnam County) – Arts, entertainment, and recreation, and accommodation and food services (22.0 percent); Manufacturing (16.2 percent); and Educational services, and health care and social assistance (15.2 percent)

- CT 1 BG 2 (Putnam County) – Manufacturing (43.1 percent); Educational services, and health care and social assistance (13.2 percent) and Construction (12.9 percent)
- CT 1 BG 4 (Putnam County) – Retail trade (22.0 percent); Educational services, and health care and social assistance (20.5 percent); and Manufacturing (16.1 percent)
- CT 2.02 BG 2 (Putnam County) – Finance, and insurance, and real estate, and rental and leasing (22.8 percent); Transportation and warehousing, and utilities (13.8 percent); Manufacturing (19.3 percent); and Arts, entertainment, and recreation, and accommodation and food services (18.6 percent)
- CT 9750 BG 1 (Smith County) – Retail trade (20.3 percent); Educational services, and health care and social assistance (18.7 percent); and Construction (15.8 percent)
- CT 9750 BG 2 (Smith County) – Manufacturing (17.2 percent); Educational services, and health care and social assistance (16.0 percent); and Construction (15.4 percent)
- CT 9750 BG 3 (Smith County) – Manufacturing (32.0 percent); Retail trade (18.5 percent); and Public Administration (18.5 percent)
- CT 901 BG 1 (Trousdale County) – Professional, scientific, and management and administrative and waste management services (23.1 percent); Other services, except public administration (22.2 percent); and Educational services, and health care and social assistance (15.8 percent)
- CT 901 BG 3 (Trousdale County) – Retail trade (26.9 percent); Transportation and warehousing, and utilities (15.7 percent); and Public Administration (11.0 percent)
- CT 902 BG 2 (Trousdale County) – Wholesale trade (23.4 percent); Transportation and warehousing, and utilities (23.2 percent); and Public Administration (13.8 percent)

Table 3.4-15. Additional Data for the Alternative A Environmental Justice Census Block Groups (Minority, Low-Income, and LEP) Identified for the TVA Expanded EJ Study Area

Geography	% Minority	Poverty Ratio, Two Times US Threshold	% Speaking English Less than Well	% of Population 65 Years and Over	Median Age	% High School or Higher	% of Occupied Housing Units, Renter Occupied	Median Year Housing Units Built	% of 16+ Civilian Population in Labor Force	Unemployment Rate	Per Capita Income
Tennessee	*27.8*	*33.8*	*1.5*	*16.4*	*38.8*	*88.2*	*33.5*	*1984*	*61.1*	*5.3*	*$30,869*
Fentress County	*4.6*	*45.4*	*0.1*	*21.4*	*45.5*	*80.7*	*24.0*	*1989*	*50.2*	*6.3*	*$20,295*
CT 9653 BG 1 (Minority)	6.5	43.3	0.0	23.6	50.6	84.1	19.7	2000	52.5	0.0	$21,047
CT 9653 BG 2 (Low-income)	3.7	55.0	0.0	17.9	37.5	91.1	1.2	1991	54.8	17.0	$18,276
CT 9653 BG 4 (Minority)	5.4	49.4	0.0	11.8	36.0	91.0	29.2	2000	68.6	3.5	$18,120
Jackson County	*6.5*	*43.6*	*0.6*	*22.5*	*47.4*	*80.5*	*19.5*	*1985*	*50.9*	*7.6*	*$21,148*
CT 9601 BG 2 (Minority and Low-income)	4.4	31.5	2.9	23.2	49.4	77.5	12.1	1993	36.8	12.1	$21,073
CT 9602 BG 1 (Minority)	6.7	47.9	0.0	20.1	38.6	86.0	13.9	1983	65.0	4.5	$22,219
CT 9602 BG 2 (Minority and Low-income)	11.1	56.8	0.7	30.4	52.7	83.2	14.5	1981	41.7	7.7	$17,531
CT 9603 BG 4 (Minority)	7.3	18.4	0.0	13.6	40.2	82.9	18.7	1994	66.9	1.8	$27,394
Morgan County	*9.1*	*45.1*	*0.3*	*18.0*	*41.5*	*81.5*	*17.6*	*1984*	*43.4*	*7.7*	*$20,258*
CT 1101 BG 2 (Low-income)	3.8	63.7	0.1	13.6	47.8	70.2	17.2	1995	52.4	1.4	$21,193
CT 1102 BG 2 (Low-income)	5.7	53.7	0.0	20.0	54.0	88.5	10.8	1991	32.6	8.2	$21,399
CT 1103 BG 1 (Low-income)	5.5	60.8	0.0	23.3	37.0	81.5	44.0	1978	45.7	8.9	$17,720
CT 1103 BG 3 (Minority)	33.0	43.2	0.6	6.8	35.3	70.6	19.0	1987	16.4	0.0	$8,596
Overton County	*5.2*	*44.4*	*0.1*	*20.4*	*43.2*	*80.4*	*22.0*	*1980*	*55.3*	*3.6*	*$22,864*
CT 9506 BG 2 (Low-income)	5.0	50.8	0.8	18.4	37.3	80.5	25.0	1995	46.4	5.9	$18,501
Putnam County	*14.9*	*41.0*	*1.6*	*16.7*	*36.7*	*88.2*	*38.1*	*1988*	*59.4*	*5.9*	*$25,208*
CT 1 BG 1 (Low-income)	13.9	51.0	1.4	11.2	29.1	88.9	40.5	1984	64.7	2.9	$22,216
CT 1 BG 2 (Minority, Low-income and LEP)	21.0	52.5	13.0	20.4	38.9	71.1	41.1	1976	51.0	3.7	$15,964
CT 1 BG 4 (Minority)	22.0	37.7	4.9	10.2	32.8	85.2	30.2	1991	65.0	1.5	$18,779
CT 2.02 BG 2 (Low-income)	14.8	68.4	0.0	45.1	62.4	83.6	48.1	1995	27.0	0.0	$18,911
Roane County	*9.3*	*31.6*	*0.2*	*22.7*	*47.3*	*89.8*	*24.4*	*1978*	*54.5*	*6.0*	*$32,067*
CT 307 BG 2 (Minority)	7.8	41.0	0.0	35.2	55.8	98.1	32.2	1952	66.8	0.0	$45,789
Smith County	*8.6*	*36.6*	*0.4*	*16.6*	*40.6*	*85.9*	*24.3*	*1982*	*58.6*	*3.7*	*$28,134*
CT 9750 BG 1 (Minority)	9.4	15.6	0.0	17.5	49.3	95.1	20.4	1979	64.5	1.4	$32,904
CT 9750 BG 2 (Minority and Low-income)	6.0	56.8	0.0	15.8	47.9	77.5	6.7	1974	54.1	1.3	$20,245
CT 9750 BG 3 (Minority and Low-income)	7.9	48.6	0.0	16.4	46.7	88.8	21.0	1976	49.1	2.1	$52,438
Trousdale County	*23.5*	*27.6*	*0.4*	*13.3*	*33.9*	*85.0*	*25.5*	*1984*	*54.6*	*4.6*	*$24,036*
CT 901 BG 1 (Low-income)	14.4	20.1	0.0	15.9	37.2	80.7	21.6	1983	64.7	4.9	$26,394
CT 901 BG 3 (Minority and Low-income)	33.4	37.7	0.4	7.7	32.6	84.2	28.0	1982	32.8	11.7	$13,627
CT 902 BG 2 (Minority and Low-income)	34.7	14.3	0.0	18.4	28.9	91.7	40.3	1973	63.3	0	$24,231

Source: 2020 ACS

EJ indices, available from USEPA's online EJScreen tool, displayed the levels of environmental pollutants present among the 22 EJ-qualifying block groups associated with the pipeline project. These indicators were examined in order to determine the risk of negative health impacts for residents living within these block groups. The 12 indicators that were examined included particulate matter, ozone, diesel particulate matter, air toxins resulting in cancer risk, respiratory HI, traffic proximity, lead paint, superfund proximity, RMP facilities, hazardous waste, underground storage tanks, and wastewater discharge. Indicator levels of 50 or greater were considered to have above average pollution levels (above the 50th percentile as compared to the state).

The results of this examination indicated that the majority of the EJ-qualifying census block groups in the area generally contained below average levels of pollution. Therefore, a small portion of these groups may be at risk for amplified and cumulative negative health impacts.

Two off the 22 total EJ-qualifying populations scored above average pollution levels and indicated six or more environmental indicators above the 50th percentile. These include one qualifying block group in Morgan County and one in Putnam County. Fourteen of EJ-qualifying census block groups had below-average pollution percentiles and indicated between one to five environmental indicators above the 50th percentile. These include two block groups from Fentress County, two from Jackson County, three from Morgan County, one from Overton County, three from Putnam County, two from Smith County, and one from Trousdale County. Six EJ-qualifying census block groups did not indicate the presence of any adverse environmental indicators with above average pollution levels. These include one block group from Fentress County, two from Jackson County, one from Smith County, and two from Trousdale County. The EJ-qualifying block groups and the environmental indicator percentiles are shown in Table 3.4-16. Those above average pollution levels (above the 50th percentile) are shown in emboldened text in that table. The highest percentile (80th) in the EJ-qualifying census block groups occurs in Morgan County CT 1103 BG 3 for the presence of a superfund site.

Table 3.4-16. Environmental Indicator Percentiles in Comparison with State in the Alternative A TVA Expanded Environmental Justice Study Area

Geography	% Particulate Matter	% Ozone	% Diesel Particulate Matter	% Cancer Risk	% Respiratory HI[1]	% Traffic Proximity	% Lead Paint	% Superfund Proximity	% RMP Facility[2]	% Hazardous Waste	% Underground Storage Tanks	% Wastewater Discharge
Tennessee	46	57	56	39	50	51	39	23	59	60	56	53
Fentress County												
CT 9653 BG 1 (Minority)	4	6	4	47	19	22	0	49	4	5	37	N/A
CT 9653 BG 2 (Low-income)	5	6	5	**55**	25	15	28	**54**	15	17	39	N/A
CT 9653 BG 3 (Minority)	6	7	5	**61**	28	38	0	**54**	17	13	50	10
Jackson County												
CT 9601 BG 2 (Minority and Low-income)	22	6	7	**53**	24	N/A	57	2	3	42	0	**55**
CT 9602 BG 1 (Minority)	12	2	10	33	11	N/A	46	0	9	27	29	26
CT 9602 BG 2 (Minority and Low-income)	22	4	20	**66**	32	N/A	**75**	0	13	42	0	**66**
CT 9603 BG 4 (Minority)	8	0	9	18	5	N/A	0	0	6	15	24	N/A
Morgan County												
CT 1101 BG 2 (Low-income)	6	10	18	**65**	32	0	**60**	**71**	6	5	32	N/A
CT 1102 BG 2 (Low-income)	5	13	18	**55**	25	N/A	**58**	**68**	2	8	0	16
CT 1103 BG 1 (Low-income)	10	24	14	**66**	32	**52**	**74**	**78**	15	12	**57**	**57**
CT 1103 BG 3 (Minority)	12	27	16	**71**	36	8	49	**80**	28	19	45	12
Overton County												
CT 9506 BG 2 (Low-income)	6	5	2	0	24	N/A	**56**	26	39	3	28	**55**
Putnam County												
CT 1 BG 1 (Low-income)	6	5	12	**52**	23	**55**	**61**	18	**51**	3	45	46
CT 1 BG 2 (Minority, Low-income and LEP)	10	8	21	**77**	41	15	**78**	40	**76**	10	**58**	**81**
CT 1 BG 4 (Minority)	7	6	15	**64**	30	**72**	**65**	38	**71**	14	**55**	**54**
CT 2.02 BG 2 (Low-income)	14	2	52	**66**	32	**70**	**77**	10	21	10	**55**	N/A
Smith County												
CT 9750 BG 1 (Minority)	15	8	11	26	8	N/A	48	4	6	35	18	29
CT 9750 BG 2 (Minority and Low-income)	32	16	25	**67**	33	N/A	48	4	6	35	18	29
CT 9750 BG 3 (Minority and Low-income)	31	16	24	**65**	31	N/A	**77**	4	2	27	31	N/A
Trousdale County												
CT 901 BG 1 (Low-income)	20	17	14	20	5	13	36	13	11	26	24	N/A
CT 901 BG 3 (Minority and Low-income)	46	40	36	**65**	32	N/A	**76**	15	23	**75**	31	**51**
CT 902 BG 2 (Minority and Low-income)	29	25	30	37	14	N/A	31	13	21	**50**	40	37

1. Air toxins resulting in cancer risk
2. Risk management plan (RMP) facilities

3.4.2.3 Alternative B

3.4.2.3.1 East Tennessee TVA Power Service Area

The Alternative B EJ Study Area consists of the East Tennessee region, as based on regions in the TVA PSA defined by the TVA Economic Development team (TVA 2022e; Figure 3.4-3). The Alternative B EJ Study Area is separated into 49 associated counties for evaluation purposes.

3.4.2.3.1.1 Minority Populations

Minority percentages and ethnicities for the Alternative B EJ Study Area are presented in Table 3.4-17. Depending on the county, these minority percentages are generally due to relatively high percentages of Latino, Black or African American, and Asian populations. One of the 49 counties identified for the East Tennessee TVA PSA under Alternative B was identified as a minority EJ population area, Hamilton County (emboldened text in Table 3.4-17), where the chance for amplified environmental and human health effects may be the greatest. The percentage of minority populations in Hamilton County are 10 percentage points or more above the Alternative B EJ Study Area average of 15.1 percent. The remaining 48 counties in the Alternative B EJ Study Area had lower minority percentages than the average minority percentage for Tennessee.

Table 3.4-17. Minority Percentages and Ethnicities for the Alternative B Environmental Justice Study Area

Geography	% Minority	% White[1]	% Black / African American	% Am. Indian /Alaska Native	% Asian	% Native Hawaiian / Pacific Islander	% Some Other Race	% Hispanic / Latino[2]
Alt B EJ Study Area	*15.1*	*84.9*	*5.3*	*0.4*	*1.2*	*0.1*	*2.5*	*5.2*
Tennessee	*27.8*	*92.7*	*1.2*	*0.6*	*2.0*	*0.1*	*3.6*	*6.9*
Anderson County	13.3	86.7	3.7	0.4	1.3	0.1	1.6	3.7
Bledsoe County	11.1	88.9	5.3	0.5	0.3	0.0	1.3	3.1
Blount County	11.8	88.2	2.7	0.4	1.0	0.0	1.8	4.2
Bradley County	17.6	82.4	4.8	0.4	1.1	0.1	3.6	7.8
Campbell County	5.1	94.9	0.3	0.2	0.2	0.0	0.6	1.3
Cannon County	9.1	90.9	1.4	0.2	0.3	0.0	1.0	2.7
Carter County	7.4	92.6	1.3	0.3	0.4	0.0	0.8	2.1
Claiborne County	5.8	94.2	1.0	0.2	0.5	0.0	0.7	1.5
Clay County	4.4	95.6	1.0	0.3	0.1	0.0	0.7	1.7
Cocke County	8.3	91.7	1.6	0.5	0.5	0.0	0.8	2.7
Cumberland County	7.0	93.0	0.5	0.3	0.6	0.0	1.3	3.2
DeKalb County	11.5	88.5	1.2	0.4	0.4	0.0	4.1	7.2
Fentress County	4.6	95.4	0.2	0.2	0.2	0.0	0.5	1.7
Grainger County	6.8	93.2	0.5	0.3	0.2	0.0	1.7	3.3
Greene County	9.0	91.0	2.0	0.3	0.4	0.0	1.5	3.6
Grundy County	6.3	93.7	0.3	0.2	0.4	0.0	0.5	1.3
Hamblen County	20.6	79.4	3.4	0.7	1.1	0.5	7.6	14.7
Hamilton County	**30.4**	69.6	17.6	0.5	2.2	0.0	3.4	7.4
Hancock County	4.1	95.9	0.5	0.4	0.0	0.0	0.4	0.6
Hawkins County	6.3	93.7	1.2	0.2	0.5	0.0	0.7	1.6
Jackson County	6.5	93.5	0.4	0.3	0.1	0.0	0.7	2.1
Jefferson County	9.4	90.6	1.5	0.3	0.5	0.0	2.3	4.4
Johnson County	9.6	90.4	4.1	0.3	0.2	0.1	1.4	2.9
Knox County	20.8	79.2	8.4	0.4	2.5	0.1	2.8	6.0
Loudon County	13.7	86.3	1.1	0.4	0.8	0.0	5.4	9.8
Macon County	9.6	90.4	0.5	0.4	0.2	0.0	3.6	6.7

Geography	% Minority	% White[1]	% Black / African American	% Am. Indian /Alaska Native	% Asian	% Native Hawaiian / Pacific Islander	% Some Other Race	% Hispanic / Latino[2]
Marion County	10.3	89.7	3.6	0.4	0.5	0.0	0.9	2.1
McMinn County	12.6	87.4	3.5	0.3	0.8	0.0	1.7	4.1
Meigs County	6.8	93.2	1.1	0.5	0.2	0.0	0.9	1.7
Monroe County	9.9	90.1	1.6	0.4	0.4	0.0	1.9	4.2
Morgan County	9.1	90.9	4.6	0.3	0.2	0.0	0.8	1.4
Overton County	5.2	94.8	0.4	0.3	0.3	0.0	0.5	1.5
Pickett County	3.4	96.6	0.2	0.2	0.3	0.0	0.8	1.7
Polk County	6.3	93.7	0.4	0.4	0.2	0.1	0.7	1.7
Putnam County	14.9	85.1	2.7	0.9	1.4	0.1	4.1	7.8
Rhea County	11.8	88.2	1.8	0.6	0.6	0.0	3.4	6.0
Roane County	9.3	90.7	2.4	0.4	0.6	0.0	0.8	1.9
Scott County	3.7	96.3	0.2	0.2	0.2	0.0	0.2	0.9
Sequatchie County	7.8	92.2	0.5	0.6	0.4	0.0	2.0	3.9
Sevier County	12.9	87.1	0.8	0.5	1.1	0.0	4.4	8.8
Smith County	8.6	91.4	1.8	0.5	0.4	0.0	1.0	2.6
Sullivan County	8.7	91.3	2.1	0.3	0.8	0.0	1.0	2.2
Trousdale County	23.5	76.5	16.5	0.3	0.2	0.0	1.8	3.2
Unicoi County	8.6	91.4	0.2	0.4	0.2	0.0	2.7	6.2
Union County	5.2	94.8	0.3	0.2	0.2	0.0	1.0	2.0
Van Buren County	4.5	95.5	0.4	0.1	0.2	0.0	0.2	1.3
Warren County	15.0	85.0	2.7	0.4	0.6	0.0	5.3	9.6
Washington County	14.3	85.7	4.2	0.3	1.5	0.0	2.1	4.6
White County	8.5	91.5	1.5	0.3	0.5	0.0	0.8	2.7

Source: 2020 ACS

[1] Race percentages are provided for those reporting a particular race alone or in combination. Just over 4 percent of the US population reported two or more races in the 2020 Census; thus, these percentages are closely representative of the whole ethnic group population.

[2] This group is calculated separately from the other ethnicities and may include overlap from the other categories, as the USCB does not consider Hispanic or Latino a "race."

Note: Emboldened census block groups represent identified EJ populations as compared with the overall Alternative B EJ Study Area percentage; the percentage is based on an average of the counties.

3.4.2.3.1.2 Low-Income Populations

Table 3.4-18 presents poverty ratios for the counties in the Alternative B EJ Study Area, along with those for the overall study area and state. This EJ study area has a higher poverty ratio than the state according to the 2020 ACS, and all but eight of the 49 counties had higher low-income percentages than the state as well. No county had a poverty percentage that was 20 percentage points or more above the study area average (36.0), but four counties (Clay, Hancock, Johnson, and Scott counties) had above 50 percent based on the 2020 ACS (Table 3.4-18).

Table 3.4-18. Poverty Rates for the Alternative B Environmental Justice Study Area

Geography	2021 SAIPE Poverty %	2020 ACS Poverty %, Households	2020 ACS Poverty Ratio, Two Times US Threshold
Alt B EJ Study Area			*36.0*
Tennessee	*13.7*	*14.4*	*33.8*
Anderson County	14.3	15.2	35.0
Bledsoe County	22.1	21.5	45.7
Blount County	9.7	10.5	27.8
Bradley County	11.7	15.0	34.6
Campbell County	19.9	20.7	43.3
Cannon County	14.9	16.5	33.7
Carter County	17.1	18.7	42.1
Claiborne County	17.1	24.3	47.3
Clay County	18.7	25.0	**50.8**
Cocke County	21.0	18.5	49.0
Cumberland County	14.9	13.1	39.0
DeKalb County	15.5	19.7	43.9
Fentress County	19.9	18.7	45.4
Grainger County	16.9	15.7	39.3
Greene County	12.5	17.0	41.9
Grundy County	20.5	19.3	40.9
Hamblen County	18.4	16.7	41.2
Hamilton County	12.6	12.0	30.0
Hancock County	27.6	30.4	**54.9**
Hawkins County	16.5	16.9	40.8
Jackson County	21.2	16.6	43.6
Jefferson County	14.7	11.8	34.9
Johnson County	23.7	20.5	**51.8**
Knox County	12.1	13.2	30.7
Loudon County	9.6	12.2	28.0
Macon County	15.9	17.6	40.3
Marion County	16.2	17.9	35.2
McMinn County	14.5	16.5	40.7
Meigs County	15.2	15.8	36.6
Monroe County	15.6	16.9	38.1
Morgan County	18.1	19.7	45.1
Overton County	14.9	20.3	44.4

Geography	2021 SAIPE Poverty %	2020 ACS Poverty %, Households	2020 ACS Poverty Ratio, Two Times US Threshold
Pickett County	14.2	21.1	38.6
Polk County	13.5	15.0	37.4
Putnam County	13.7	17.3	41.0
Rhea County	15.8	17.5	44.1
Roane County	13.1	15.0	31.6
Scott County	22.4	25.0	**53.9**
Sequatchie County	13.6	21.3	44.0
Sevier County	13.2	13.1	37.6
Smith County	11.7	13.9	36.6
Sullivan County	17.1	15.0	36.5
Trousdale County	17.8	11.0	27.6
Unicoi County	14.5	19.5	39.8
Union County	15.6	20.3	42.8
Van Buren County	17.0	13.7	40.9
Warren County	15.6	19.9	43.3
Washington County	14.3	15.7	35.3
White County	16.4	15.2	44.1

Source: 2021 SAIPE, 2020 ACS
Note: Emboldened geographies represent identified EJ populations.

3.4.2.3.1.3 Limited English Proficiency Populations

Table 3.4-19 presents county counts and percentages for the population aged five years and older who live in LEP households. Thirteen counties exceeded the study area-wide county average (518) for numbers of LEP households. Those counties include Anderson, Blount, Bradley, Hamblen, Hamilton, Jefferson, Knox, Loudon, Marion, Putnam, Sevier, Warren, and Washington. Fourteen counties also have an LEP household percentage that exceeded the overall study area percentage of 1.0 percent. Those counties include Bledsoe, Bradley, Clay, Grainger, Hamblen, Hamilton, Knox, Loudon, Macon, Putnam, Rhea, Sevier, Unicoi, and Warren. All counties in East Tennessee have fewer than five percent of their population aged five years and older living in LEP households.

Table 3.4-19. Limited English Proficiency for the Alternative B Environmental Justice Study Area

Geography	Population 5 Years and Over in Limited English Households	Percent of Population Age 5 Years and Over in Limited English Households
Alt B EJ Study Area	518	1.0
East Tennessee County		
Anderson County	594	0.8
Bledsoe County	266	1.8
Blount County	940	0.8
Bradley County	1,355	1.3
Campbell County	35	0.1
Cannon County	11	0.1
Carter County	200	0.4

Geography	Population 5 Years and Over in Limited English Households	Percent of Population Age 5 Years and Over in Limited English Households
Claiborne County	134	0.4
Clay County	82	1.1
Cocke County	117	0.3
Cumberland County	125	0.2
DeKalb County	148	0.8
Fentress County	21	0.1
Grainger County	250	1.1
Greene County	220	0.3
Grundy County	53	0.4
Hamblen County	1,329	2.2
Hamilton County	5,019	1.5
Hancock County	18	0.3
Hawkins County	180	0.3
Jackson County	67	0.6
Jefferson County	529	1.0
Johnson County	89	0.5
Knox County	5,364	1.2
Loudon County	883	1.7
Macon County	279	1.2
Marion County	37	0.1
McMinn County	423	0.8
Meigs County	43	0.4
Monroe County	141	0.3
Morgan County	64	0.3
Overton County	20	0.1
Pickett County	0	0.0
Polk County	39	0.2
Putnam County	1,192	1.6
Rhea County	448	1.4
Roane County	121	0.2
Scott County	29	0.1
Sequatchie County	37	0.3
Sevier County	1,864	2.0
Smith County	72	0.4
Sullivan County	421	0.3
Trousdale County	44	0.4
Unicoi County	258	1.5
Union County	14	0.1
Van Buren County	15	0.3
Warren County	589	1.5
Washington County	1,197	1.0
White County	18	0.1

Source: 2020 ACS
*Study Area is an average of the counties.

3.4.3 Environmental Consequences

This section provides a summary of the EJ effects analysis for the No Action Alternative and a discussion of the potential effects to EJ populations based on the effects to other resource areas. Resource area-specific EJ-related effects are discussed in more detail in the EJ Consideration sections in the subsequent resource area sections of Chapter 3.

3.4.3.1 The No Action Alternative

TVA would continue to operate and maintain the nine KIF units. Employment at the Kingston Reservation would continue to be an option in the labor market area, and contracts associated with the Kingston Reservation operations and maintenance and indirect and induced economic activities would continue to support the regional economy. However, for the existing KIF units to remain operational, repairs and maintenance would be necessary to maintain reliability and to meet requirements in future environmental regulations. As a result, there would be short-term beneficial economic effects from these activities, including a temporary, local and/or regional increase in employment and income and the purchase of materials, equipment, and services, which could positively affect EJ populations.

These maintenance costs, along with subsequent environmental compliance costs to meet requirements under new regulations, may also have a minor adverse effect on ratepayers. Future rate increases to recoup these costs could affect low-income populations more than other populations; thus, EJ populations may experience increased economic effects as compared to non-EJ populations. Low-income populations also have limited ability to participate in energy efficiency programs that could reduce their future power bills, as some costs must be incurred by those participating in energy efficiency programs. However, TVA works with local power companies to implement programs benefiting low-income homeowners and renters, which may partially offset impacts to EJ populations associated with rate increases (see the TVA IRP EIS for more details).

3.4.3.2 Retirement, Decommissioning, Decontamination, and Deconstruction of Kingston Reservation Plant (D4)

Under the Action Alternatives, the coal facilities at the Kingston Reservation would be retired by the end of 2027 and would transition to the D4 process detailed in Table 2.1-1. Routine plant deliveries would also be discontinued. All previously approved CCR projects would continue to be implemented.

3.4.3.2.1 Environmental Justice Considerations

There would be short-term beneficial economic effects to human populations, including EJ populations, from Kingston coal unit retirement and D4 activities associated with all Action Alternatives, including a temporary increase in employment and income and the purchase of materials, equipment, and services. This increase would be local or regional, depending on where the workers, goods, and services were obtained, and could positively affect EJ populations. Beneficial effects may also be experienced by EJ and other populations from improved air and water quality in response to ceasing of Kingston coal operations. Beneficial water quality effects could have positive effects on aquatic life, including potential subsistence resources for EJ populations, which could in turn have slight beneficial effects to EJ and other populations utilizing these resources.

There could also be minor adverse effects to human populations, including EJ populations, from KIF retirement and D4 activities associated with all Action Alternatives. Due to the loss of direct and indirect employment associated with Kingston, competition for employment in other fields in the Kingston labor market area, such as manufacturing, educational services, health care, and construction, may increase. Such trends could lead EJ populations and other populations to compete for employment and, potentially, relocate for work or follow recent depopulation trends and permanently relocate to different locations in Tennessee or beyond. These changes may affect familial and community relations among EJ and other populations in the Kingston labor market area. Given their particular economic and cultural vulnerabilities, these effects may be amplified for EJ populations.

Waste-related effects from KIF D4 activities may occur at selected waste facilities in the area. These facilities, which are located off the TVA-owned reservation, have not yet been identified and have the potential to be located in EJ areas; therefore, amplified effects to EJ populations from disposing of KIF-related wastes at these facilities are possible.

Transportation effects associated with KIF D4 activities would be concentrated on public roads within a relatively small area around the TVA-owned Kingston Reservation (where EJ populations are not located) and along the haul routes to waste facilities, which have not yet been identified. Haul routes could be in areas of EJ populations. Therefore, there would be a minor effect related to increased traffic and driver safety. While they would be minimized as much as feasible, these effects may be amplified for EJ populations depending on the location of these elevated traffic effects. Effects to EJ populations resulting from Kingston retirement-related traffic on haul routes to waste facilities is not yet known, as these facilities have not been identified.

TVA has been conducting outreach to EJ populations in the course of this environmental review. TVA has provided project information via email, fact sheets, and in-person presentations and will continue to do so during planned engagements and events. TVA also plans to hold multiple public information meetings for the release of the Kingston draft EIS, which would include a virtual public meeting, followed by a general in-person public meeting to be held near the Kingston Reservation, and a third in-person public meeting to be held at a public location located in an EJ-qualifying population near the Kingston Reservation. Printed copies of the draft EIS will also be placed at local libraries to facilitate access to the draft EIS during the public review period.

3.4.3.3 Alternative A

3.4.3.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Under Alternative A, the Kingston Reservation coal facilities would be retired and demolished, as described in Section 2.1.3.2. The existing switchyard would be maintained for use in future operations associated with the proposed CC/Aero CT Plant. Employment at the plant would be reduced. All previously studied CCR projects would continue to be implemented. The proposed CC/Aero CT Plant would be constructed on the Kingston Reservation in Roane County.

There would be beneficial effects to human populations, including EJ populations, from the CC/Aero CT Plant. Construction of the CC/Aero Plant would temporarily increase employment in the Kingston labor market area and have a minor beneficial effect to area EJ populations. Some slight beneficial effects to human populations, including EJ populations, may also result from displacement of wildlife from the immediate CC/Aero Plant site to surrounding areas, including potentially to hunting areas in the vicinity.

There could also be minor adverse effects to human populations, including EJ populations, from the CC/Aero Plant. Construction of the CC/Aero Plant may cause negative effects to current and prospective renters and guests of rental homes and establishments through reduced rental inventory and/or increased prices with the influx of nonresident laborers. Since renters are prevalent throughout the Kingston labor market area, this has the potential to result in amplified effects for EJ-qualifying low-income populations, especially in EJ-qualifying census block groups.

3.4.3.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located within the Kingston Reservation. Therefore, the environmental consequences for environmental justice are as described in Section 3.4.2.3.1.

3.4.3.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW battery facility and related transmission corridor would be located within the Kingston Reservation. Therefore, the environmental consequences for environmental justice are as described in Section 3.4.2.3.1.

3.4.3.3.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission connections to the proposed CC/Aero Plant. Therefore, the environmental consequences for on-site transmission upgrades on environmental justice populations are the same as those described in Section 3.4.2.2.

3.4.3.3.5 Off-site Transmission Upgrades

Off-site transmission systems for Alternative A would potentially need to be upgraded if the proposed CC/Aero CT Plant is constructed. Additionally, new temporary or permanent access roads to support upgrading the existing transmission lines will be needed. The proposed transmission upgrades would occur in two off-site locations: the Western Transmission Corridor (L5383) within Cumberland County, and the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) within Anderson and Roane counties. A one-mile radius was used around the existing transmission line ROWs and access roads to define the Transmission Corridor EJ Study Area. These two transmission corridors include all or portions of 34 census block groups with resident populations.

While not anticipated to be significant based on a review of EJ effects, potential impacts would include development of new temporary or permanent access roads and/or modification of existing access roads. Minor ground disturbance would be expected and where ground disturbance occurs, areas would be revegetated using native plant species (TVA 2020b). Areas such as pasture, agricultural fields, or lawns would be returned to their pre-disturbance condition. Construction activity would likely cause temporary and minor disruptions in these areas. Because these effects may occur in areas with EJ populations, the effects may be amplified depending on the exact location of the access roads due to the greater susceptibility of those populations.

3.4.3.3.6 Construction and Operations of Natural Gas Pipeline

The proposed CC/Aero CT Plant would require construction of approximately 122 miles of new natural gas pipeline (up to 30-inch-diameter) and associated gas system infrastructure in, Fentress, Jackson, Morgan, Overton, Putnam, Roane, Smith, and Trousdale counties. The pipeline would be built largely within or adjacent to existing pipeline ROW. The TVA Expanded EJ Study Area also included Cumberland and Sumner counties due to proximity of the project.

The route of the proposed pipeline has been placed primarily along the right of way of an existing pipeline, thereby minimizing construction activities on residential land. Based on tabular data provided in ETNG's Tennessee's draft Resource Report 8 Land Use, Recreation, and Aesthetics, (ETNG 2022i),196 residences are located within 50 feet of construction activities, and of those, approximately two-thirds are within 25 feet. The report states:

> In locations where residences are within 25 feet of the construction work area, site-specific residential plans would be developed which show the residence in relation to the new pipeline, the edge of the construction work area, the edge of the new permanent ROW; and other nearby residences, structures, roads, wetlands, or waterbodies. Site-specific mitigation would also be shown on the residential construction plans.

ETNG further states:

> Effects during construction on existing residences and buildings adjacent to the [pipeline] include noise and dust from construction equipment and temporary visual effects from removal of vegetation and excavation of soils. Disturbance postconstruction would be minimal and related to maintenance activities including periodic mowing and inspection.

The ETNG EJ Study Area crosses census block groups that include minority, low-income and LEP populations. Because these census block groups are considered EJ populations, ETNG "will continue to work closely with government and community leaders to address concerns of the community" (ETNG 2022f). ETNG outreach among stakeholders has been extensive and is ongoing, as demonstrated in their General Project Description Report 1 (ETNG 2022b):

> In June 2021, [ETNG] began engaging Project stakeholders to share information about the proposed Project; to seek input regarding route alternatives, construction constraints, or methods; to help identify Environmental Justice communities; and to ensure the public has opportunities to provide comments about specific issues and concerns. [ETNG] has made significant efforts to inform the public, particularly landowners and public officials, about the proposed Project. The objective in implementing a comprehensive stakeholder outreach strategy has been to identify and potentially resolve issues raised by stakeholders in a timely fashion.
>
> In accordance with the guidelines adopted by FERC, [ETNG] has encouraged landowners, municipal, county, state and Federal government officials, Native American tribes, and environmental groups and other stakeholders to share their concerns with [ETNG] as well as FERC, and to provide input on the most appropriate locations for the compressor station, pipeline, and related facilities associated with the Project. [ETNG] has attempted to address concerns raised by various stakeholders and where it has not been possible to modify the Project facilities in the manner requested, to identify clearly the basis for that conclusion.

ETNG has conducted a total of eight open houses, consisting of two sessions of open houses (one in 2021 and one in 2022) conducted within each of the following four counties: Morgan, Putnam, Jackson, and Trousdale (ETNG 2022b). A virtual open house was also created to provide information about the project and to provide the same informational pieces as were available at the in-person meetings. ETNG Resource Report 5 Socioeconomics (ETNG 2022f) states:

> As discussed in draft Resource Report 1, public outreach efforts for the Project have included intentional, targeted community meetings and presentations to county commissions, and individual briefings with public officials and community leaders. [ETNG] has and will continue working to meaningfully engage EJ justice communities through multiple mechanisms, including:
>
> - Creating and sharing accessible, accurate, and interactive communication materials between [ETNG] and the public.
> - Sharing Project materials and information in non-traditional outlets such as grocery stores, convenience stores, churches, and other easily accessible locations where the community may frequent.
> - Providing accessible methods that facilitate engagement with the Project team including in-person meetings, a virtual open house, toll-free landowner phone number, and emails of Project materials.
> - Hosting meetings during times and at locations that are convenient for EJ communities to explain the Project and receive their input, feedback, and concerns.
> - Incorporating time in the Project schedule to follow up with the community, provide consistent updates, and build partnerships for implementation.
> - Communicating anticipated Project milestones, including the process for regulatory reviews and decisions, to identified communities.
> - Communicating through media and other publications that are accessible to EJ communities.
> - Hosting meetings with the public, elected officials, public opinion leaders, and organizations to explain the Project and receive their input, feedback, and concerns.
> - Supporting economic development and job training in the region.
>
> [ETNG] is also evaluating methods to further facilitate meaningful engagement with identified EJ communities throughout the certificating, permitting, construction, and restoration phases of the Project.

ETNG is currently assessing impacts to EJ communities. As stated in draft Resource Report 5 Socioeconomics (ETNG 2022f):

> Environmental impacts associated with the construction and operation of the Project are still being evaluated. [ETNG] will evaluate impacts specific to identified EJ communities associated with air quality, noise, traffic, water quality, visual aesthetics, and land use. Further discussion on these topics will be provided in the final Resource Report 5.

TVA's analysis draws upon ETNG's EJ analysis and provides TVA's independent assessment of potential impacts associated with construction and operation of the natural gas pipeline. TVA's analysis concluded that there would be beneficial effects to human populations, including EJ populations, from the natural gas pipeline due to temporary increases in employment in the area. ETNG also found that even if a larger percentage of non-local workers than expected occurred, the number of available units in most of the pipeline area and surrounding communities is sufficient to meet the temporary demand for non-local worker housing, and that for the one relatively small county where that is not the case (Trousdale County), non-local workers could commute from the surrounding area. ETNG concludes that the pipeline project would have a minor short-term positive effect on the area's rental industry, and that the temporary demand for housing is unlikely to displace permanent residents or adversely affect housing prices.

Pipeline construction would have transportation effects that would be temporary, minor, and concentrated on public roads within a relatively small area around the ETNG Construction ROW, where EJ populations are intermixed with non-EJ populations. These effects would be due to road crossings, equipment and material deliveries, and commuting by construction workers. ETNG states:

> Construction of the [pipeline] across most roads will be accomplished either by boring under the roadbed or by open-cut methods. To minimize traffic delays at open-cut road crossings, [ETNG] will establish detours before and during construction or keep at least one traffic lane of the road open, as practicable. Construction will be scheduled for work within roadways and specific crossings to avoid commuter traffic and schedules for school buses and local transit buses to the greatest extent practical. Appropriate traffic management and signage will be set up and necessary safety measures will be developed in compliance with applicable permits for work in the public roadway. Roadway opening permits will be obtained from applicable state and county agencies.
>
> The movement of construction equipment and materials and the daily commuting of employees to and from the construction work areas may also slightly increase traffic volumes in the [pipeline]analysis area. Traffic congestion could occur if each construction worker commuting to work used a personal vehicle to travel to the work site and if most of this travel took place during peak traffic hours. The total traffic volume from construction worker commutes and equipment/material deliveries is anticipated to be small relative to existing traffic volumes on most roadways used to access [pipeline] facilities. Some local roads may experience temporary increases in traffic. To minimize traffic congestion, [ETNG] will encourage construction workers to share rides. Contractors may also provide buses to move workers from common parking areas to the construction work areas.
>
> [ETNG] will [also] prepare a Traffic Management Plan ….

TVA has independently reviewed and concurs with the environmental justice-related findings in Resource Report 5 (ETNG 2022f).

While transportation effects would be minimized to the extent practicable, these effects may be amplified for EJ populations depending on the location of the traffic effects, within a mix of EJ qualifying and non-EJ populations. ETNG plans to develop a traffic management plan that would minimize impacts.

Safety-related effects due to pipeline construction and operations activities may also be experienced by EJ populations, and some of this would be heightened near traffic construction areas. Waste-related effects occurring as a result of pipeline construction activities, while minor, would be outside of TVA-owned reservations or at selected waste facilities in the area. The off-site waste facilities have the potential to be located in EJ areas based on the history of the siting of these types of facilities (and the general assumptions that are made in evaluating EJ effects) (United States Sentencing Commission 2003). While utilities-related effects may be experienced by EJ populations potentially affected during construction and operations for maintenance activities that may involve excavation and repair, these minimal to minor effects may be amplified for EJ populations due to their cultural and economic vulnerabilities.

Pipeline construction activities would also increase the noise effects on local populations, and some of the activities and components that produce higher noise levels may be located in EJ areas. While these effects would be minimized or mitigated as much as feasible, given their location in EJ areas, the noise effects associated with Alternative A may be amplified for EJ populations.

Effects to prime farmland resources due to construction of the natural gas pipeline lateral may also have temporary, minor adverse effects on populations that currently farm the corridor where the pipeline would be constructed. Such effects would occur where farming populations and prime farmland soils co-exist. These effects may be amplified for farming EJ populations in the ETNG EJ Study Area. Long-term effects to land use within the ETNG Construction ROW could in turn adversely affect EJ populations due to their proximity to the corridor.

With the location of EJ populations throughout the TVA Expanded EJ Study Area, effects to aquatic life resulting from construction activities are likely to effect EJ populations. If indirect effects to aquatic life occur, these could in turn affect EJ populations that currently fish the affected waters. While fishing activities likely occur among both EJ and non-EJ populations, the effects could be amplified for low-income and minority populations due to the likelihood of their reliance on these resources for long-term cultural practices or for sustenance.

While they would be minor, temporary, minimized or mitigated through CWA 404, 401, and 402 (NPDES) permitting, effects to streams due to the pipeline may be amplified for EJ populations due to the prevalence of EJ populations throughout the EJ Study Area. Further, these populations may be more vulnerable to the effects from temporary impact activities regulated under CWA 401 or 404. While certain actions would be taken to minimize risks, effects to floodplains resulting from the construction of the natural gas pipeline may impact human populations. These effects may be amplified for EJ populations since these populations may be more vulnerable to temporary effects that cause minor flood loss or effects to human safety, health, and welfare.

As much as feasible, the pipeline would be located parallel and adjacent to existing natural gas pipeline ROW, which would generally minimize effects to vegetation and other resource areas. The greatest impact of the pipeline on vegetation would be from the clearing of forested areas. In areas that are currently used by EJ populations, potentially including forested areas, there is potential for amplified effects to EJ populations, particularly for those that currently utilize wildlife from these areas. While vegetation displacement could result in more wildlife in nearby areas, the benefits to human populations, including EJ populations, would be negligible.

Lastly, effects to air quality due to the pipeline would be short-term, minor, and generally limited to the ETNG Construction ROW, and fugitive emission releases of gases are expected to be minor compared with existing conditions. The immediate pipeline corridor vicinity, where fugitive dust, particulate, and natural gas emissions have some but low likelihood of occurring, has varying percentages of both EJ and non-EJ populations. Emissions are expected to be minor and widely distributed, though the effects may be amplified for EJ populations already experiencing cumulative air quality effects.

3.4.3.3.7 Summary of Alternative A

TVA Actions

Beneficial and adverse effects to EJ populations resulting from the effects of TVA actions under Alternative A to other resource areas are summarized below in Table 3.4-20. Effects to resource areas not discussed in the sections below would be minimized or mitigated, or otherwise temporary and minor and generally limited to the immediate disturbance of Alternative A components. Where effects extend beyond the identified Alternative A component footprints, these effects would likewise be minor to mitigated and are not anticipated to be amplified for EJ populations due to specific regulatory requirements, such as stakeholder involvement in cultural resources decision-making or the protected status of threatened and endangered species. While these minor effects would likely be experienced by both EJ and non-EJ communities, those effects may be amplified for EJ populations due to cumulative environmental impacts.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Beneficial and adverse effects to EJ populations resulting from the effects of ETNG actions under Alternative A to other resource areas are summarized below in Table 3.4-20. Effects to resource areas not discussed in the sections below would be temporary and minor to minimized or mitigated and generally limited to the immediate disturbance within the within the ETNG Construction ROW. Where effects go outside of these footprints, these would likewise be minimized or mitigated, or otherwise temporary and minor and are not anticipated to be amplified for EJ populations due to specific regulatory requirements or steps and agreements implemented through the regulatory and consultation processes. For example, these steps may include stakeholder involvement in cultural resources decision-making, development of a MOU with SHPO identifying minimization and mitigation steps to be taken on unavoidable cultural resource impacts, or through additional avoidance and minimization efforts identified for protected species during consultation with USFWS. While these minor effects would likely be experienced by both EJ and non-EJ communities, those effects may be amplified for EJ populations due to cumulative environmental impacts.

Table 3.4-20. Summary of Environmental Justice Effects by Alternative and Resource Area

Resource Area	Retirement and Demolition of KIF Plant (All Action Alternatives)	Alternative A	Alternative B
Physical Characteristics	Due to the small size of the subsurface disturbances and existing industrial development of the site, only minor direct effects to potential subsurface geological resources are anticipated. No adverse effects to geology, soils, or prime farmland are anticipated. Therefore, no effects are anticipated on EJ populations.	Effects to physical resources as a result of the CC/Aero CT Plant would be minor and limited to the Kingston Reservation, where no populations are present. Therefore, no effects are anticipated to EJ populations. Minor geologic hazards, such as those presented by karst features, are distributed across the ETNG Construction ROW and off-site transmission corridors, would be minimized as much as feasible, and are not anticipated to pose a particular risk to EJ populations. Runoff and erosion soil effects may temporarily increase due to pipeline construction activities, but these effects would be temporary and mitigated through BMPs. Effects to soils may be amplified for EJ populations. Effects to prime farmland resources as a result of construction of the natural gas pipeline and transmission line may have temporary, minor adverse effects on populations that currently farm the corridor where these project components would be located. These effects would likely be amplified for farming EJ populations if these communities farm as their livelihood. Effects to floodplains due to construction of the natural gas pipeline may have temporary, with minor to moderate effects on human populations where the floodplains and EJ populations intersect. Low-income and minority populations may be more vulnerable to temporary effects that cause minor flood loss or effects to human safety, health, and welfare.	Grading and clearing activities associated with the construction of the solar and battery storage facilities would cause minor, localized increases in erosion and sedimentation, resulting in minor effects to soils. These effects would be temporary and mitigated through BMPs. Potential effects on EJ populations would be verified for individual solar and storage facilities. East Central Tennessee is located over limestone bedrock that is susceptible to erosion and the creation of sinkholes. Based on the finalized location of the solar and storage facilities and associated transmission lines, sinkholes could be a minor to moderate risk. These results may be amplified for EJ population depending on the location of the facilities. Temporary or permanent loss of prime farmland resources as a result of construction of the solar facilities and the transmission line activities, may have temporary effects on populations that currently farm the sites where the facilities would be constructed. The potential effects on EJ populations would be verified for individual solar and storage facilities. Floodplains effects on EJ populations are anticipated to be minor and minimized; however, whether these effects may be amplified for EJ populations would be verified through reviews for individual solar and storage facilities.
Water Resources	Effects to groundwater that would occur as a result of the Kingston coal facility retirement, D4 activities, and CRR management would be minor and minimized through BMPs. Minor, adverse effects to EJ populations could occur if groundwater effects migrate off-site. Effects to surface water due to Kingston retirement and D4 activities would be minor and minimized and largely limited to the Kingston Reservation, where no populations are present, meaning that amplified EJ effects would not occur. Long term, beneficial effects from improved water quality in response to ceasing Kingston operations are anticipated, benefiting human populations in the vicinity.	Effects to groundwater as a result of the CC/Aero CT Plant would be minimized with implementation of BMPs and generally limited to the TVA-owned Kingston Reservation, where no populations are present. Therefore, effects to EJ populations are not anticipated. Effects to groundwater due to the pipeline and transmission line upgrades would be minimized or mitigated through BMPs. Construction activities would take place in accordance with FERC's Plan to minimize potential impacts to groundwater in the vicinity of the pipeline. Prior to construction, pre- and post-construction monitoring of water quality and yield for all wells within the appropriate buffer zones would take place with permission from landowners. As such, no effects on EJ populations are anticipated. Effects to surface water due to the CC/Aero CT Plant would be minor, minimized, or mitigated through CWA 404, 401, and 402 (NPDES) permitting and is not anticipated to result in amplified effects towards EJ populations. Minor beneficial effects would occur from the proposed reduction in cooling water withdrawals after retirement of the existing KIF units. Effects to surface water due to the pipeline and transmission line upgrades may result in amplified effects towards EJ populations which tend to be more vulnerable to the effects from temporary 404/401 permitting impacts/activities. Cumulative effects would include decreased water quality and aquatic habitat due to accidental hazardous spills or in-stream sedimentation caused by erosion of disturbed soils. These cumulative effects may result in amplified effects to EJ populations using these resources for sustenance.	Effects to groundwater would be minor, minimized, or mitigated through BMPs, though amplified effects to EJ populations are possible. The potential effects on EJ populations would be verified for individual solar and storage facilities. Effects to surface water would be minor, minimized, or mitigated through CWA 404, 401, and 402 (NPDES) permitting and largely limited to project sites and transmission corridors, though amplified effects to EJ populations are possible. The potential effects on EJ populations would be verified for individual solar and storage facilities.

Resource Area	Retirement and Demolition of KIF Plant (All Action Alternatives)	Alternative A	Alternative B
Air Quality and GHGs	Decontamination and deconstruction activities are expected to have short-term, localized, and minor effects on air quality and no appreciable direct or indirect effect on regional climate change. Any impacts would generally be limited to the Kingston Reservation where no EJ populations reside. Minor positive effects to human populations near the Kingston Reservation may occur due to beneficial long-term changes to local air quality from Kingston retirement.	Effects resulting from the CC/Aero CT Plant would cause short-term, localized, and minor effects to air quality in comparison to existing conditions. The immediate Kingston Reservation vicinity, where fugitive dust and particulate emissions have some likelihood of becoming airborne, would be minimized through permitting and BMPs. This area does not contain residential populations so it is unlikely that EJ populations would be affected by fugitive dust emissions and would not experience amplified effects. Short-term, regional, and minor effects are anticipated from GHG emissions on climate change Effects to air quality due to the pipeline would be short-term, minor and generally limited to the ETNG Construction ROW, and fugitive emission releases of gases are expected to be minor compared to existing conditions. The immediate pipeline corridor vicinity, where fugitive dust, particulate, and natural gas emissions have some but low likelihood of occurring, has varying percentages of both EJ and non-EJ populations. Emissions are expected to be minor and widely distributed, though the effects may be amplified for EJ populations already experiencing cumulative air quality effects. Impacts to climate change are anticipated to be minor, regional, and short-term.	Effects to air quality are anticipated to be minor to negligible or mitigated and limited to the immediate project sites and transmission corridors. The main effects of consideration for EJ populations would likely result from construction activities, operations and can be mitigated by BMPs. Solar and storage facility construction activities are expected to have short-term, localized, and moderate effects on air quality. The solar and storage facility operations are expected to have long-term, moderate, beneficial effects on air quality and on regional climate change. Full EJ considerations would be made for each solar and storage facility once the location of these facilities has been determined.
Biological Environment	Effects to vegetation and wildlife would be minor and limited to the Kingston Reservation, where no populations are present. Thus, no adverse effects would occur to EJ populations. While minor displacement of wildlife could result in more wildlife in nearby recreation areas and wildlife refuges, the benefits to human populations would be negligible. Effects to aquatic life, including potential subsistence resources for EJ populations, due to Kingston retirement and D4 activities would be minor to minimized or mitigated especially if offshore fishing locations remain open even upon the closure of Kingston. There may be slight beneficial effects to human populations utilizing these resources, while those utilizing aquatic life that depend on the heated effluent may have slight negative effects. These minor to minimal adverse effects on EJ populations would be unlikely due to due to the absence of EJ populations in the area. Most natural areas within the Kingston boundary consist of herbaceous vegetation dominated by non-native plant species that possesses little conservation value and have no potential to support state or federally listed plant species or unique plant communities. Therefore, effects resulting from D4 activities are not anticipated to have amplified human health or environmental effects on EJ populations.	Effects to vegetation due to the CC/Aero CT Plant would be minor and limited to the Kingston Reservation boundaries, where no populations are settled. Thus, no effects would occur to EJ populations. To the extent feasible, the pipeline would be located adjacent to an existing pipeline corridor, which would generally minimize effects. The greatest impact of the pipeline on vegetation construction would be from the clearing of forested areas. In areas that are currently used by EJ populations, including the forested areas there may be amplified effects on EJ populations who use resources from the forest for subsistence. Effects to wildlife that would result from the CC/Aero CT Plant would have negligible beneficial effects to human populations using these resources in locations off the Kingston Reservation due to potential displacement of wildlife from the CC/Aero CT Plant site. Effects to wildlife from the proposed natural gas pipeline would be minor and outside of TVA-owned reservations. To the extent feasible, the natural gas pipeline would generally be located adjacent to an existing pipeline corridor which would minimize effects to wildlife. However, habitats would be altered, and wildlife would be displaced temporarily and permanently from portions of the pipeline. These effects would occur in areas where EJ populations are present and could result in amplified effects in instances where wildlife is utilized for sustenance. While displacement could result in more wildlife in nearby areas, the benefits to human populations are anticipated to be negligible. Effects to aquatic life due to the CC/Aero CT Plant would be minor and permanent by reducing fish mortality from impingement and entrainment at the intake of the existing KIF plant. Though there are no human populations within the Kingston Reservation, improved habitat for fish species would have wide-spread beneficial effects to population numbers. Effects to aquatic life as a result of the natural gas pipeline may have amplified effects on EJ populations in areas where construction activities occur. If indirect effects to aquatic life occur, EJ populations that currently fish the affected waters would experience amplified effects. Effects to vegetation, wildlife, and aquatic life in conjunction to transmission line upgrades would be temporary and minor. Effects to threatened and endangered species that would occur as a result of the proposed CC/Aero CT Plant, transmission line activities, and natural gas pipeline are not anticipated to have amplified human health or environmental effects on EJ populations within the TVA EJ Study Area or TVA Expanded EJ Study Area, as these species are unlikely to be utilized by EJ populations.	Impacts to EJ populations associated with vegetation effects would primarily be associated with the direct removal of forested areas. These effects would be minor and generally limited to the immediate project sites and transmission corridors. This may result in amplified effects to EJ populations in the surrounding areas. The addition of wildlife into surrounding suitable habitat may be beneficial to EJ and other populations that utilize those habitats for subsistence and other purposes. Effects to threatened and endangered species would be minimized or mitigated as required due to the protected status of these species and would not be expected to lead to amplified effects on EJ populations. While not anticipated to be significant, these effects on EJ populations would be more fully evaluated for individual solar and storage facilities.

Resource Area	Retirement and Demolition of KIF Plant (All Action Alternatives)	Alternative A	Alternative B
Natural Areas, Parks, and Recreation	Dispersed recreation use patterns, especially bank fishing, may be temporarily limited or not allowed on some portions of the Kingston Reservation. There would be no project related impacts to natural areas, parks, and recreation areas in the vicinity of the Kingston Reservation. Consequently, there would be no impacts to EJ populations.	Effects from the construction and operation of the CC/Aero CT Plant would not result in any impact to natural area, parks, and recreation because these resources do not exist within the Kingston Reservation. The construction of the off-site natural gas pipeline and upgrades to the transmission line are likely to result in minor, temporary effects on EJ populations in areas where natural areas, parks, and recreation sites are closed due to construction. These effects may be amplified among EJ populations in instances where these populations rely on hunting and fishing to provide additional sustenance.	Because the exact project locations for solar and/or storage projects are not known at this time, individual facilities would be sited to avoid effects to natural areas, parks, and other developed recreation areas to the extent feasible.
Land Use	Land use effects would be limited to the Kingston Reservation boundary; therefore, there would be no effects on EJ populations.	Effects from the construction and operation of the CC/Aero CT Plant would not result in any impact to land use because these human populations do not live within the Kingston Reservation area. Long-term effects to land use associated with the Permanent ROW would be unlikely to result in amplified effects to EJ populations, because land could return to its previous use for livelihood or sustenance after the completion of pipeline construction activities.	Potential for moderate adverse effects to land use through conversion of agricultural land, particularly cropland, to developed land with potential for later restoration of agricultural use. Effects to EJ populations may occur and, in future analyses, some solar facilities may be found to have amplified effects on EJ populations. Temporary to permanent moderate direct effects may occur from loss of on-site prime farmland soils depending on location of battery storage facilities. Effects from prime farmland and forested area impacts on EJ populations are evaluated in the Geology, Soils, and Prime Farmland and Vegetation sections.
Transportation	Transportation effects would be temporary, moderate, and concentrated on public roads within a relatively small area around the Kingston Reservation, especially on Highway 40, Swan Pond Road, and Steam Plant Road. EJ populations are not located in this vicinity so there would be no amplified effects for these populations. There may be minor effects related to increased traffic and driver safety though these would also be minimized as much as feasible.	Transportation effects would be temporary, minor, and concentrated on public roads within a relatively small area around the Kingston Reservation (where EJ populations are not present) and the ETNG Construction ROW. Given that the more elevated traffic activities associated with Alternative A would be in EJ areas, these moderate, temporary effects may become amplified for those EJ populations.	Transportation effects would be temporary, minor, and concentrated on public roads within a relatively small area around the project sites and transmission line activities. Whether these effects would be amplified for EJ populations would be evaluated for individual solar and storage facilities
Utilities	Short-term outages would be minor and would occur in the immediate vicinity of the Kingston Reservation, where EJ populations are not present.	CC/Aero CT Plant-related effects to utilities would be minor, with effects primarily occurring on the Kingston Reservation, where no residential populations exist. While utilities-related effects may be experienced by EJ populations in the ETNG Construction ROW, effects are anticipated to be limited to construction, except for maintenance activities that may involve excavation and repair. The effects to EJ populations may result in amplified effects to these communities.	Effects to utilities would be minor, with some service interruptions possible, and minimized or mitigated and would be anticipated to be the same for all human populations utilizing the affected utility resources. Whether or not these effects would be amplified for EJ populations would be verified through individual reviews for solar and storage facilities.
Cultural Resources	Cultural resources-related effects associated with Kingston coal facility retirement and D4 activities would be avoided, minimized, or mitigated in consultation with Native American tribes and interested stakeholders, which could include other EJ populations. Therefore, they are not anticipated to result in adverse or amplified effects on EJ populations.	Cultural resources-related effects associated with Kingston coal facility retirement and D4 activities would be avoided, minimized, or mitigated in consultation with Native American tribes and interested stakeholders, which could include other EJ populations. Therefore, they are not anticipated to result in adverse or amplified effects on EJ populations.	Cultural resources-related effects associated with Kingston coal facility retirement and D4 activities would be avoided, minimized, or mitigated in consultation with Native American tribes and interested stakeholders, which could include other EJ populations. Therefore, they are not anticipated to result in adverse or amplified effects on EJ populations.
Solid and Hazardous Waste	Demolition and construction wastes would be disposed off-site as required by state and federal regulations. Though off-site waste facilities have the potential to be located in EJ areas, (per the history of the siting of these type facilities and the general assumptions that are made in evaluating EJ effects), EJ populations may experience amplified effects as compared to non-EJ populations depending on the location of waste facilities.	Waste-related effects resulting from CC/Aero CT Plant construction would be temporary and mitigated, with most effects occurring on or near the Kingston Reservation. EJ populations are not present in this area so amplified effects would not occur to these populations. Waste-related effects due to the pipeline activities, while still minor, would be outside of TVA-owned reservations or at selected waste facilities in the area. As the off-site facilities have the potential to be located in EJ areas, per the history of the siting of these type facilities, EJ populations may experience amplified effects.	Waste-related effects would be temporary, mitigated, and generally limited to the immediate project sites on which construction would occur and the transmission corridors. However, to determine amplified effects for a given solar facility, EJ effects analyses would occur for each solar facility and transmission line activity.

Resource Area	Retirement and Demolition of KIF Plant (All Action Alternatives)	Alternative A	Alternative B
Safety	Safety-related effects from Kingston retirement and D4 activities would primarily occur on the Kingston Reservation, where no residential populations are present, and in the vicinity, where high traffic concentration could occur. Given that EJ populations do not exist in the vicinity of the Kingston Reservation it is unlikely that these safety effects would result in amplified safety conditions to EJ populations. OSHA regulations and BMPs for site safety management would minimize potential risks to workers.	The public health and safety impacts of air quality from coal plant operations would be reduced, as the CC/Aero CT Plant would produce less emissions than current Kingston operations. This would result in minor positive effects to surrounding populations which may experience the highest levels of air toxin exposure. The populations near the Kingston Reservation are not EJ-qualifying. Other safety-related effects such as increased traffic near high traffic construction areas could result in negative safety effects for people living near Kingston and the pipeline. In areas where pipeline activities intersect with EJ populations amplified safety effects may occur to these communities.	Safety-related effects would be temporary, minor and mitigated, and limited to the immediate project sites and transmission corridors. While safety related-effects are not anticipated, effects on EJ populations would be more fully evaluated for individual solar and storage facilities.
Socioeconomics	Due to the loss of direct and indirect employment associated with Kingston, competition for employment in other fields in the Kingston labor market area, such as manufacturing, educational services, health care, and construction, may increase. Such trends could lead EJ populations and other populations to relocate for work or follow recent depopulation trends and permanently relocate to different locations in Tennessee or beyond. These changes may affect familial and community relations among EJ and other populations in the Kingston labor market area. Given their particular vulnerabilities, the effects may be amplified for EJ populations. These effects would be offset due to the benefit of temporary employment increases during D4 activities.	It is currently undetermined as to whether displacements would occur because of the pipeline construction, although the pipeline would be placed along current pipeline ROW so as to minimize disruption. Construction of the CC/Aero CT Plant and the pipeline associated with Alternative A would temporarily increase employment in the labor market area and have a minor beneficial effect to area EJ populations, as some employment is expected to occur from within the area. While not anticipated to have significant adverse impacts on EJ populations, negative effects may occur to current and prospective renters and guests of rental homes and establishments through reduced rental inventory and/or increased prices. This may result in amplified effects for EJ-qualifying low-income populations, especially in EJ-qualifying census block groups with higher percentages of renter-occupied housing units than the associated county.	Construction of the solar facilities associated with Alternative B would temporarily increase employment within portions of East Tennessee. These socioeconomic effects could potentially have a minor beneficial effect to EJ populations in the areas selected for the solar facilities. Correspondingly, short-term economic and tax revenues increases may occur with the increased employment.
Noise	Noise-related effects would be temporary and minor and generally limited to the Kingston Reservation and immediate vicinity. EJ populations are not present within 0.5 mile of these activities and would thus not experience amplified effects.	Alternative A-related activities would increase the noise effects on local populations. Given the absence of EJ populations near the CC/Aero CT Plant location, there would not be amplified effects near the Kingston Reservation. Noise-related effects, including vehicular traffic, in the ETNG Construction ROW would generally be experienced by EJ populations more than other populations. Further, some of the loudest activities and components are located in EJ areas. While these effects would be mitigated as much as feasible, noise effects associated with Alternative A are likely to be amplified for EJ populations.	To determine noise-related effects for a given solar facility, detailed EJ analyses would occur for each solar facility and transmission line activity under future NEPA reviews.
Visual	Visual effects would be temporary, minor, and limited to the Kingston Reservation or immediate vicinity, eventually merging into the surroundings of mixed landscape with trees and agriculture. EJ populations are not present near Kingston so no amplified effects would occur to these populations.	Alternative A-related activities would increase the visual effects on local populations in the Kingston vicinity, where EJ-qualifying populations do not occur. Construction of pipeline components would occur where EJ populations are distributed among other populations; therefore, visual-related effects experienced by both EJ and non-EJ populations would be the same.	While not anticipated to be significant, visual effects would be evaluated for individual solar and storage facilities.

3.4.3.4 Alternative B

TVA anticipates that the solar facilities proposed under Alternative B would be located within portions of the East Tennessee region in order to offset transmission system upgrades that may be required following the retirement of the Kingston Reservation. Power from these facilities would typically be delivered by direct connection to TVA's transmission system or via interconnections with local power companies that distribute power from TVA.

Generalized beneficial effects and any amplified adverse effects to EJ populations resulting from the effects of Alternative B to other resource areas are summarized below and in Table 3.4-20. Focused, site-specific analyses for each proposed solar site would be needed to determine whether the specific project effects would be amplified for EJ populations.

3.4.3.4.1 Construction and Operation of Solar and Storage Facilities

As specific sites have not yet been determined for evaluation under this alternative, typical EJ effects associated with solar facilities are listed under Section 3.2 and cannot be determined on a location-specific basis at this time. In general, the main effects of consideration for EJ populations would likely result from construction activities, operations, and considerations of greenhouse gases and climate change under Alternative B. Solar and storage facility construction activities are expected to have short-term, localized, and minor effects on air quality and, along with operation activities, no appreciable direct or indirect effect on regional climate change. Additionally, the solar and storage facility operations are expected to have long-term, moderate, beneficial effects on air quality and on regional climate change in comparison to existing conditions.

Construction of the solar facilities associated with Alternative B would temporarily increase employment primarily within portions of East Tennessee. These socioeconomic effects could potentially have a minor beneficial effect to EJ populations in the areas selected for the solar facilities.

While no solar facilities previously developed by TVA had amplified adverse effects on EJ populations, if effects were to occur, they would likely be associated with land use and vegetation changes; recreational areas; water and wildlife effects; construction traffic, noise, and safety issues; and short-term and long-term visual effects, and these could be exacerbated by cumulative effects. However, based on the number of solar sites that would be needed to replace generation at Kingston, estimated at 17 one-hundred MW sites (10,950 acres based on values provided in Table 3.2-1), there would be potential for moderate effects to land use through conversion of agricultural land, particularly cropland, to developed land with potential for later restoration of agricultural use. While these land use conversions are not expected to have amplified effects on EJ populations, depending on the number and location of solar facilities, individual EJ reviews would be completed for each solar and storage facility associated with Alternative B as it is proposed.

3.4.3.4.2 Transmission and Other Components

Based on a review of EJ effects caused by past TVA transmission line upgrade efforts, the EJ effects of transmission upgrades associated with Alternative B are not expected to be significant. Because the locations of the transmission line upgrades for Alternative B have not yet been identified and the EJ populations are, therefore, not known, the site-specific effects to EJ populations associated with transmission upgrades would be assessed in future environmental reviews if TVA adopts this alternative.

3.5 Physical Characteristics

3.5.1 Geology, Soils, and Prime Farmland

3.5.1.1 Affected Environment

The alternative actions considered in this EIS would occur in one or more of the following physiographic provinces of the U.S. (see Figure 3.5-1) (Fenneman 1938; Miller 1974):

- Blue Ridge
- Valley and Ridge
- Interior Low Plateaus Province
- Highland Rim
- Nashville Basin
- Appalachian Plateaus Province
    - Cumberland Plateau
    - Cumberland Mountains

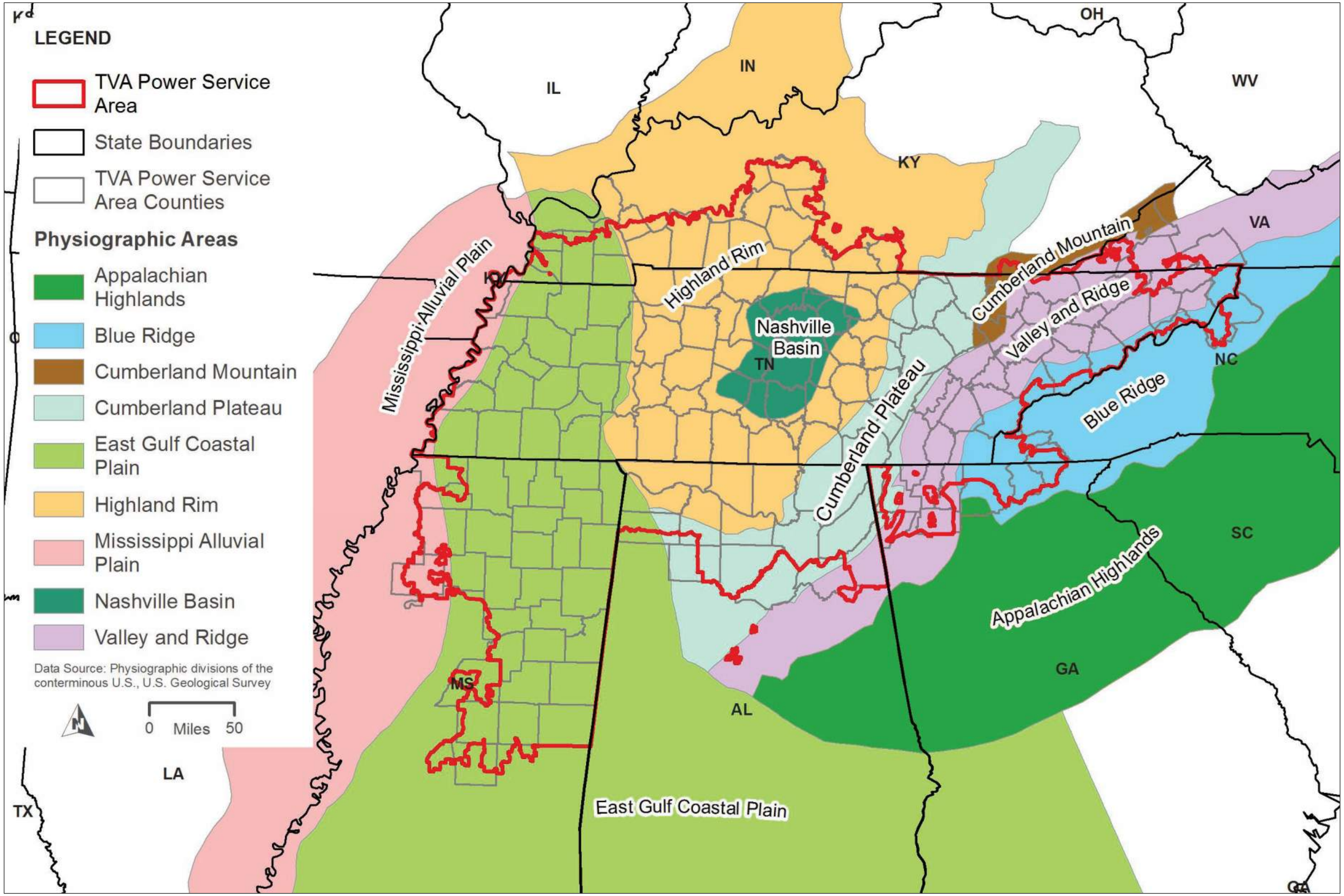

Figure 3.5-1. Physiographic Areas of TVA Region

3.5.1.1.1 Kingston Reservation (No Action and D4 Activities)

3.5.1.1.1.1 Geology

The Kingston Reservation is situated in the Valley and Ridge Physiographic Province, which is characterized by northeast-trending ridges underlain by resistant rock separated by valleys underlain by less resistant rock, near the physiographic boundary with the Cumberland Plateau of Tennessee. The rock formations in the vicinity of Kingston are steeply tilted and crop out in long, narrow belts parallel to the trend of ridges and valleys, and some belts are bounded by faults (Zurawski 1978). The Kingston Reservation is primarily underlain by alluvial deposits of sand, silt, clay, and gravel between 20 and 60 feet thick, which in turn is underlain by the Knox Group Dolomite. The Conasauga Shale and Rome Formations underlie the Knox Group; both formations are predominantly shale and siltstone with minor amounts of limestone and dolomite of Cambrian age (Rodgers 1993). The Chattanooga Fault is located approximately 0.75-mile west-northwest of KIF and the Kingston Reservation and is apparent by the presence of the Ordovician-age Knox Group formation overlying the Conasauga Shale and Rome Formations atop Pine Ridge.

Principal aquifers in the Valley and Ridge Physiographic Province are carbonate rocks of Cambrian and Ordovician age. The Knox Dolomite, which underlies about 60 percent of the province, is the most significant water-bearing formation (Zurawski 1978).

3.5.1.1.1.2 Paleontology

During the Precambrian period, the area that is now current-day Tennessee was located in the southern hemisphere and was covered by a shallow, tropical sea that was home to diverse species of sea life. By the Paleozoic period, Tennessee was located along the southern border of present-day North America and was still covered by sea water. During the Early Carboniferous (Mississippian) period, Tennessee was covered by a warm tropical sea that supported an abundance of marine life. The limestones produced from the sediments that accumulated on the seafloor during this period are rich in fossils of bryozoans, brachiopods, and crinoids. During the Late Carboniferous period, mountain building in the east caused soil erosion and deposition resulting in swampy deltas to form in central Tennessee. Western Tennessee remained underwater while the central and eastern portions of Tennessee were above sea level; this continued through the Mesozoic and Cenozoic periods (The Paleontology Portal 2021).

Fossil discovery is possible and likely throughout Tennessee. The geologic formations underlying the Project may contain fossiliferous remains of marine invertebrates. A review of existing paleontological information for Tennessee was conducted. While invertebrate fossils may be found in Tennessee, unique paleontological resources are not known to exist within the proposed location of the project (Paleobiology Database 2022).

3.5.1.1.1.3 Geological Hazards

Geological hazards include landslides, volcanoes, earthquakes/seismic activity, and subsidence/ sinkholes. The Kingston Reservation is located in a topographically low area on a peninsula at the confluence of the Emory and Clinch rivers. Adjacent to the KIF Plant, Pine Ridge slopes gently upward to approximately 200 feet above KIF; therefore, landslides are a potential, but unlikely risk in most areas of the Project site. No volcanoes are present within several hundred miles of the Kingston Reservation.

Sinkholes and other karst features can occur where the rock below the land surface is a carbonate rock such as a limestone or dolomite, as well as in salt beds, and other rocks that are naturally dissolved by groundwater circulating through them (e.g., gypsum). Development of karst topography/underground caverns takes many years to decades, and when the land above the underground cavern is no longer supported, a sudden collapse of the land surface can occur. These collapses, called sinkholes, can vary greatly in size and shape (Kaufmann 2007).

The Kingston Reservation is located in a heavily faulted area; multiple fault lines are located in the vicinity of the Kingston Reservation, including the Chattanooga fault, which is within 0.75 mile of the Kingston Reservation. The presence of faults within carbonate rocks can contribute to the formation of karst related features if groundwater is present and the fault planes are acting as a conduit for groundwater flow.

Kingston is located within the Eastern Tennessee Seismic Zone, which is a geographic band approximately 75 miles wide by 200 miles long, capable of generating small frequent earthquakes. The largest recorded earthquake in this seismic zone was a magnitude 4.6 that occurred in 1973 near Knoxville. In 2018, a magnitude 4.4 earthquake occurred near the Watts Bar Dam, approximately 25 miles south of the Project site (U.S. Geological Survey [USGS] 2021a). The Kingston Reservation is also located approximately 200 miles west of the New Madrid Seismic Zone, which is a 150-mile-long seismic zone extending from Illinois to Arkansas and into portions of five states (Figure 3.5-2).

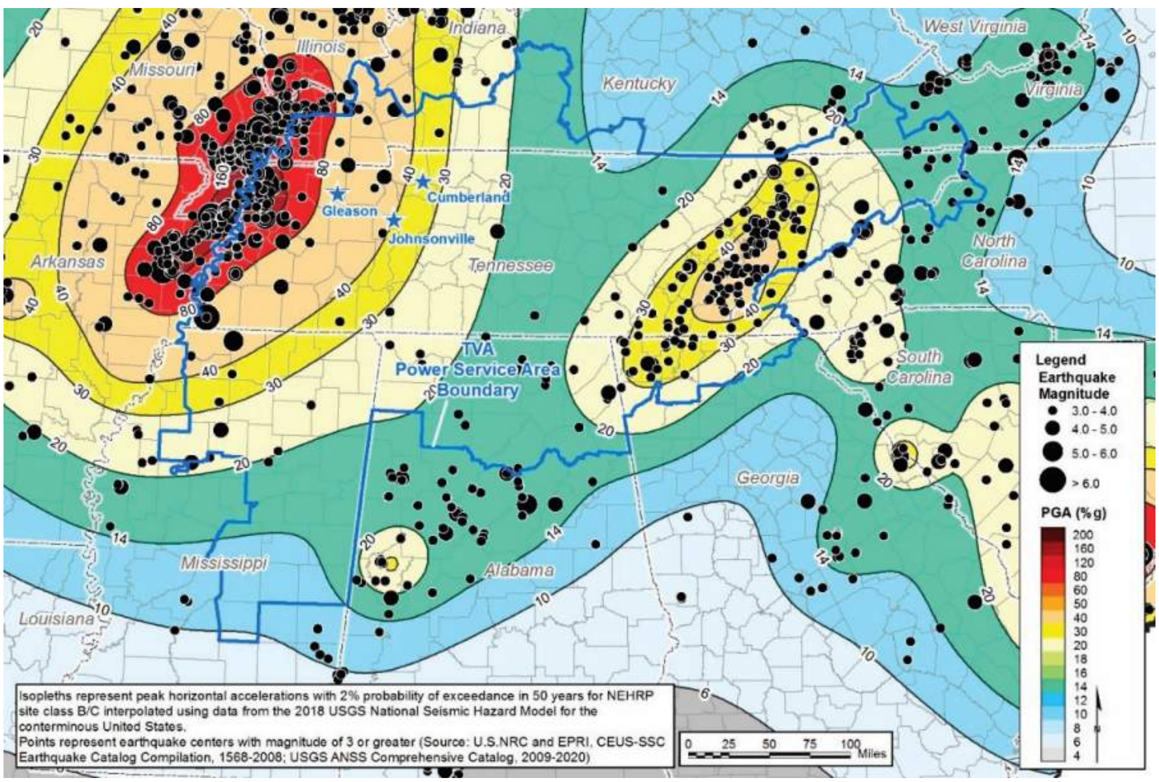

Figure 3.5-2. Seismic Hazards from the New Madrid Seismic Zone and Eastern Tennessee Seismic Zone

(Source: Modified after USGS 2020)

The largest seismic events in the New Madrid Seismic Zone occurred between the years 1811 and 1812 (USGS 2021a). Seismic instrumentation was installed in 1974 to monitor the area and since then, approximately 4,000 earthquakes have been recorded; however, they are typically too small to be felt. The New Madrid zone is considered a potential source of intraplate earthquakes in the region. A recent study indicated that faults are moving less than 0.2 millimeters per year (Gardner 2009).

3.5.1.1.1.4 Soils

Fourteen soil types have been mapped on the Kingston Reservation. Soil types include soils of the ash disposal area (29 percent); Urban land, five to 20 percent slopes (19.7 percent); Waynesboro loam, six to 15 percent slopes (11.5 percent); Dewey silt loam, 15 to 25 percent slopes (8.5 percent); Armuchee silt loam, five to 12 percent slopes (6.2 percent); and Waynesboro loam, 15 to 25 percent slopes (5.2 percent), with other types of soil consisting of less than five percent each (U.S. Department of Agriculture [USDA] 2019a; Table 3.5-1; Figure 3.5-3).

Table 3.5-1. Soils on the Kingston Reservation

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
AmC	Armuchee silt loam, 5 to 12 percent slopes	Not prime farmland	0	77.4	6.2
ASD	Ash disposal area	Not prime farmland	0	364.6	29.0
DeC	Dewey silt loam, 6 to 5 percent slopes	Not prime farmland	0	50.9	4.1
DeD	Dewey silt loam, 15 to 25 percent slopes	Not prime farmland	0	106.8	8.5
EtB	Etowah loam, 2 to 6 percent slopes	All areas are prime farmland	0	9.5	0.8
EtC	Etowah silt loam, 6 to 12 percent slopes	Not prime farmland	0	33.6	2.7
FuC	Fullerton-Pailo complex, 5 to 12 percent slopes	Not prime farmland	0	40.3	3.2
FuD	Fullerton-Pailo complex, 12 to 20 percent slopes	Not prime farmland	0	52.6	4.2
MoC	Montevallo channery silt loam, 5 to 12 percent slopes	Not prime farmland	0	15.1	1.2
MoD	Montevallo channery silt loam, 12 to 20 percent slopes	Not prime farmland	0	10.8	0.9
MoE	Montevallo channery silt loam, 20 to 35 percent slopes	Not prime farmland	0	22.0	1.7
UrD	Urban land, 5 to 20 percent slopes	Not prime farmland	0	247.9	19.7
W	Water	Not prime farmland	0	15.5	1.2
WaC	Waynesboro loam, 6 to 15 percent slopes	Not prime farmland	0	143.9	11.5
WaD	Waynesboro loam, 15 to 25 percent slopes	Not prime farmland	0	64.7	5.2
	Total Prime Farmland			**9.5**	**0.8**

Source: USDA 2019a

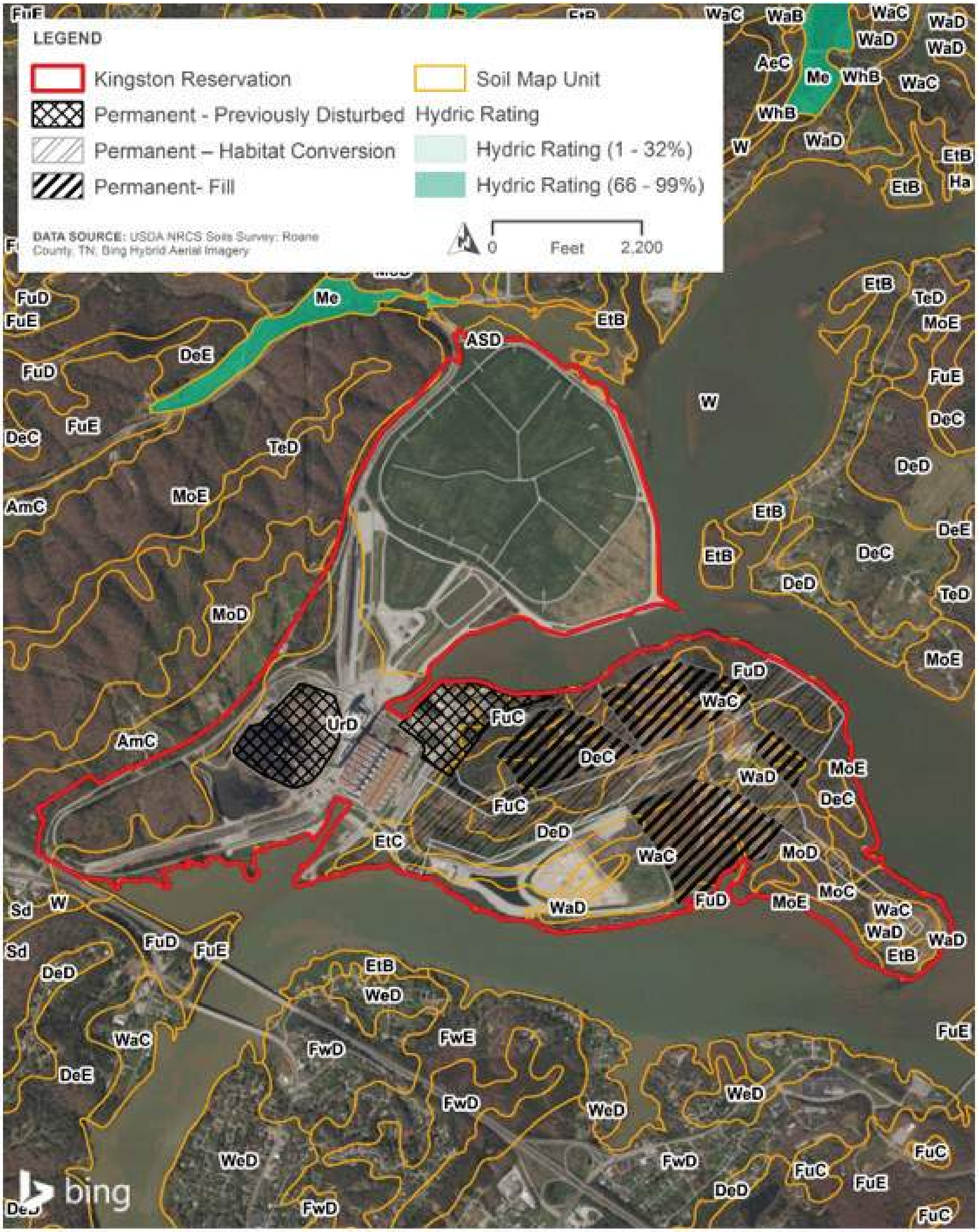

Figure 3.5-3. Soils on the Kingston Reservation

The ash disposal area soils consist of a wide range of textures derived from mainly coal, fly ash, and earthy fill material. The Urban land soils consist of areas where the surface is covered by roads, streets, parking lots, commercial buildings, houses, and other types of impervious ground cover and in places where natural drainage has been altered by a system of ditches and storm drains. The Waynesboro series soils consist of very deep, well drained, moderately permeable soils that formed in old alluvium or unconsolidated material of sandstone, shale, and limestone origin. These soils are on high terraces and uplands with slopes ranging from two to 30 percent and are used for pasture and for crops such as small grains, hay, tobacco, cotton, and truck crops (USDA 2022).

The Dewey series soils consist of very deep, well drained, moderately permeable soils that formed in residuum of limestone or in one to two feet of old alluvium and the underlying residuum from limestone. These soils are on gently sloping to steep uplands with slopes ranging from two to 40 percent and are used for row crops, small grain, hay, and pasture. The Armuchee series soils consist of moderately deep, well drained soils that formed in residuum of acid shale. These soils are on rolling to very steep uplands with slopes ranging from five to 60 percent and are used for pasture production (USDA 2022). There are no hydric soils within the Kingston Reservation boundary.

3.5.1.1.1.5 Prime Farmland

The term "prime farmland" is assigned by the USDA to land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for such uses. The Farmland Protection Policy Act (FPPA; 7 U.S.C. §4201 et seq.) requires Federal agencies to consider the adverse effects of their actions on prime or unique farmland. Farmland subject to FPPA requirements does not have to be currently used for cropland. The land can be forested land, pastureland, cropland, or other land, but it cannot be water or urban built-up land. The purpose of the FPPA is "to minimize the extent to which Federal programs contribute to the unnecessary and irreversible conversion of farmland to nonagricultural uses." FPPA does not authorize Federal agencies to regulate the use of private or non-Federal land, or in any way affect the property rights of owners.

Based on soils data obtained from the USDA Web Soil Survey, approximately 9.5 acres (0.8 percent) of the Kingston Reservation (Etowah loam, 2 to 6 percent slopes) are designated as prime farmland, as illustrated on Figure 3.5-4. Table 3.5-1 describes the soil types, including those classified as prime farmland, located on the Kingston Reservation.

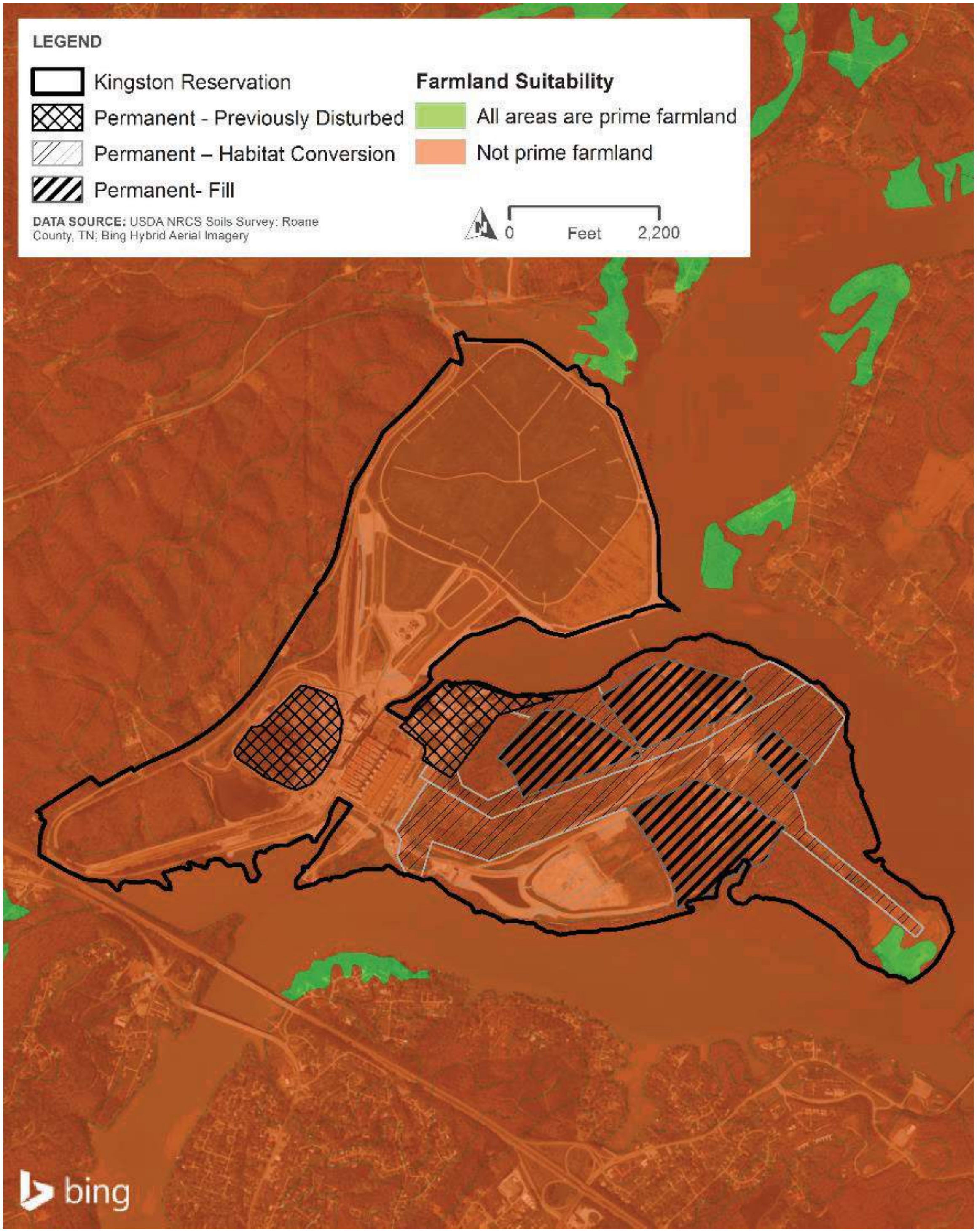

Figure 3.5-4. Soils Classified as Prime Farmland on the Kingston Reservation

3.5.1.1.2 Alternative A

3.5.1.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on Kingston Reservation

Geology

The proposed CC/Aero CT Plant site and new transmission line connections and corridors would be located within the Western Valley and Ridge and Cumberland Plateau Physiographic Provinces of Tennessee as described in Section 3.5.1.1.1.

Paleontology

The paleontology associated with the proposed CC/Aero CT Plant site is generally the same as described in Section 3.5.1.1.1.

Geological Hazards

The geological hazards associated with the proposed CC/Aero CT Plant site are generally the same as described in Section 3.5.1.1.1.

Soils

Five soil types have been mapped within the proposed CC/Aero CT Plant boundary and include Waynesboro loam, six to 15 percent slopes (82.9 percent) and Dewey silt loam, 15 to 25 percent slopes (7.6 percent), with other types of soil consisting of less than four percent each. The proposed switchyard contains two soil types: Waynesboro loam, six to 15 percent slopes (50 percent) and Waynesboro loam, 15 to 25 percent slopes (50 percent) (U.S. Department of Agriculture [USDA] 2019a; Figure 3.5-3; Table 3.5-2).

Table 3.5-2. Soils within the proposed CC/Aero CT Plant boundary, Switchyard, and Transmission Line Corridor

Soil Map Unit Symbol	Soil type	Classified as Prime Farmland	Hydric Rating	Area (acres)	Percent of Total Area
CC/Aero CT Plant					
DeD	Dewey silt loam, 15 to 25 percent slopes	No	0	4.2	7.6
EtC	Etowah silt loam, 6 to 12 percent slopes	No	0	0.5	0.9
FuD	Fullerton-Pailo complex, 12 to 20 percent slopes	No	0	2.1	3.8
W	Water	No	0	1.3	2.4
WaC	Waynesboro loam, 6 to 15 percent slopes	No	0	45.6	82.9
WaD	Waynesboro loam, 15 to 25 percent slopes	No	0	1.5	2.7
Switchyard					
WaC	Waynesboro loam, 6 to 15 percent slopes	No	0	4.3	50.0
WaD	Waynesboro loam, 15 to 25 percent slopes	No	0	4.3	50.0
On-site Transmission Line Corridor					
DeC	Dewey silt loam, 6 to 15 percent slopes	No	0	6.4	5.0
DeD	Dewey silt loam, 15 to 25 percent slopes	No	0	46.7	36.5
EtC	Etowah silt loam, 6 to 12 percent slopes	No	0	4.0	3.1
FuC	Fullerton-Pailo complex, 5 to 12 percent slopes	No	0	9.7	7.6

Soil Map Unit Symbol	Soil type	Classified as Prime Farmland	Hydric Rating	Area (acres)	Percent of Total Area
FuD	Fullerton-Pailo complex, 12 to 20 percent slopes	No	0	7.7	6.0
MoC	Montevallo channery silt loam, 5 to 12 percent slopes	No	0	2.1	1.6
MoD	Montevallo channery silt loam, 12 to 20 percent slopes	No	0	1.3	1.0
MoE	Montevallo channery silt loam, 20 to 35 percent slopes	No	0	0.6	0.5
UrD	Urban land, 5 to 20 percent slopes	No	0	1.8	1.4
WaC	Waynesboro loam, 6 to 15 percent slopes	No	0	16.6	13.0
WaD	Waynesboro loam, 15 to 25 percent slopes	No	0	31.1	24.3
	Total Prime Farmland			**0.0**	**0.0**

Source: USDA 2019a

The Fullerton series soils consist of very deep, well drained, moderately permeable soils that formed in residuum from cherty limestone. These soils are on upland ridgetops with slopes ranging from two to 70 percent and are used for growing pasture, hay, corn, cotton, small grains, and tobacco. The Pailo series soils consist of very deep, somewhat excessively drained gravelly soils that formed in residuum from cherty limestone. These soils are on sloping to very steep upland ridgetops and hillsides with slopes ranging from five to 70 percent and are primarily in forested areas but small, cleared areas are used for pasture (USDA 2022). The Waynesboro and Dewey series soils are characterized in Section 3.5.1.1.1.4.

Prime Farmland

The proposed CC/Aero CT Plant site and associated structures, as illustrated in Figure 3.5-4, have been sited to avoid prime farmland on the Kingston Reservation.

3.5.1.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be situated on 35 acres on a former coal yard on Kingston Reservation.

Geology

The proposed 3- to 4-MW solar facility would be located within the Western Valley and Ridge and Cumberland Plateau Physiographic Provinces of Tennessee as described in Section 3.5.1.1.1.

Paleontology

The paleontology associated with the proposed 3- to 4-MW Solar Facility site is generally the same as described in Section 3.5.1.1.1.

Geological Hazards

The geological hazards associated with the proposed 3- to 4-MW Solar Facility site are generally the same as those for the proposed CC/Aero CT Plant site described in Section 3.5.1.1.2.1.

Soils

The proposed 3- to 4-MW solar facility site contains one soil type: Urban land, five to 20 percent slopes (100 percent) (USDA 2019b; Figure 3.5-3). The Urban land soils consist of areas where the surface is covered by roads, streets, parking lots, commercial buildings, houses, and other types of impervious ground cover and in places where natural drainage has been altered by a system of ditches and storm drains (USDA 2022).

Prime Farmland

There are no soils classified as prime farmland within the proposed 3- to 4-MW solar facility site (Figure 3.5-4).

3.5.1.1.2.3 Construction and Operation of a 100-MW Battery Storage Facility on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.5.1.1 apply to the proposed 100-MW battery storage facility on the Kingston Reservation.

Geology

The proposed 100-MW BESS would be located within the Western Valley and Ridge and Cumberland Plateau Physiographic Provinces of Tennessee as described in Section 3.5.1.1.1.

Paleontology

The paleontology associated with the proposed 100-MW BESS site is generally the same as described in Section 3.5.1.1.1.

Geological Hazards

The geological hazards associated with the proposed 100-MW BESS site are generally the same as those for the proposed CC/Aero CT Plant site described in Section 3.5.1.1.2.1.

Soils

Three soil types have been mapped within the proposed Battery Site 1: Urban land, 5 to 20 percent slopes (68.7 percent); Fullerton-Pailo complex, 5 to 12 percent slopes (29.0 percent); and Dewey silt loam, 15 to 25 percent slopes (1.7 percent) (USDA 2019a; Figure 3.5-3; Table 3.5-3). These soils are characterized in under the Soils headings in Section 3.5.1.1.2.1 and Section 3.5.1.1.2.2.

Four soil types have been mapped within the proposed Battery Site 2: Dewey silt loam, 6 to 15 percent slopes (52.3 percent); Dewey silt loam, 15 to 25 percent slopes (28.9 percent); Fullerton-Pailo complex, 5 to 12 percent slopes (18.9 percent); and Fullerton-Pailo complex, 12 to 20 percent slopes (0.3 percent) (USDA 2019a; Figure 3.5-3; Table 3.5-3). These soils are characterized in under the Soils headings in Section 3.5.1.1.2.1 and Section 3.5.1.1.2.2.

Five soil types have been mapped within the proposed Battery Site 3: Waynesboro loam, 6 to 15 percent slopes (37.5 percent); Dewey silt loam, 15 to 25 percent slopes (29.3 percent); Dewey silt loam, 6 to 15 percent slopes (20.3 percent); Fullerton-Pailo complex, 12 to 20 percent slopes (13.3 percent); and Waynesboro loam, 15 to 25 percent slopes (0.1 percent) (USDA 2019a; Figure 3.5-3; Table 3.5-3). These soils are characterized in under the Soils headings in Section 3.5.1.1.2.1 and Section 3.5.1.1.2.2.

Table 3.5-3. Soils within the proposed 100-MW BESS sites and Battery Transmission Line Connects

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
	Proposed Battery Site 1				
DeD	Dewey silt loam, 15 to 25 percent slopes	Not prime farmland	0	0.5	1.7
FuC	Fullerton-Pailo complex, 5 to 12 percent slopes	Not prime farmland	0	8.7	29.0
UrD	Urban land, 5 to 20 percent slopes	Not prime farmland	0	20.6	68.7
W	Water	Not prime farmland	0	0.1	0.3
	Proposed Battery Site 2				
DeC	Dewey silt loam, 6 to 15 percent slopes	Not prime farmland	0	18.3	52.3
DeD	Dewey silt loam, 15 to 25 percent slopes	Not prime farmland	0	10.1	28.9
FuC	Fullerton-Pailo complex, 5 to 12 percent slopes	Not prime farmland	0	6.6	18.9
FuD	Fullerton-Pailo complex, 12 to 20 percent slopes	Not prime farmland	0	0.1	0.3
	Proposed Battery Site 3				
DeC	Dewey silt loam, 6 to 15 percent slopes	Not prime farmland	0	8.1	20.3
DeD	Dewey silt loam, 15 to 25 percent slopes	Not prime farmland	0	11.7	29.3
FuD	Fullerton-Pailo complex, 12 to 20 percent slopes	Not prime farmland	0	5.3	13.3
WaC	Waynesboro loam, 6 to 15 percent slopes	Not prime farmland	0	15.0	37.5
WaD	Waynesboro loam, 15 to 25 percent slopes	Not prime farmland	0	<0.1	0.1
	Proposed Battery Transmission Line Connects				
DeC	Dewey silt loam, 6 to 15 percent slopes	Not prime farmland	0	8.3	20.2
DeD	Dewey silt loam, 15 to 25 percent slopes	Not prime farmland	0	9.1	22.2
FuC	Fullerton-Pailo complex, 5 to 12 percent slopes	Not prime farmland	0	7.7	18.8
FuD	Fullerton-Pailo complex, 12 to 20 percent slopes	Not prime farmland	0	11.8	28.8
UrD	Urban land, 5 to 20 percent slopes	Not prime farmland	0	1.5	3.7
W	Water	Not prime farmland	0	0.2	0.5
WaC	Waynesboro loam, 6 to 15 percent slopes	Not prime farmland	0	1.1	2.7
WaD	Waynesboro loam, 15 to 25 percent slopes	Not prime farmland	0	1.3	3.2
	Total Prime Farmland			**0.0**	**0.0**

Source: USDA 2019a

Prime Farmland

There are no soils classified as prime farmland within the proposed 100-MW BESS sites or proposed Battery Transmission Line Connects footprint (Figure 3.5-4).

3.5.1.1.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT facilities and switchyard. Eleven soil types have been mapped within the proposed transmission line corridor and include Dewey silt loam, 15 to 25 percent slopes (36.5 percent); Waynesboro loam, 15 to 25 percent slopes (24.3 percent); Waynesboro loam, 6 to 15 percent slopes (13.0 percent); Fullerton-Pailo complex, five to 12 percent slopes (7.6 percent); Fullerton-Pailo complex, 12 to 20 percent slopes (6.0 percent); and Dewey silt loam, 6 to 15 percent slopes (5.0 percent), with other types of soil consisting of less than five percent each (USDA 2019a; Figure 3.5-3; Table 3.5-2). Additional details on these soils, as well as geologic and palaeontologic resources are included in Seven soil types have been mapped within the proposed transmission line connections footprint and the majority are composed of Fullerton-Pailo complex, 12 to 20 percent slopes (28.8 percent); Dewey silt loam, 15 to 25 percent slopes (22.2 percent); Dewey silt loam, 6 to 15 percent slopes (20.2 percent); and Fullerton-Pailo complex, 5 to 12 percent slopes (18.8 percent); with other types of soil consisting of less than four percent each (USDA 2019a; Figure 3.5-3; Table 3.5-3). These soils are characterized in under the Soils headings in Section 3.5.1.1.2.1 and Section 3.5.1.1.2.2.

3.5.1.1.2.5 Off-site Transmission Upgrades

3.5.1.1.2.5.1 Eastern Transmission Corridor

3.5.1.1.2.5.1.1 Geology, Paleontology, and Geological hazards

The transmission lines (L5108, L5116, L5280, L5302, and L5381) within the Eastern Transmission Corridor are in the western Valley and Ridge Physiographic Province; as such, the affected environment is the same as described in Section 3.5.1.1.1.

3.5.1.1.2.5.1.2 Soils and Prime Farmland

The Eastern Transmission Corridor extends eastward from the Kingston Reservation and terminates in the city of Oak Ridge. Forty-four soil types have been mapped on the 1,609-acre Eastern Transmission Corridor that is proposed for transmission upgrades. Approximately 60.4 percent of the area within the Eastern Transmission Corridor is unmapped (labeled as “NOTCOM” on figures) and no digital data are publicly available.

Based on the data available for the remaining area of the Eastern Transmission Corridor, the majority of the mapped soils are composed of Dewey silt loam, 15 to 25 percent slopes (4.5 percent); Fullerton-Pailo complex, 20 to 35 percent slopes (4.3 percent); Fullerton-Pailo complex, 12 to 20 percent slopes (4.3 percent); Dewey silt loam, 20 to 45 percent slopes (3.9 percent); Dewey silt loam, 6 to 15 percent slopes (2.7 percent); Colbert-Lyerly-Rock outcrop complex, 5 to 20 percent slopes (2.6 percent); Armuchee silt loam, 5 to 12 percent slopes (2.3 percent); and Montevallo channery silt loam, 20 to 35 percent slopes (2.1 percent), with other types of soil consisting of less than two percent each (USDA 2019b), as illustrated in Figure 3.5-5a through Figure 3.5-5d and summarized in Table 3.5-4. The Capshaw silt loam, two to five percent slopes; Cedarbluff loam, zero to three percent slopes, occasionally flooded; Chenneby silt loam, frequently flooded; Colbert-Lyerly-Rock outcrop complex, five to 20 percent slopes; and Hamblen silt loam, zero to two percent slopes, occasionally flooded, hydric minor component soils have hydric ratings of one to 33 percent.

Based on soils data obtained from the USDA Web Soil Survey, approximately 50.8 acres (3.2 percent) of the Eastern Transmission Corridor (L5108, L5302, L5116, L5280, and L5381) proposed for upgrades are designated as prime farmland, as illustrated in Figure 3.5-6a through Figure 3.5-6d. Table 3.5-4 describes the soil types, including those classified as prime farmland, located on the Eastern Transmission Corridor (L5108, L5302, L5116, L5280, and L5381) proposed for upgrades.

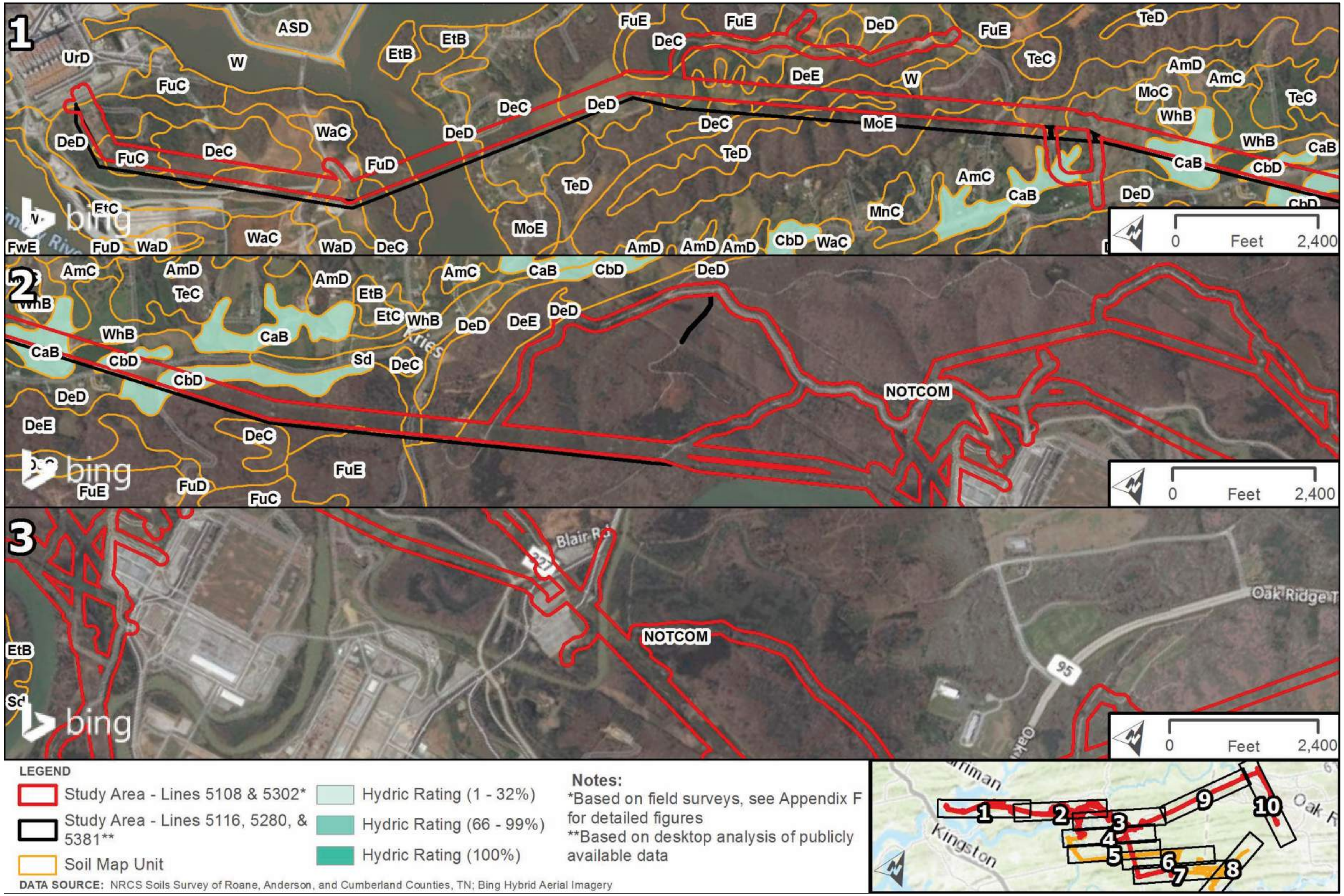

Figure 3.5-5a. Soils in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

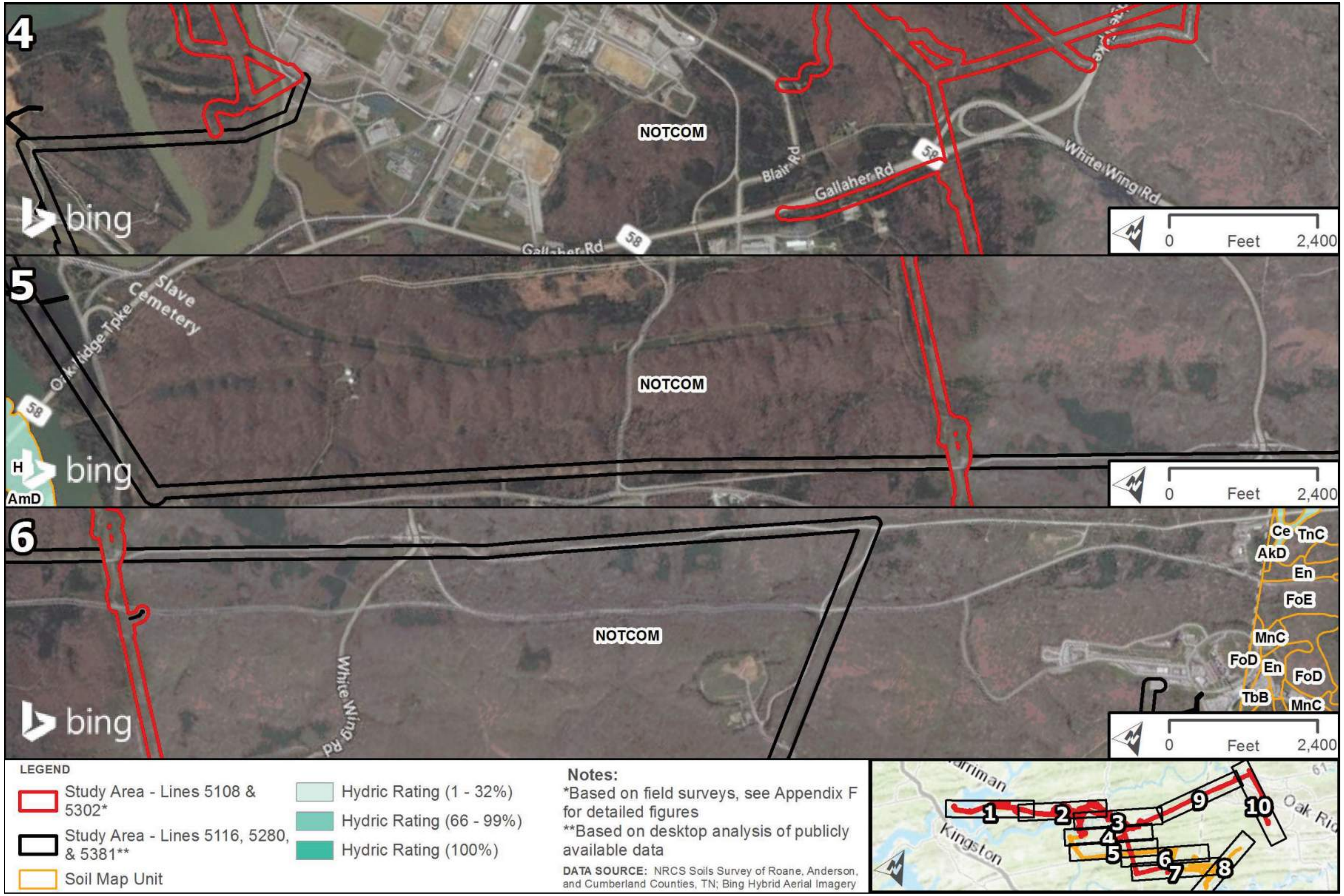

Figure 3.5-5b. Soils in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

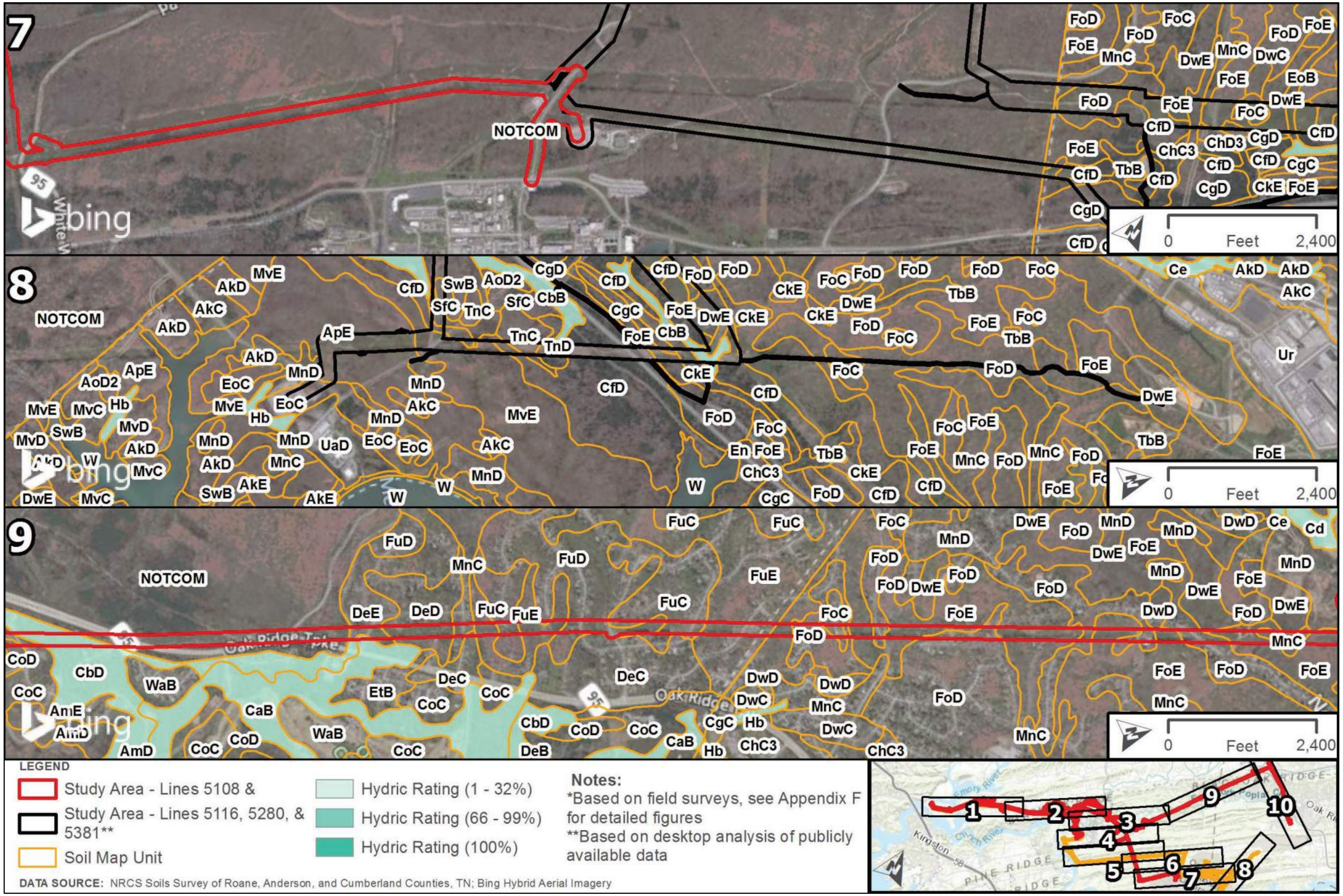

Figure 3.5-5c. Soils in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

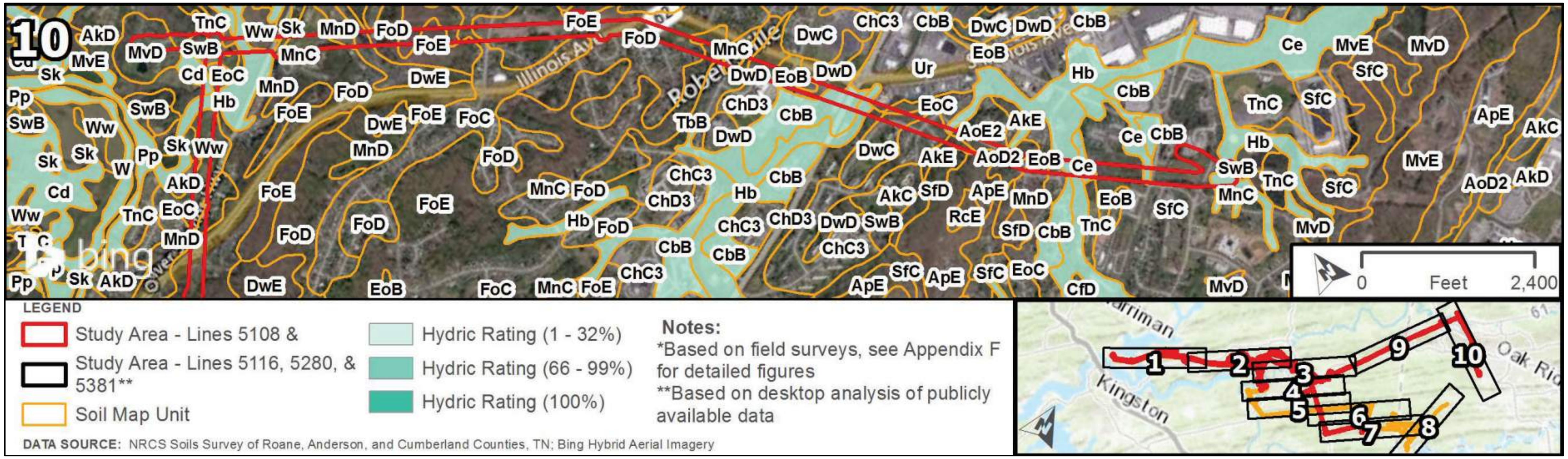

Figure 3.5-5d. Soils in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

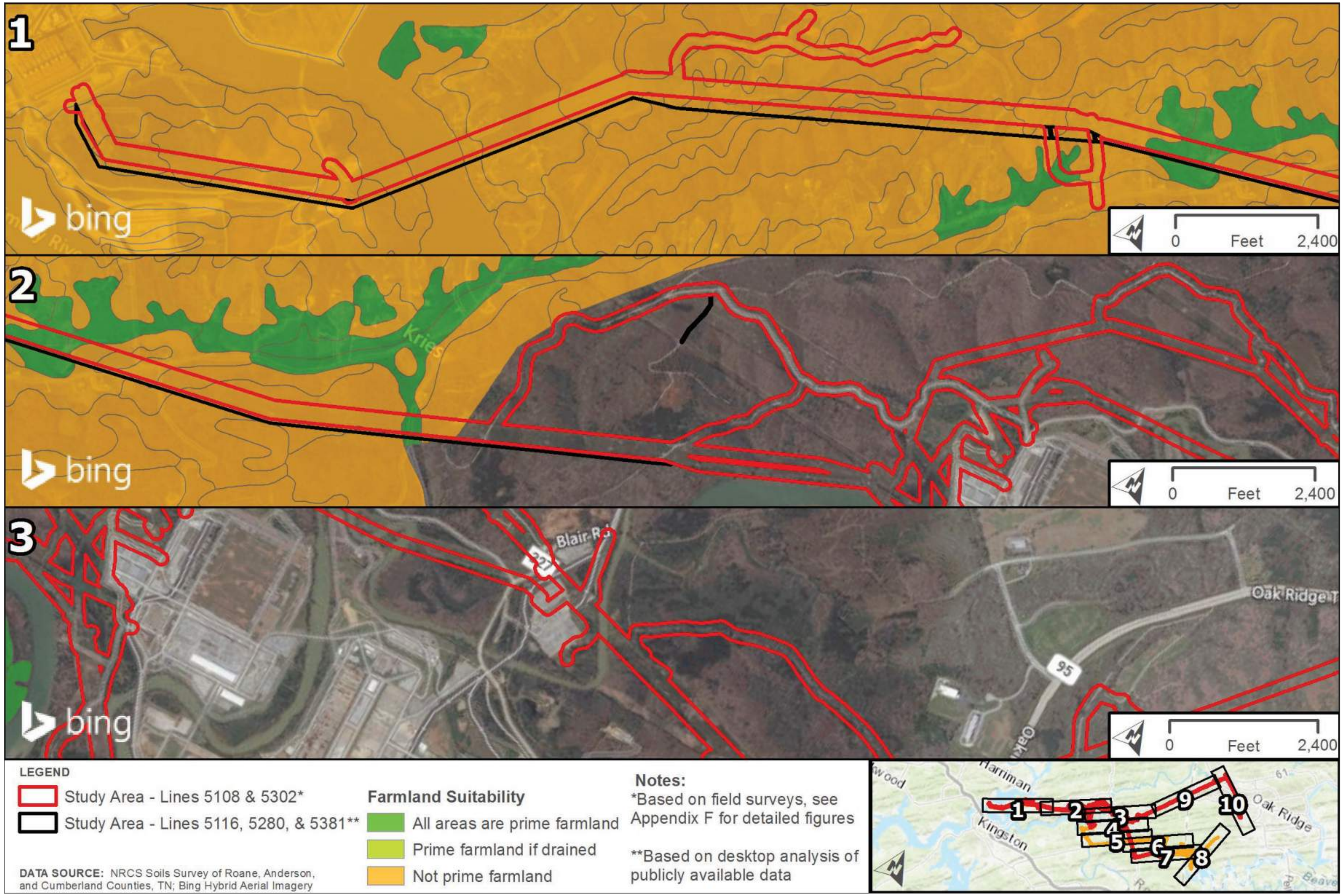

Figure 3.5-6a. Soils Classified as Prime Farmland in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

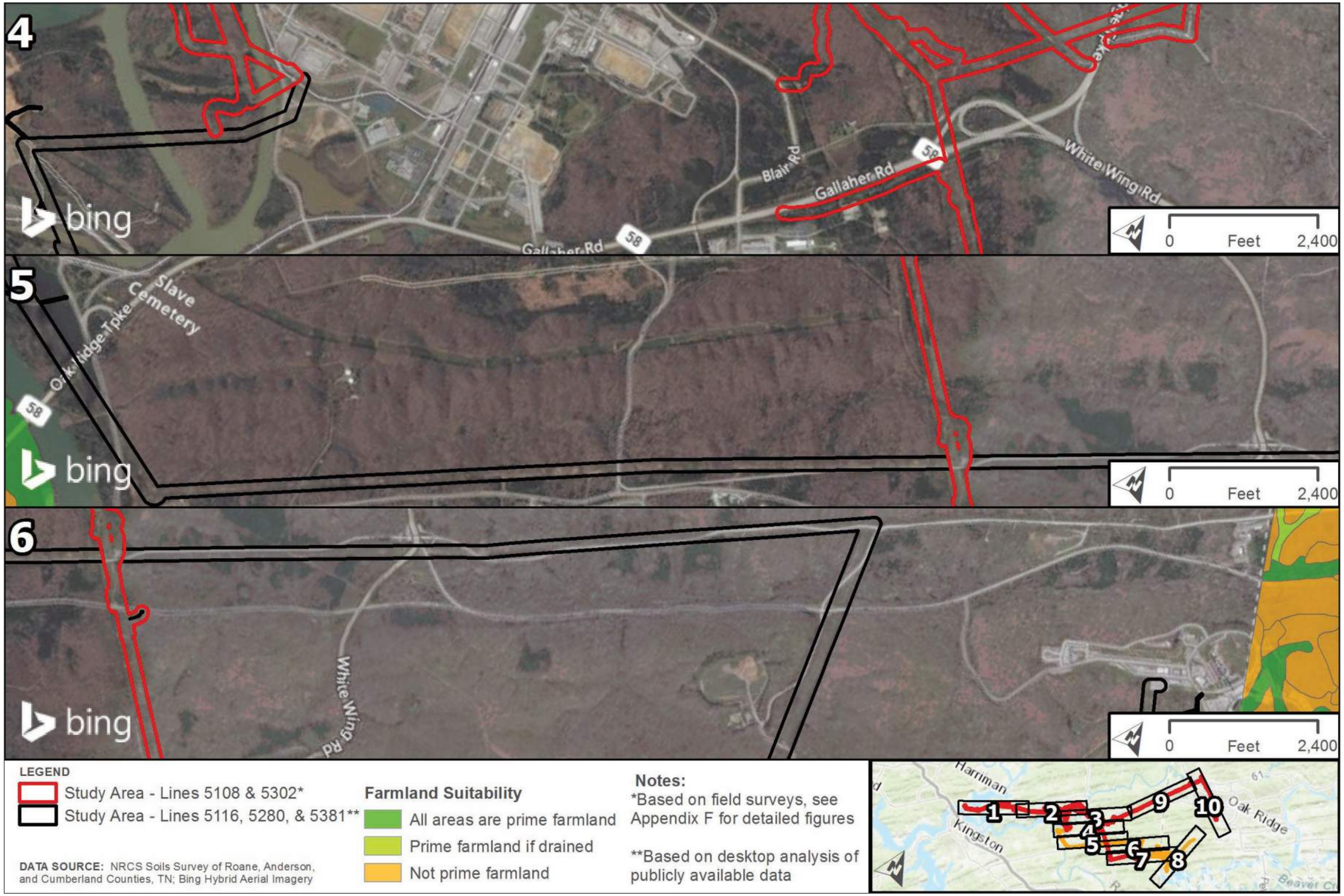

Figure 3.5-6b. Soils Classified as Prime Farmland in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

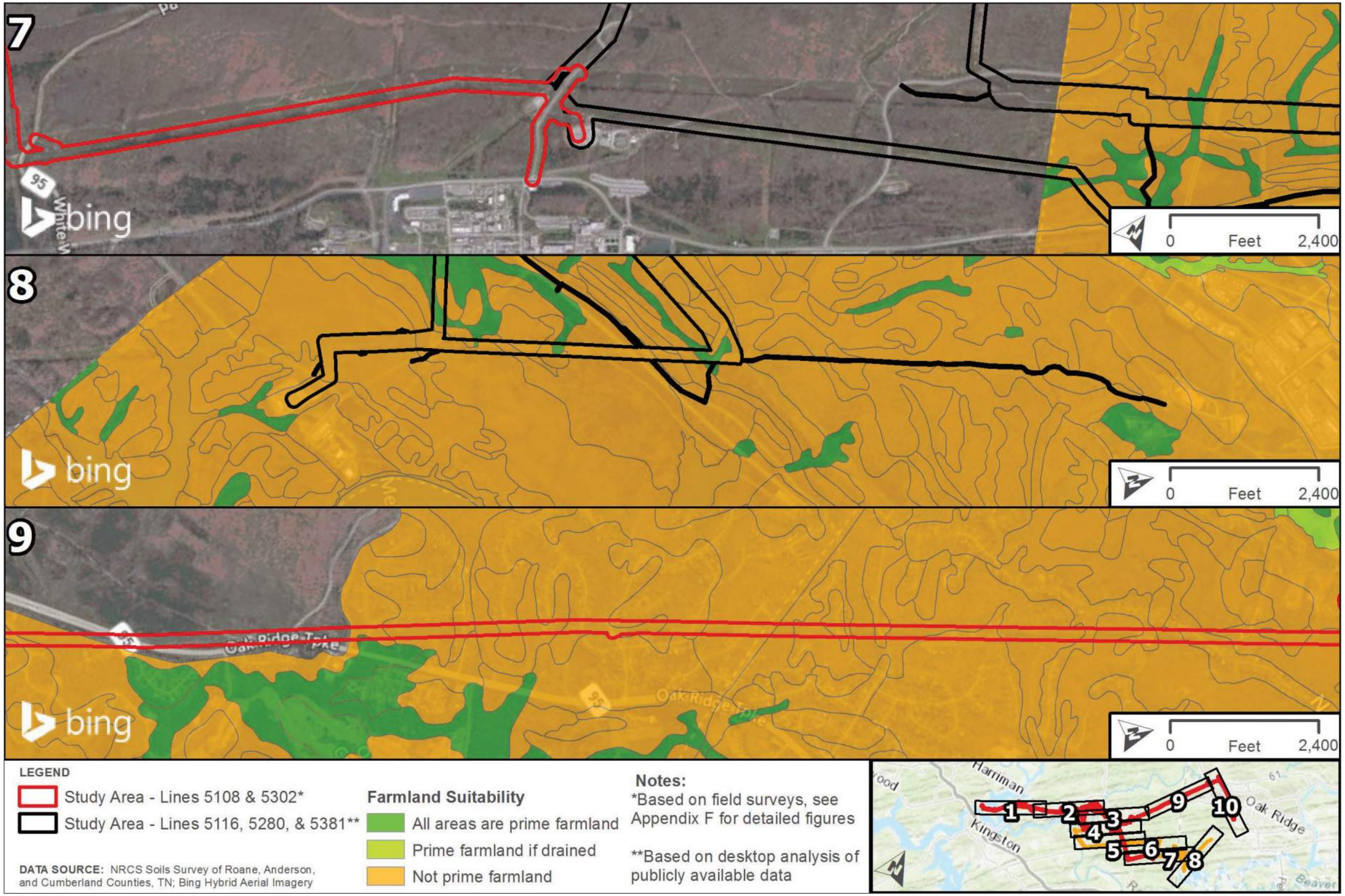

Figure 3.5-6c. Soils Classified as Prime Farmland in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

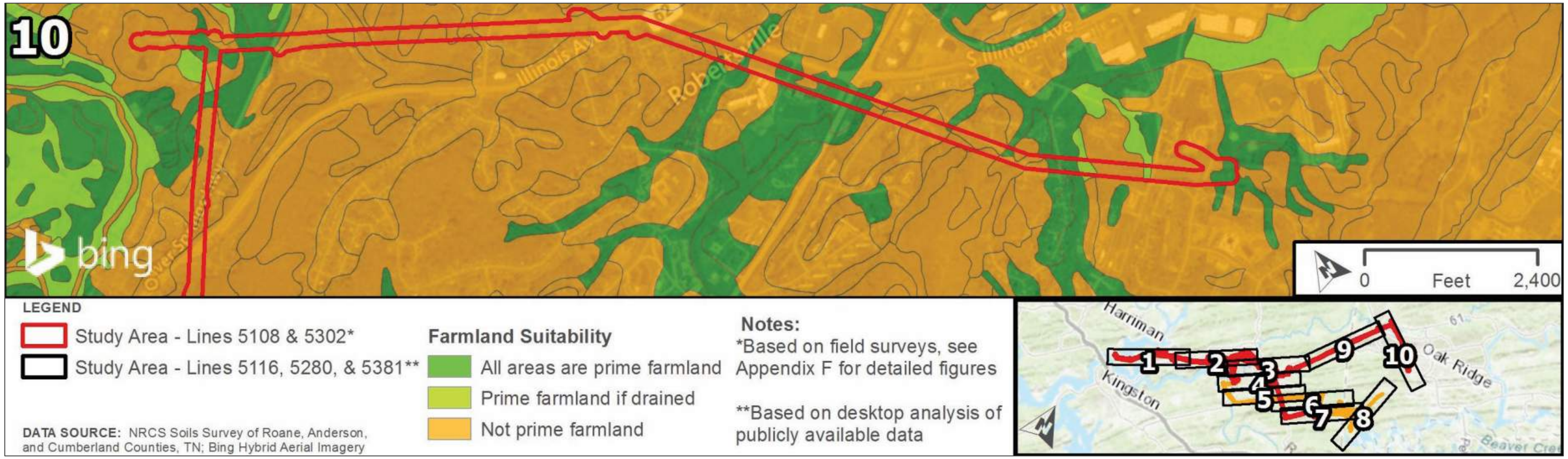

Figure 3.5-6d. Soils Classified as Prime Farmland in the Eastern Transmission Corridor Proposed for Upgrades under Alternative A

The Dewey series soils consist of very deep, well drained, moderately permeable soils that formed in residuum of limestone or in one to two feet of old alluvium and the underlying residuum from limestone. These soils are on gently sloping to steep uplands with slopes ranging from two to 40 percent and are used for row crops, small grain, hay, and pasture. The Fullerton series soils consist of very deep, well drained, moderately permeable soils that formed in residuum from cherty limestone. These soils are on upland ridgetops with slopes ranging from two to 70 percent and are used for growing pasture, hay, corn, cotton, small grains, and tobacco. The Pailo series soils consist of very deep, somewhat excessively drained gravelly soils that formed in residuum from cherty limestone. These soils are on sloping to very steep upland ridgetops and hillsides with slopes ranging from five to 70 percent and are primarily in forested areas but small, cleared areas are used for pasture. The Colbert series soils consist of deep, moderately well drained, very slowly permeable soils that formed in residuum weathered from argillaceous or shaly limestone. These soils are on uplands of limestone valleys with slopes ranging from one to 25 percent and are used for pasture, hay, corn, cotton, and small grains. The Lyerly series soils consist of moderately well drained to well drained, very slowly permeable soils that formed in residuum from limestone bedrock. These soils are on nearly level to moderately steep uplands with slopes ranging from one to 25 percent and are used for pasture, corn, grain sorghum, and small grain. The Armuchee series soils consist of moderately deep, well drained soils that formed in residuum of acid shale. These soils are on rolling to very steep uplands with slopes ranging from five to 60 percent and are used for pasture production. The Montevallo series soils consist of shallow, well drained, moderately permeable soils that formed in residuum from acid shale or siltstone. These soils are on hillslopes and ridges with slopes ranging from two to 80 percent and are used for pasture, hay, small grain, and row crops (USDA 2022).

Table 3.5-4. Soils in Alternative A of the Eastern Transmission Corridor (L5108, L5302, L5116, L5280, and L5381)

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
AkD	Armuchee silt loam, 12 to 20 percent slopes	Not prime farmland	0	9.5	0.6
AkE	Armuchee silt loam, 20 to 35 percent slopes	Not prime farmland	0	0.9	0.1
AmC	Armuchee silt loam, 5 to 12 percent slopes	Not prime farmland	0	36.2	2.3
AoD2	Armuchee channery silty clay loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	0.4	<0.1
AoE2	Armuchee channery silty clay loam, 20 to 35 percent slopes, eroded	Not prime farmland	0	2.1	0.1
ApE	Armuchee-Montevallo complex, 25 to 60 percent slopes	Not prime farmland	0	13.9	0.9
CaB	Capshaw silt loam, 2 to 5 percent slopes	All areas are prime farmland	6	17.2	1.1

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
CbD	Colbert-Lyerly-Rock outcrop complex, 5 to 20 percent slopes	Not prime farmland	1	42.4	2.6
Cd	Cedarbluff loam, 0 to 3 percent slopes, occasionally flooded	Prime farmland if drained	2	0.7	<0.1
Ce	Chenneby silt loam, frequently flooded	Prime farmland if protected from flooding or not frequently flooded during the growing season	5	1.5	0.1
ChC3	Collegedale clay, 5 to 12 percent slopes, severely eroded	Not prime farmland	0	2.3	0.1
ChD3	Collegedale clay, 12 to 20 percent slopes, severely eroded	Not prime farmland	0	0.8	<0.1
CkE	Collegedale-Rock outcrop complex, 20 to 35 percent slopes	Not prime farmland	0	1.5	0.1
CoC	Collegedale silt loam, 5 to 12 percent slopes	Not prime farmland	0	3.8	0.2
CoD	Collegedale silt loam, 12 to 20 percent slopes	Not prime farmland	0	11.1	0.7
DeC	Dewey silt loam, 6 to 15 percent slopes	Not prime farmland	0	44.0	2.7
DeD	Dewey silt loam, 15 to 25 percent slopes	Not prime farmland	0	71.9	4.5
DeE	Dewey silt loam, 20 to 45 percent slopes	Not prime farmland	0	62.3	3.9
DwC	Dewey silt loam, 5 to 12 percent slopes	Not prime farmland	0	1.6	0.1
DwD	Dewey silt loam, 12 to 20 percent slopes	Not prime farmland	0	2.6	0.2
DwE	Dewey silt loam, 20 to 35 percent slopes	Not prime farmland	0	6.5	0.4
EoB	Etowah loam, 2 to 5 percent slopes	All areas are prime farmland	0	4.8	0.3

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
EoC	Etowah loam, 5 to 12 percent slopes	Not prime farmland	0	12.2	0.8
FoC	Fullerton-Pailo complex, 5 to 12 percent slopes	Not prime farmland	0	23.5	1.5
FoD	Fullerton-Pailo complex, 12 to 20 percent slopes	Not prime farmland	0	69.1	4.3
FoE	Fullerton-Pailo complex, 20 to 35 percent slopes	Not prime farmland	0	69.4	4.3
Hb	Hamblen silt loam, 0 to 2 percent slopes, occasionally flooded, hydric minor component	All areas are prime farmland	3	6.5	0.4
MnC	Minvale gravelly silt loam, 5 to 12 percent slopes	Not prime farmland	0	1.3	0.1
MnC	Minvale silt loam, 5 to 12 percent slopes	Not prime farmland	0	5.4	0.3
MnD	Minvale silt loam, 12 to 20 percent slopes	Not prime farmland	0	6.0	0.4
MoE	Montevallo channery silt loam, 20 to 35 percent slopes	Not prime farmland	0	34.4	2.1
MvD	Montevallo channery silt loam, 12 to 20 percent slopes	Not prime farmland	0	2.6	0.2
NOTCOM	No Digital Data Available	--	0	972.4	60.4
SfC	Salacoa silt loam, 5 to 12 percent slopes	Not prime farmland	0	11.8	0.7
SfD	Salacoa silt loam, 12 to 20 percent slopes	Not prime farmland	0	1.3	0.1
Sk	Shady loam, occasionally flooded	All areas are prime farmland	0	2.9	0.2
SwB	Swafford loam, 2 to 5 percent slopes	All areas are prime farmland	0	7.9	0.5
TbB	Tasso loam, 2 to 5 percent slopes	All areas are prime farmland	0	6.2	0.4
TeD	Townley silt loam, 12 to 20 percent slopes	Not prime farmland	0	7.1	0.4

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
TnC	Townley silt loam, 5 to 12 percent slopes	Not prime farmland	0	2.4	0.1
Ur	Urban land	Not prime farmland	0	0.5	<0.1
UrD	Urban land, 5 to 20 percent slopes	Not prime farmland	0	2.5	0.2
W	Water	Not prime farmland	0	9.0	0.6
WaC	Waynesboro loam, 6 to 15 percent slopes	Not prime farmland	0	6.6	0.4
WaD	Waynesboro loam, 15 to 25 percent slopes	Not prime farmland	0	6.7	0.4
Ww	Whitwell loam, 1 to 4 percent slopes, occasionally flooded	All areas are prime farmland	0	3.1	0.2
	Total Prime Farmland			**50.8**	**3.2**

Source: USDA 2019a

3.5.1.1.2.5.2 Western Transmission Corridor

3.5.1.1.2.5.2.1 ***Geology, Paleontology, and Geological hazards***

L5383 is within the Western Transmission Corridor located north of Crossville and within the Cumberland Plateau Physiographic Province. The Cumberland Plateau lies between the Ridge and Valley and Highland Rim and reaches elevations between 600 to 3,000 feet in elevation. It is comprised of Pennsylvania age conglomerate, sandstone, siltstone, and shale and Mississippian to Ordovician age limestone, dolomite, and shale. The Crossville Fault, part of the Cumberland Plateau Overthrust, trends northeast to southwest and crosses the L5383 transmission corridor near the eastern extent of the proposed transmission corridor upgrades (Watkins 1964).

The paleontology and geologic hazards associated with the Western Transmission Corridor upgrades is generally the same as described in Section 3.5.1.1.2.

3.5.1.1.2.5.2.2 ***Soils and Prime Farmland***

The Western Transmission Corridor (for L5383) extends southeastward from a substation in unincorporated Crossville, on Plateau Road and terminates north of the Crossville city limits (Figure 3.5-7). Eight new access roads are proposed along the route in agricultural areas. Eighteen soil types have been mapped on the Western Transmission Corridor proposed for upgrades and the majority are composed of Lily loam, 6 to 12 percent slopes (38.5 percent); Lily loam, 2 to 6 percent slopes (22.2 percent); Ramsey-Rock outcrop complex, 12 to 20 percent slopes (13.9 percent); and Lily-Lonewood complex, 5 to 12 percent slopes, rocky (10.3 percent) (Table 3.5-5). All other soils were less than 10 percent of the Western Transmission Corridor (USDA 2019b). The Atkins loam, frequently flooded and Bonair loam, occasionally flooded, soils have a hydric rating of 100 percent.

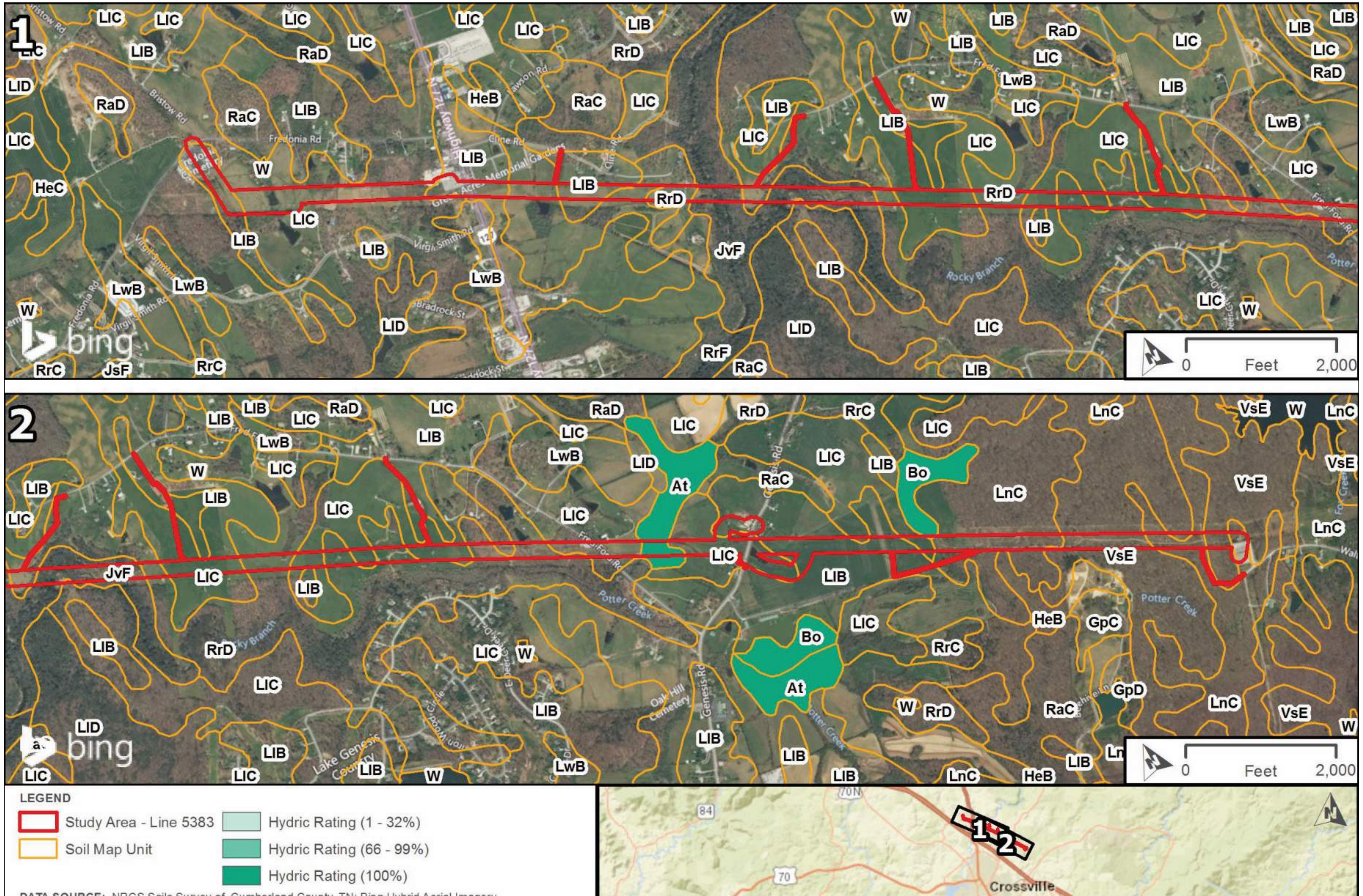

Figure 3.5-7. Soils in the Western Transmission Corridor Proposed for Upgrades under Alternative A

Figure 3.5-8. Soils Classified as Prime Farmland in the Western Transmission Corridor under Alternative A

Table 3.5-5. Soils on the Western Transmission Corridor (L5383) under Alternative A

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
At	Atkins loam, frequently flooded	Not prime farmland	100	2.1	1.7
Bo	Bonair loam, occasionally flooded	Not prime farmland	100	0.06	<0.1
HeB	Hendon silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	<0.01	<0.1
JvF	Jefferson-Varilla-Shelocta complex, 20 to 60 percent slopes, very stony	Not prime farmland	0	9.4	7.3
Llb	Lily loam, 2 to 6 percent slopes	All areas are prime farmland	0	28.8	22.2
LlC	Lily loam, 6 to 12 percent slopes	Not prime farmland	0	49.9	38.5
RrD	Ramsey-Rock outcrop complex, 12 to 20 percent slopes	Not prime farmland	0	18.0	13.9
VsE	Varilla-Shelocta complex, 15 to 30 percent slopes, very rocky	Not prime farmland	0	8.0	6.2
	Total Prime Farmland			**28.8**	**22.2**

Source: USDA 2019a

The Lily series of soils, which consist of moderately deep, well drained soils that formed in residuum weathered primarily from sandstone. These soils are on upland ridges and hillsides with slopes ranging from zero to 65 percent and are used for growing corn, tobacco, small grains, hay, and pasture. The Ramsey series soils consist of shallow and very shallow, somewhat excessively drained soils that formed in residuum or colluvium weathered from sandstone or quartzite. These soils are on plateaus and upper slopes of mountains with slopes ranging from 3 to 70 percent and are used for pasture area (USDA 2021). Based on soils data obtained from the USDA Web Soil Survey, approximately 28.8 acres (22.2 percent) of the L5383 corridor proposed for transmission line upgrades are designated as prime farmland, as summarized in Table 3.5-5 and illustrated on Figure 3.5-8.

3.5.1.1.2.6 Construction and Operation of a Natural Gas Pipeline Corridor and Associated Structure

The construction and operation of a new CC/Aero CT Plant would require construction of approximately 122 miles of new natural gas pipeline, primarily located within or adjacent to the ROW of an existing natural gas pipeline, an electric motor drive compressor station, and gas system infrastructure to connect the plant to the new gas pipeline. Additional compression requirements, if any, would be determined by the technical requirements of the CT brand chosen and located on the Kingston Reservation. This NEPA analysis considers impacts associated with construction and operation of the pipeline and associated structures as a related action.

As noted in Section 2.1.3.6, ETNG is currently evaluating the construction and proposed environmental effects of a natural gas pipeline and compressor station in connection with its application for their FERC certificate. The proposed gas pipeline system overview map is shown on Figure 2.1-4 and identifies the approximate route of a new natural gas line that would be up to 30 inches in diameter and built largely within or adjacent to existing pipeline ROW.

ETNG's Ridgeline Expansion Project encompasses the Construction ROW (including Permanent ROW), temporary workspace (TWS), and ATWS, and includes the compressor station and other aboveground project structures. However, for the purposes of this draft EIS, the project study area for the Ridgeline Expansion Project is referred to as the ETNG Construction ROW. Resource areas where site-specific study results were not yet available from ETNG were evaluated by TVA using desktop analyses of an expanded, 200-foot-wide study area boundary, centered on the natural gas pipeline centerline and hereafter referred to as the TVA Expanded Construction ROW.

The assessment first uses publicly available resources and information to perform a desktop evaluation of potentially affected resources within the TVA-defined Study Area. For resources where site-specific survey data were provided in ETNG's revised resource reports (submitted to FERC in December 2022), TVA has restricted the analysis of effects to reflect that available data provided in ETNG's Resource Reports submitted to FERC in December 2022 (Construction ROW).

Geology

The ETNG Construction ROWtransects several physiographic provinces of Tennessee, including the Valley and Ridge and Cumberland Plateau as described in Section 3.5.1.1.1.1. Going westward from KIF in the Valley and Ridge Physiographic Province, the proposed ETNG Construction ROW will cross the Cumberland Plateau, then the Eastern Highland Rim, and terminate within the Nashville Basin Physiographic Province. ETNG states in Resource Report 6 as follows (ETNG 2022g):

> The [natural gas] Project pipeline facilities are located in north-central/S Tennessee and will start in Trousdale County near Hartsville, Tennessee, extend east-southeast approximately 122.5 miles, and end in Roane County near Kingston, Tennessee. According to the Tennessee Department of Environment and Conservation (TDEC 2022a), the Project facilities will cross formations formed in the Paleozoic era, between 541 and 252 million years ago. The counties of Trousdale, Smith, and Jackson are generally dominated by Ordovician-aged sedimentary rocks, including limestone, shale, dolomite, siltstone, sandstone and claystone. Moving east along the [pipeline] Project route, the eastern portion of Jackson, Overton, and the western portion of Fentress Counties are dominated by Mississippian-aged rocks including limestone, chert, shale, siltstone, sandstone, and dolomite. Continuing east, eastern Fentress County and Morgan County are dominated by Pennsylvanian-aged sedimentary rocks, including sandstone, shale, conglomerate, siltstone and coal. Continuing to the project terminus, Roane County is dominated by Ordovician-Cambrian sedimentary rocks including dolomite, limestone, shale, chert, siltstone and sandstone.

Additionally, ETNG has identified that from milepost 36.3 to milepost 39.0, the proposed ETNG Construction ROW will cross areas of geologic interest known as the Flynn Creek impact structure and Hawkins Impact Cave. ETNG is currently communicating with the landowner and evaluating route options in this area. Of these structures, ETNG states in Resource Report 6 (ETNG 2022g) that:

> From MP 36.3 to MP 39.0, the Project crosses areas known as the Flynn Creek impact structure and Hawkins Impact Cave (Hawkins Cave). ... The Flynn Creek impact structure, located in north-central Tennessee, is a Late Devonian, 3.8-kilometer diameter, marine target impact crater, which formed in an epicontinental shelf setting. The Flynn Creek impact structure is thought to be the result of an extremely shallow meteorite impact that occurred in a marine environment approximately 360 million years ago. Following impact, the bedrock was uplifted approximately 450 meters above their normal stratigraphic positions, forming a prominent 0.75-kilometer diameter central peak, which was buried by Devonian/Mississippian-aged marine sediment that later became the Chattanooga Shale, Fort Payne, and other formations. When formed, the crater was likely about 100 to 120 meters deep relative to the surrounding surface (O'Dale 2022).
>
> In a post-impact phase, the Upper Devonian Chattanooga Shale was deposited in the impact crater and across what was then a shallow marine shelf. The ejecta blanket, terraced crater rim, crater-moat breccias, and central uplift were subjected to intensive erosion. This episode of erosion was followed by local transgression of the Kaskaskia Sea, which subsequently inundated the area. After Chattanooga Shale was deposited over the area including the crater, hundreds of meters of other types of sediments were deposited in the same area. Regional uplift along the Nashville Dome has accelerated erosion in the Flynn Creek impact structure, which has generated an extensive valley network that cuts into, and thus helps expose, the terraced rim, breccia fill, and central peak (O'Dale 2022).
>
> The Hawkins Cave lies in the core of the central uplift of the Flynn Creek impact structure. The Hawkins Cave is the only cave in the world known to have formed inside the central uplift of a complex impact crater. The cave was discovered in 1989 by a local landowner, Michael Hawkins, and mapped in 2003. It was formed where water penetrated the major faults from the impact, preferentially dissolving limestone along these major faults, and over time, dissolved them away. As the water table continued to drop, collapse along bedding planes and microfractures enlarged the Hawkins Cave passages. The Hawkins Cave features two large rooms. [ETNG] is currently reviewing available mapping and technical documents in an effort to determine an approximate location of the cave extent in relation to the proposed pipeline.
>
> The Flynn Creek impact structure was studied by NASA in advance of moon landing missions, and it and Hawkins Cave continue to be the site of geological research for several universities (Milam et al. 2005).

Paleontology

The paleontology associated with the 122-mile ETNG Construction ROW is the same as described in Section 3.5.1.1.1.2. While fossils may be found throughout the state, unique paleontological resources are not known to exist within the ETNG Construction ROW based on a review of desktop resources (TDEC 2022b). The natural gas pipeline would have the potential to encounter paleontological resources; however, encountering unique and/or significant paleontological resources would be unexpected.

Geological Hazards

The geological hazards associated with the eastern portion of the 122-mile ETNG Construction ROW are the same as described in Section 3.5.1.1.1. The corridor may transverse steep slopes and rugged natural areas as it crosses from the Valley and Ridge Physiographic Province into the Cumberland Plateau and may do so again as it crosses from the Eastern Highland Rim Physiographic Province into the Nashville Basin. Therefore, landslides could be a potential risk along the ETNG Construction ROW. Landslides have a higher likelihood in areas with increased steeper slopes. Landslides can be initiated by rainfall, snowmelt, changes in water level, stream erosion, changes in groundwater, earthquakes, disturbance by human activities, or any combination of these activities. Review of USGS fault mapping indicates that there are no active faults within the Study Area (USGS 2022a).

The USGS produces hazard probability peak ground acceleration maps. Earthquake shaking that is described as strong, very strong, or more violent using the Modified Mercalli Intensity (MMI) (VI and greater) has caused significant slope failures during past seismic events. Using relationships between Modified Mercalli Intensity, peak ground acceleration (PGA) and peak ground velocity (PGV) (Worden et al., 2012), a MMI of VI and higher translates into an unstable slope triggering PGA of 0.12-0.22 g (12-22 percent of gravity) and greater or a PGV of 9.6-20 cm/s (3.8-7.9 in./s) or greater. For example, Mackey and Quigley (2014) and Massey et al. (2014) documented that rock cliffs subjected to PGA and PGV in this range experienced rockfall. The lower limit for any seismic triggering of landslides may be as low as 0.02-0.08 g (Jibson and Harp 2016) so some discretion about whether one is interested in isolated landslides on very susceptible slopes or concentrated land sliding on most susceptible slopes is warranted. PGA values are represented at factors of “g”, the acceleration of a falling object due to gravity.

The USGS produces hazard probability peak ground acceleration maps. Peak ground acceleration values are represented at factors of “g”, the acceleration of a falling object due to gravity. The USGS Seismic Hazard Maps indicate there is a 2 percent probability of reaching a 13 to 15 precent “g” in 50 years. Based on a review of the USGS Peak Ground Acceleration Map (USGS 2020), the risk for seismic ground motion (earthquakes) to cause damage to structures in the Study Area is low to moderate. From this, it is noted that earthquakes and seismic hazards are unlikely to occur in the Study Area. In addition, given the low potential for earthquakes to occur in the vicinity of the Study Area, the potential for soil liquefaction to occur in the Study Area is low. ETNG evaluated the risks associated with slope instability based on available USGS maps. Land areas are categorized by USGS based on susceptibility to landslides, as well as past incidence of landslides. According to ETNG, their project would cross areas in the following risk categories: low susceptibility and incidence, moderate susceptibility and incidence, high susceptibility and low incidence, and high susceptibility and moderate incidence, as summarized in Table 3.5-6, taken from ETNG Resource Report 06 (ETNG 2022g).

Table 3.5-6. Landslide Susceptibility and Incidence Summary

County, State	Milepost Begin	Milepost End	Landslide Susceptibility and Incidence
Trousdale, Smith, and Jackson, TN	0.0	30.0	Low susceptibility and incidence
Jackson and Putnam, TN	30.0	48.5	Moderate susceptibility and incidence
Putnam, TN	48.5	56.5	Low susceptibility and incidence
Putnam and Overton, TN	56.5	65.5	Moderate susceptibility and incidence
Overton, Fentress, and Morgan TN	65.5	87.0	High susceptibility, low incidence
Morgan and Roane, TN	87.0	122.0	High susceptibility, moderate incidence

Source: ETNG 2022g

Ground subsidence, involving the localized or regional lowering of the ground surface, may be caused by karst dissolution, sediment compaction, oil and gas extraction, underground mines, and groundwater pumping. In many areas of Middle Tennessee, the bedrock is limestone and is usually exposed at the surface, forming rocky ledges and barrens. These areas also develop into karst landscapes. The Study Area crosses areas with high sensitivity to karst and a high incidence of sinkhole and cave development (Tennessee Cave Survey 2001; UTIA 2018). Based on the presence of carbonate rocks at or near the land surface, the proposed pipeline would likely cross karst areas in Trousdale, Smith, Jackson, Putnam, Overton, and Roane counties. Preliminary analysis indicates that the ETNG Construction ROW would transverse seven potential karst areas for a total of approximately 55 miles (with the shortest crossing being one mile, and the longest crossing being over 18 miles) (ETNG 2022g). An estimated 1,515 acres, or 51 percent of the Study Area, contains geology favorable for karst terrain.

Soils

Approximately 181 unique soil types are mapped within the proposed natural gas pipeline Study Area. These soils range from somewhat excessively drained to poorly drained and are dominated by silty loam textures. These soils have a deep depth to the root restrictive layer, at which soil conditions become unfavorable to root penetration. They typically do not flood or pond and rarely meet hydric criteria.

The Lily series soils consist of moderately deep, well drained soils that formed in residuum weathered primarily from sandstone. These soils are on upland ridges and hillsides with slopes ranging from zero to 65 percent and are used for growing corn, tobacco, small grains, hay, and pasture. The Barfield series soils consist of shallow well drained to excessively drained, moderately slow permeable soils that formed in residuum from limestone. These soils are on uplands with slopes ranging from one to 70 percent and are used for pasture. The Ashwood series soils consist of moderately deep, well drained soils that formed in residuum weathered from phosphatic limestone. These soils are on uplands with slopes ranging from two to 70 percent and are used for pasture. The Hawthorne series soils consist of moderately deep, somewhat excessively drained soils that formed in residuum of interbedded siltstone and cherty limestone. These soils are on uplands with slopes ranging from five to 70 percent and are used for pasture or hay (USDA 2022).

The construction workspace associated with the pipeline compressor station would encompass four different soil map units (ETNG 2022h). These soil types are Barfield-Ashwood-Rock outcrop complex, five to 20 percent slopes; Harpeth silt loam, five to 10 percent slopes, eroded; Mimosa silt loam, five to 12 percent slopes, eroded; and Mimosa silt loam, 12 to 20 percent slopes, eroded. The construction workspace associated with the Columbia Gulf M&R Station would cross two different soil map units. These are Egam silt loam, occasionally flooded, and Byler silt loam, one to four percent slopes. The construction workspace associated with the Gainsboro Crossover Site would cross two different soil map units. These are Mimosa silty clay loam, five to 12 percent slopes, eroded, and Mimosa silty clay loam, 12 to 20 percent slopes, eroded. The construction workspace associated with the Clarkrange Crossover Site would cross one soil map unit, Lily loam, three to eight percent slopes.

According to ETNG's Resource Report 7 (ETNG 2022h):

> The Texas Eastern Transmission, LP (Texas Eastern) and Midwestern Gas Transmission Company (Midwestern Gas) Meter and Regulating (M&R) Stations are existing paved sites; native soil is not present. […] [ETNG] is currently evaluating a location for the [Kingston M&R Station and Harriman Lateral Crossover Site] and will provide the corresponding soil information for the final locations in the Project Application. […] The locations of the pipe/contractor yards have not been finalized at this time. Land requirements for the proposed pipe/contractor yards will be provided in the Project Application. […] [ETNG] has identified 77 temporary access roads (TARS) to provide construction access to the ROWs for construction of the mainline and lateral pipelines. [ETNG] utilized existing roads or driveways as TARs wherever feasibly possible. In addition, 17 new permanent access roads (PARs) are proposed to provide permanent use for ongoing operations and maintenance activities following construction. These PARs will provide access at select locations along the pipeline ROW and to the aboveground facilities and will be maintained by [ETNG's] operations personnel.

Table 3.5-7. Soils within the ETNG Construction Right-of-Way

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
AaC3	Allen clay loam, 5 to 12 percent slopes, severely eroded	Not prime farmland	0	3.0	0.2
Ac	Allegheny-Cotaco complex, occasionally flooded	All areas are prime farmland	2	30.4	1.6
AmB	Allen loam, 2 to 5 percent slopes	All areas are prime farmland	0	1.1	0.1
AmB2	Armour silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	24.6	1.3
AmC	Allen loam, 5 to 12 percent slopes	Not prime farmland	0	0.8	<0.1
AmC	Armuchee silt loam, 5 to 12 percent slopes	Not prime farmland	0	0.4	<0.1
AmC2	Armour silt loam, 5 to 12 percent slopes	Not prime farmland	0	4.6	0.2
AmD	Allen loam, 12 to 20 percent slopes	Not prime farmland	0	3.3	0.2
AmD	Armuchee silt loam, 12 to 20 percent slopes	Not prime farmland	0	1.1	0.1

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
AmD2	Armour silt loam, 12 to 20 percent slopes	Not prime farmland	0	5.7	0.3
Ar	Arrington silt loam, 0 to 2 percent slopes, occasionally flooded	All areas are prime farmland	0	21.8	1.1
AwE	Ashwood-Mimosa-Rock outcrop complex, 15 to 45 percent slopes	Not prime farmland	0	47.7	2.4
BaC	Barfield-Rock outcrop complex, 5 to 20 percent slopes	Not prime farmland	0	7.5	0.4
BaC2	Sengtown gravelly silt loam, 5 to 12 percent slopes	Not prime farmland	0	1.9	0.1
BaE	Baxter cherty silt loam, 20 to 30 percent slopes	Not prime farmland	0	14.0	0.7
BaF	Barfield-Gladdice-Rock outcrop complex, 30 to 70 percent slopes	Not prime farmland	0	27.9	1.4
BcD3	Baxter cherty silty clay loam, 12 to 20 percent slopes, severely eroded	Not prime farmland	0	0.6	<0.1
BcE3	Sengtown gravelly silty clay loam, 20 to 30 percent slopes, severely eroded	Not prime farmland	0	0.9	<0.1
BcF	Barfield-Ashwood-Rock outcrop complex, 20 to 50 percent slopes	Not prime farmland	0	13.8	0.7
BeB	Bewleyville silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	3.1	0.2
BeC	Bewleyville silt loam, 5 to 12 percent slopes	Not prime farmland	0	1.0	0.1
BeC2	Bewleyville silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	10.1	0.5
BfC	Barfield-Ashwood-Rock outcrop complex, 5 to 20 percent slopes	Not prime farmland	0	65.6	3.4
BfF	Barfield-Ashwood-Rock outcrop complex, 20 to 50 percent slopes	Not prime farmland	0	10.3	0.5
Bm	Bethesda-mines pit complex, 10 to 80 percent slopes	Not prime farmland	0	9.8	0.5
BmC3	Bewleyville silty clay loam, 5 to 12 percent slopes, severely eroded	Not prime farmland	0	2.3	0.1
BrC2	Bradyville silt loam, 5 to 12 percent slopes	Not prime farmland	0	<0.1	<0.1
ByB	Byler silt loam, 1 to 4 percent slopes	All areas are prime farmland	0	11.7	0.6
ByF	Bouldin and Grimsley soils, 20 to 70 percent slopes, very stony	Not prime farmland	0	1.7	0.1
CcC3	Christian silty clay loam, 5 to 12 percent slopes, severely eroded	Not prime farmland	0	3.3	0.2
CcD3	Christian silty clay loam, 12 to 20 percent slopes, severely eroded	Not prime farmland	0	6.6	0.3
CcE3	Christian silty clay loam, 20 to 30 percent slopes, severely eroded	Not prime farmland	0	2.8	0.1
ChC	Christian loam, 5 to 12 percent slopes	Not prime farmland	0	1.8	0.1

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
ChC2	Christian loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	11.4	0.6
ChD2	Christian loam, clay loam substratum, 12 to 20 percent slopes, eroded	Not prime farmland	0	5.4	0.3
ChE	Christian loam, 20 to 30 percent slopes	Not prime farmland	0	1.6	0.1
CkB	Clarkrange loam, 2 to 5 percent slopes	All areas are prime farmland	0	0.2	<0.1
CpB	Capshaw silt loam, 2 to 6 percent slopes	All areas are prime farmland	0	6.0	0.3
CrC2	Christian silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	10.3	0.5
DaF	Dellrose and Mimosa soils, 20 to 60 percent slopes	Not prime farmland	0	3.6	0.2
DeC	Dellrose gravelly silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	11.2	0.6
DeC	Dewey silt loam, 6 to 15 percent slopes	Not prime farmland	0	4.2	0.2
DeD	Dewey silt loam, 15 to 25 percent slopes	Not prime farmland	0	11.8	0.6
DeE	Dewey silt loam, 20 to 45 percent slopes	Not prime farmland	0	8.3	0.4
DeF	Dellrose gravelly silt loam, 20 to 45 percent slopes, eroded	Not prime farmland	0	0.1	<0.1
Dk	Dickson silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	9.9	0.5
DkC2	Dickson silt loam, 5 to 12 percent slopes	Not prime farmland	0	0.3	<0.1
Eg	Egam silt loam, occasionally flooded	All areas are prime farmland	0	14.2	0.7
En	Ennis silt loam, local alluvium	All areas are prime farmland	0	1.1	0.1
FuC	Fullerton-Pailo complex, 5 to 12 percent slopes	Not prime farmland	0	1.4	0.1
FuD	Fullerton-Pailo complex, 12 to 20 percent slopes	Not prime farmland	0	0.5	<0.1
FuE	Fullerton-Pailo complex, 20 to 35 percent slopes	Not prime farmland	0	10.4	0.5
GnC	Gilpin silt loam, 5 to 12 percent slopes	Not prime farmland	0	45.0	2.3
GnD	Gilpin silt loam, 12 to 20 percent slopes	Not prime farmland	0	35.8	1.8
GpC	Gilpin loam, 5 to 12 percent slopes	Not prime farmland	0	2.5	0.1
GpD	Gilpin loam, 12 to 20 percent slopes	Not prime farmland	0	4.1	0.2
GpE	Gilpin loam, 20 to 40 percent slopes	Not prime farmland	0	24.4	1.2
GpE	Gilpin-Petros complex, 20 to 35 percent slopes	Not prime farmland	0	30.1	1.5
GpF	Gilpin-Petros complex, 35 to 80 percent slopes	Not prime farmland	0	10.2	0.5
GsF	Gilpin-Boulin-Petros complex, 25 to 80 percent slopes, very stony	Not prime farmland	0	19.4	1.0

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
GsF	Gilpin-Shelocta complex, 40 to 70 percent slopes	Not prime farmland	0	9.0	0.5
Ha	Hamblen silt loam, 0 to 3 percent slopes, occasionally flooded, hydric minor component	All areas are prime farmland	4	8.1	0.4
HaB	Hartsells loam, 2 to 5 percent slopes	All areas are prime farmland	0	1.8	0.1
HaC	Hartsells loam, 5 to 12 percent slopes	Not prime farmland	0	0.7	0.1
HaC2	Hampshire silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	1.9	0.1
HaC2	Hartsells loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	3.1	0.2
HaD2	Hampshire silt loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	6.9	0.4
HbD	Hawthorne gravelly silt loam, 5 to 20 percent slopes	Not prime farmland	0	11.2	0.6
HbF	Hawthorne gravelly silt loam, 20 to 60 percent slopes	Not prime farmland	0	63.2	3.2
HhB2	Harpeth silt loam, 2 to 5 percent slopes, eroded	All areas are prime farmland	0	9.7	0.5
HhC2	Harpeth silt loam, 5 to 10 percent slopes, eroded	Not prime farmland	0	7.5	0.4
HnB	Holston loam, 2 to 5 percent slopes	All areas are prime farmland	0	0.1	<0.1
HoB	Holston silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	19.0	1.0
HoC	Holston silt loam, 5 to 12 percent slopes	Not prime farmland	0	4.3	0.2
HoC2	Holston silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	20.8	1.1
HoD2	Holston loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	3.2	0.2
Ht	Huntington fine sandy loam	All areas are prime farmland	0	7.1	0.4
Hu	Huntington silt loam	All areas are prime farmland	0	3.4	0.2
HuB	Humphreys gravelly silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	1.7	0.1
HuC	Humphreys gravelly silt loam, 5 to 12 percent slopes	Not prime farmland	0	0.9	<0.1
Hv	Huntington silt loam, local alluvium	All areas are prime farmland	0	2.2	0.1
InD2	Inman flaggy silty clay loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	1.4	0.1
InE2	Inman flaggy silty clay loam, 20 to 30 percent slopes, eroded	Not prime farmland	0	20.6	1.1
JeE	Jefferson loam, 12 to 35 percent slopes	Not prime farmland	0	5.2	0.3

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
JeE	Jefferson-Ramsey complex, 15 to 35 percent slopes	Not prime farmland	0	3.7	0.2
LaB	Landisburg silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	3.5	0.2
LaC	Landisburg silt loam, 5 to 12 percent slopes	Not prime farmland	0	3.1	0.2
LbB	Lily loam, 2 to 5 percent slopes	All areas are prime farmland	0	31.4	1.6
LbC	Lily loam, 5 to 12 percent slopes	Not prime farmland	0	50.9	2.6
LbD	Lily loam, 12 to 20 percent slopes	Not prime farmland	0	4.1	0.2
Ld	Lindell silt loam, 0 to 2 percent slopes, occasionally flooded	All areas are prime farmland	4	0.7	<0.1
LgC	Lily-Gilpin complex, 5 to 12 percent slopes	Not prime farmland	0	44.3	2.3
LgD	Lily-Gilpin complex, 12 to 20 percent slopes	Not prime farmland	0	14.4	0.7
LgE	Lily-Gilpin complex, 20 to 35 percent slopes	Not prime farmland	0	4.4	0.2
LlB	Lily loam, 2 to 6 percent slopes	All areas are prime farmland	0	1.4	0.1
LlC	Lily loam, 3 to 8 percent slopes	All areas are prime farmland	0	127.9	6.5
LlC	Lily loam, 6 to 12 percent slopes	Not prime farmland	0	68.9	3.5
LlD	Lily loam, 12 to 20 percent slopes	Not prime farmland	0	6.6	0.3
Lm	Lawrence silt loam	All areas are prime farmland	8	0.2	<0.1
LmC	Lily-Ramsey complex, 5 to 12 percent slopes	Not prime farmland	0	6.2	0.3
LmD	Lily-Ramsey complex, 12 to 20 percent slopes	Not prime farmland	0	24.3	1.2
LmE	Lily-Ramsey complex, 20 to 35 percent slopes	Not prime farmland	0	3.4	0.2
Ln	Lindell silt loam, 0 to 2 percent slopes, occasionally flooded	All areas are prime farmland	4	14.1	0.7
LoB	Lonewood silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	4.1	0.2
LoC	Lonewood-Clarkrange complex, 2 to 6 percent slopes	All areas are prime farmland	0	42.6	2.2
LoC	Lonewood silt loam, 5 to 12 percent slopes	Not prime farmland	0	19.8	1.0
LwB	Lonewood loam, 2 to 5 percent slopes	All areas are prime farmland	0	17.4	0.9
LwC	Lonewood loam, 5 to 12 percent slopes	Not prime farmland	0	18.8	1.0
Ma	Melvin silt loam	Not prime farmland	100	2.3	0.1
Me	Melvin silt loam, frequently flooded	Not prime farmland	100	0.8	<0.1
MeC	Minvale silt loam, 5 to 12 percent slopes	Not prime farmland	0	0.4	<0.1
MmC2	Mimosa-Ashwood complex, 5 to 12 percent slopes, eroded	Not prime farmland	0	20.8	1.1

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
MmC2	Mimosa silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	27.7	1.4
MmC2	Mimosa silty clay loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	13.1	0.7
MmD2	Mimosa silt loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	15.4	0.8
MmD2	Mimosa silty clay loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	11.8	0.6
MmD3	Mimosa silty clay, 8 to 20 percent slopes, severely eroded	Not prime farmland	0	1.1	0.1
Mn	Minter silt loam, occasionally flooded	Not prime farmland	100	0.1	<0.1
MnB	Monongahela silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	18.1	0.9
MnC	Minvale gravelly silt loam, 5 to 12 percent slopes	Not prime farmland	0	2.4	0.1
MnC2	Mimosa silt loam, 5 to 20 percent slopes, eroded, very rocky	Not prime farmland	0	10.8	0.6
MoE	Montevallo channery silt loam, 20 to 35 percent slopes	Not prime farmland	0	15.3	0.8
MrD	Muskingum very rocky sandy loam, 12 to 20 percent slope	Not prime farmland	0	1.0	0.1
MrD2	Mimosa-Ashwood complex, 12 to 30 percent slopes, rocky	Not prime farmland	0	32.2	1.6
MsB	Mountview silt loam, shallow, 2 to 5 percent slopes	All areas are prime farmland	0	0.7	<0.1
MsC2	Mountview silt loam, shallow, 5 to 12 percent slopes, eroded	Not prime farmland	0	0.7	<0.1
MsC3	Mountview silt loam, shallow, 5 to 12 percent slopes, severely eroded	Not prime farmland	0	0.7	<0.1
MtB2	Mountview silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	16.3	0.8
MtC2	Mountview silt loam, 5 to 12 percent slopes	Not prime farmland	0	4.5	0.2
MuC	Muskingum silt loam, 5 to 12 percent slopes	Not prime farmland	0	0.2	<0.1
MuE	Muskingum silt loam, 20 to 30 percent slopes	Not prime farmland	0	<0.1	<0.1
MvB	Mountview silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	6.8	0.4
MvC2	Mountview silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	1.6	0.1
NeB2	Nesbitt silt loam, 2 to 6 percent slopes, eroded	All areas are prime farmland	0	0.8	<0.1
NeC2	Nesbitt silt loam, 6 to 12 percent slopes, eroded	Not prime farmland	0	0.2	<0.1
Oc	Ocana gravelly silt loam, 0 to 3 percent slopes, occasionally flooded	All areas are prime farmland	0	52.8	2.7

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
PaB	Paden silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	12.1	0.6
Pd	Purdy silt loam	Not prime farmland	100	4.1	0.2
Pd	Purdy silt loam, ponded	Not prime farmland	85	0.1	<0.1
Pp	Pope-Philo complex, frequently flooded	Prime farmland if protected from flooding or not frequently flooded during the growing season	2	1.2	0.1
RaC	Ramsey loam, 5 to 12 percent slopes	Not prime farmland	0	0.9	<0.1
RaD	Ramsey-Alticrest-Rock outcrop complex, 5 to 20 percent slopes	Not prime farmland	0	9.0	0.5
RaD	Ramsey loam, 12 to 20 percent slopes	Not prime farmland	0	2.0	0.1
SeB	Sequatchie loam, 2 to 5 percent slopes	All areas are prime farmland	0	4.4	0.2
SeC2	Sequatchie loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	1.8	0.1
SeD	Sengtown gravelly silt loam, 12 to 20 percent slopes	Not prime farmland	0	6.4	0.3
ShB	Shady loam, 2 to 5 percent slopes	All areas are prime farmland	0	2.6	0.1
Sk	Skidmore gravelly loam, occasionally flooded	Not prime farmland	0	20.7	1.1
SpF	Shelocta-Pineville complex, 20 to 70 percent slopes, very stony	Not prime farmland	0	7.0	0.4
StC2	Sengtown gravelly silt loam, 5 to 12 percent slopes	Not prime farmland	0	5.8	0.3
Su	Sullivan silt loam, depressional	Not prime farmland	0	6.0	0.3
SuC2	Sugargrove gravelly silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	23.6	1.2
SuD2	Sugargrove gravelly silt loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	19.6	1.0
SwB	Swafford loam, 2 to 5 percent slopes	All areas are prime farmland	0	2.3	0.1
SwC	Swafford loam, 5 to 12 percent slopes	Not prime farmland	0	1.8	0.1
SyB	Sykes silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	1.0	0.1
SyB2	Sykes silt loam, 2 to 5 percent slopes, eroded	All areas are prime farmland	0	5.0	0.3
SyC2	Sykes silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	6.9	0.4
TbC	Talbott silt loam, 3 to 10 percent slopes, rocky	Not prime farmland	0	1.9	0.1
TeC	Townley silt loam, 5 to 12 percent slopes	Not prime farmland	0	3.1	0.2
TeD	Townley silt loam, 12 to 20 percent slopes	Not prime farmland	0	9.9	0.5

Soil Map Unit Symbol	Soil type	Farmland classification	Hydric Rating	Area (acres)	Percentage of area
Ty	Tyler silt loam	All areas are prime farmland	8	4.6	0.2
uAlgB2	Algood silt loam, 2 to 5 percent slopes, eroded	All areas are prime farmland	0	1.7	0.1
uAlgC2	Algood gravelly silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	13.7	0.7
uAlgD2	Algood gravelly silt loam, 12 to 20 percent slopes, eroded	Not prime farmland	0	10.8	0.6
uAlgE	Algood gravelly silt loam, 20 to 30 percent slopes	Not prime farmland	0	3.3	0.2
uBemF	Beetree-Muse complex, 15 to 40 percent slopes, stony	Not prime farmland	0	13.2	0.7
uBlhF	Standingstone-Hayter complex, 15 to 40 percent slopes, very rocky	Not prime farmland	0	11.9	0.6
uBouF	Bouldin very cobbly fine sandy loam, 15 to 40 percent slopes, very stony	Not prime farmland	0	5.9	0.3
uCanF	Caneyville-Rock outcrop-Standingstone complex, 12 to 35 percent slopes	Not prime farmland	0	<0.1	<0.1
uCbrE	Carbo-Rock outcrop complex, 12 to 30 percent slopes	Not prime farmland	0	3.8	0.2
uColC2	Colbert silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	7.8	0.4
UD	Udorthents, gravelly, undulating	Not prime farmland	0	3.4	0.2
uDewC2	Dewey silt loam, 5 to 12 percent slopes, eroded	Not prime farmland	0	0.1	<0.1
uNelC	Nella cobbly loam, 5 to 12 percent slopes	Not prime farmland	0	5.1	0.3
uNelD	Nella cobbly loam, 12 to 20 percent slopes	Not prime farmland	0	3.8	0.2
uNelE	Nella cobbly loam, 20 to 30 percent slopes	Not prime farmland	0	0.9	<0.1
uSeqE	Sequoia silty clay loam, 15 to 30 percent slopes	Not prime farmland	0	0.7	<0.1
W	Water	Not prime farmland	0	2.8	0.1
WaC	Waynesboro loam, 6 to 15 percent slopes	Not prime farmland	0	3.6	0.2
WaD	Waynesboro loam, 15 to 25 percent slopes	Not prime farmland	0	3.2	0.2
WeC	Wellston silt loam, 5 to 12 percent slopes	Not prime farmland	0	0.2	<0.1
WrB	Wernock silt loam, 2 to 5 percent slopes	All areas are prime farmland	0	35.1	1.8
WrC	Wernock silt loam, 5 to 12 percent slopes	Not prime farmland	0	48.0	2.5
	Total Prime Farmland			**586.3**	**30.0**

Source: USDA 2019a

Prime Farmland

Table 3.5-4 describes the soil types, including those classified as prime farmland, located within the ETNG Construction ROW. Based on soils data obtained from the USDA Web Soil Survey (USDA 2019b), approximately 586.3 acres (30.0 percent) are designated as prime farmland, as illustrated on Prime Farmland figures in Appendix D-2.

3.5.1.1.3 Alternative B

3.5.1.1.3.1 East Tennessee TVA Power Service Area

TVA anticipates that the solar facilities proposed under Alternative B would be primarily located in East Tennessee to offset transmission system upgrades that may be required following the retirement of KIF. Power from these facilities would typically be delivered by direct connection to TVA's transmission system or via interconnections with local power companies that distribute power from TVA.

Geology

A portion of the potential solar and storage facility sites would be located within East Tennessee, which lies within the Cumberland Plateau, Highland Rim, and Valley and Ridge Physiographic Provinces.

The Valley and Ridge Province is characterized by northeast-trending ridges underlain by resistant rock separated by valleys underlain by less resistant rock. The rock formations are steeply tilted and crop out in long, narrow belts parallel to the trend of ridges and valleys, some belts are bounded by faults (Zurawski 1978). Bedrock in the province is primarily massive beds of Cambrian to Ordovician age shale and siltstone and massive beds of limestone and dolomite of Cambrian Age (Hardeman et al. 1966). The Valley and Ridge is a heavily faulted area and features the major Chattanooga Fault system.

The Cumberland Plateau lies between the Valley and Ridge and Highland Rim and reaches elevations between 600 to 3,000 feet in elevation. It is comprised of Pennsylvania age conglomerate, sandstone, siltstone, and shale and Mississippian to Ordovician age limestone, dolomite, and shale.

The Highland Rim Province is a plateau characterized by rolling hills to flat areas in the northwest and southeast, which lies between the Cumberland Plateau and Gulf Coastal Plain. Bedrock in the area is Mississippian limestones, chert, shale, and sandstone. Underlying bedrock of the region is chiefly Mississippian to Ordovician-age limestone, chert, shale, siltstone, and sandstone (Luther 2018; Griffith et al. 1997).

Paleontology

The paleontology associated with the TVA Power Service Area (PSA) would be generally the same as described in Section 3.5.1.1.1.2.

Geological Hazards

The geological hazards under Alternative B would be generally consistent with those described in Section 3.5.1.1.1.3.

Soils

Given the lack of identified potential solar and storage facility sites, it is not possible to provide a detailed description of the soils at potential facility sites at this time. Generally, soils in East Tennessee are composed of loamy and clayey textures and range from excessively drained to well drained.

Prime Farmland

Approximately 11 percent of the East Tennessee TVA PSA is classified as prime farmland (USDA 2019a). An additional 0.6 percent would be classified as prime farmland if drained or protected from flooding. Trends in recent decades show an increase in developed land, mostly through conversion of farmland.

3.5.1.2 Environmental Consequences

3.5.1.2.1 The No Action Alternative

Under the No Action Alternative, current operations would continue. TVA would implement the planned actions related to the current and future management and storage of CCRs at KIF, which have either been reviewed or would be in subsequent NEPA analyses. There would be no anticipated adverse cumulative effects, either direct or indirect, to geology, soils, or prime farmland.

3.5.1.2.1.1 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Under all Action Alternatives, TVA would retire, decommission, deactivate, decontaminate, and deconstruct the KIF units and associated infrastructure. These activities would affect geologic resources by the removal of the fossil plant and associated structures with controlled explosives, which would result in vibrations at the surface in the immediate vicinity of the facility when they are felled. Buildings within the deconstruction boundary would be deconstructed and decontaminated to a depth of three feet below grade, which would generate vibrations throughout the course of deconstruction of the buildings and grading and backfilling of the facility. Due to the small size of the subsurface disturbances and existing industrial development of the site, only minor direct effects to potential subsurface geological resources are anticipated. Following removal of the buildings, disturbed ground/soils would be stabilized with native vegetation to prevent sedimentation or erosion. No adverse cumulative impacts to geology, soils, or prime farmland are anticipated.

3.5.1.2.1.2 Environmental Justice Considerations

Effects to geology and soil resources that would occur as a result of the Kingston coal facility retirement and D4 activities are not anticipated to have amplified effects on EJ populations within the Kingston Reservation. These effects would be minor and limited to the TVA-owned Kingston Reservation, where no residential populations are present.

3.5.1.2.2 Alternative A

3.5.1.2.2.1 Construction and Operation of CC/Aero CT Plant and Switchyard on Kingston Reservation

Geology and Paleontology

Under Alternative A, minor effects to geology could occur. Foundations for equipment anticipated for the proposed CC/Aero CT Plant would be excavated. Transmission structures are typically driven or drilled into the ground to shallow depths. Due to the small size of the subsurface disturbances, only minor direct effects to potential subsurface geological resources are anticipated.

In the event paleontological resources (e.g., fossilized vertebrate remains, such as bones, teeth, etc.) are encountered during construction, the construction contractor would report the finding to on-site inspection staff. The inspection staff would temporarily suspend construction activities in the immediate area of the paleontological finding, while a qualified paleontologist is consulted. The on-site inspection staff would coordinate with TVA's Kingston project manager to determine the appropriate actions if the find is determined to be a significant paleontological resource. TVA would comply with applicable laws, regulations, procedures, and recommendations from the Tennessee Geological Survey.

Geologic Hazards
Based on regional data, the potential for minor seismic activity exists due to Alternative A's proximity to both the Eastern Tennessee and the New Madrid Seismic Zones. The facilities would be designed to comply with applicable seismic standards. In the unlikely event of seismic activity, it would likely cause minor effects to the project site and equipment on the site based on construction activities meeting state and federal earthquake/seismic guidelines. No other geologic hazards are anticipated.

Soils
Vegetation clearing, grading, and other site preparation activities associated with the construction of the CC/Aero CT Plant have the potential to disturb soil stability and increase erosion. The CC/Aero CT Plant would occupy approximately 30 acres, and an additional 10 to 25 acres on site would be used for equipment laydown and mobilization, for a total CC/Aero CT Plant footprint of 55 acres. Subsurface piles or other deep foundation systems would be installed to support foundations for plant components, as required. This area would experience minor permanent impacts due to clearing, grading, and fill related to the construction of the CC/Aero CT Plant.

Effects to soils associated with grading and site preparation activities would be temporary and mitigated through BMPs identified in Section 2.3. Stockpiled soils from the area where vegetation clearing and grading occurs, including topsoil, would be appropriately replaced following cut-and-fill activities to the extent practical and, therefore, would likely not require any off-site or on-site hauling of soils. However, some minor off-site or on-site hauling may be necessary.

Although not anticipated, should borrow material be required for project activities, sand and gravel aggregate may be obtained from local, permitted, off-site sources. The creation of new impervious surface, in the form of the CC/Aero CT Plant facility and associated components, would result in a minor increase in stormwater runoff and potential increase in soil erosion. Operation of the CC/Aero CT Plant would not impact soils. No adverse cumulative impacts to soils are anticipated.

Prime Farmland
Based on soils data obtained from the USDA Web Soil Survey, within a five-mile radius of the Kingston Reservation, approximately 4,619 acres (6.3 percent) have soils classified as prime farmland. There are no soils classified as prime farmland with the potential to be impacted by the proposed CC/Aero CT Plant or switchyard (USDA 2022). Effects on nearby prime farmland soils would be reduced using appropriate BMPs to control erosion and limit sediment and soil from leaving the CC/Aero CT Plant site. Thus, no effects or cumulative effects to prime farmland are anticipated from the proposed construction of the CC/Aero CT Plant and switchyard on the Kingston Reservation under Alternative A.

3.5.1.2.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

Geology
Foundations for equipment anticipated for the proposed 3- to 4-MW Solar Facility would be excavated and structures are typically driven or drilled into the ground to shallow depths. Due to the small size of the subsurface disturbances, only minor direct effects to potential subsurface geological resources are anticipated.

Paleontology

Since the proposed location is situated on a previously disturbed, former coal yard area on the Kingston Reservation, paleontological resources are not likely to be encountered during construction. In the event paleontological resources (e.g., fossilized vertebrate remains such as bones, teeth, etc.) are encountered during construction, the construction contractor would report the finding to TVA. The construction activities would be suspended in the immediate area of the paleontological finding while a qualified paleontologist is consulted. TVA would coordinate with the qualified paleontologist to determine the appropriate actions if the find is determined to be a significant paleontological resource. TVA would comply with applicable laws, regulations, procedures and recommendations from the Tennessee Geological Survey.

Geological Hazards

Based on regional data, the potential for minor seismic activity exists due to Alternative A's proximity to both the Eastern Tennessee and the New Madrid Seismic Zones. The facilities would be designed to comply with applicable seismic standards. In the unlikely event of seismic activity, it would likely cause minor effects to the project site and equipment on the site based on construction activities meeting state and federal earthquake/seismic guidelines. No other geologic hazards are anticipated.

Soils

Under Alternative A, the construction and operation of a 3- to 4-MW solar facility on an approximately 35-acre existing coal yard used for the KIF would result in minor, permanent impacts to soils as the result of grading and clearing activities in an area previously disturbed. These activities may result in minor, localized increases in erosion and sedimentation. Minor permanent impacts would occur from the installation of solar facility foundations; outside of these areas and beneath the panels, the soils would be revegetated with native herbaceous species to support pollinators. Impacts to soils associated with grading and clearing activities would be temporary and mitigated through BMPs identified in Section 2.3. Soils would be temporarily affected due to construction activities and other maintenance activities during operation.

Although not anticipated, should borrow material be required for project site activities, sand and gravel aggregate may be obtained from established local, permitted, off-site sources. The creation of new impervious surface, in the form of the foundations for the central inverters and other associated components, would result in a minor increase in stormwater runoff and potential increase in soil erosion. Planting of native and/or non-invasive vegetation, including plants attractive to pollinators, within the limits of disturbance, along with use of BMPs identified in Section 2.3, would minimize the potential for increased soil erosion and runoff. Following construction, implementation of soil stabilization and vegetation management measures would reduce the potential for erosion effects during site operations. No adverse cumulative impacts to soils are anticipated.

During operation and maintenance of the solar facility, minor disturbance could occur to soils. Routine maintenance would include periodic motor replacement; inverter air filter replacement; fence repair; vegetation control; and periodic PV array inspection, repairs, and maintenance. The solar facility could utilize mowing to manage vegetation within portions of the fenced-in, developed areas not limited by other constraints. Selective spot applications of herbicides may be employed around the facility and structures to control weeds. Herbicides would be applied by a professional contractor or a qualified project technician. These maintenance activities would not result in any adverse effects to soils on the project site during operations.

Prime Farmland

Based on soils data obtained from the USDA Web Soil Survey, there are no soils classified as prime farmland with the potential to be impacted by the proposed solar facility. Effects on nearby prime farmland soils would be reduced using appropriate BMPs to control erosion and limit sediment and soil from leaving the solar facility site.

3.5.1.2.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Geology

Under Alternative A, minor effects to geology could occur. Foundations for equipment anticipated for the proposed 100-MW BESS would be excavated. Transmission structures are typically driven or drilled into the ground to shallow depths. Due to the small size of the subsurface disturbances, only minor direct effects to potential subsurface geological resources are anticipated.

Paleontology

Since the proposed locations are situated on previously disturbed and/or permanent fill areas on the Kingston Reservation, paleontological resources are not likely to be encountered during construction. In the event paleontological resources (e.g., fossilized vertebrate remains such as bones, teeth, etc.) are encountered during construction, the construction contractor would report the finding to TVA. The construction activities would be suspended in the immediate area of the paleontological finding while a qualified paleontologist is consulted. TVA would coordinate with the qualified paleontologist to determine the appropriate actions if the find is determined to be a significant paleontological resource. TVA would comply with applicable laws, regulations, procedures, and recommendations from the Tennessee Geological Survey.

Geological Hazards

Based on regional data, the potential for minor seismic activity exists due to Alternative A’s proximity to both the Eastern Tennessee and the New Madrid Seismic Zones. The facilities would be designed to comply with applicable seismic standards. In the unlikely event of seismic activity, it would likely cause minor effects to the project site and equipment on the site based on construction activities meeting state and federal earthquake/seismic guidelines. No other geologic hazards are anticipated.

Soils

Under Alternative A, the construction and operation of a 100-MW BESS at one of three potential sites between 30 and 40 acres just to the north of the proposed CC/Aero CT Plant site and associated transmission line connections would result in minor impacts to soils. Grading, clearing, and fill activities associated with the construction of the BESS and transmission line connections would cause localized increases in erosion and sedimentation, resulting in minor, permanent impacts to soils. Effects to soils associated with grading and clearing activities would be temporary and mitigated through BMPs identified in Section 2.3. Soils would be temporarily affected due to construction activities and permanently impacted by the construction of the facilities. Any stockpiled soils from the area where vegetation clearing and grading occurs, including topsoil, would be appropriately replaced following cut-and-fill activities to the extent practical and, therefore, would likely not require any off-site or on-site hauling of soils. However, some minor off-site or on-site hauling may be necessary.

Although not anticipated, should borrow material be required for project site activities, sand and gravel aggregate may be obtained from established local, permitted, off-site sources. The creation of new impervious surface, in the form of the foundations for the BESS and other associated components, would result in a minor increase in stormwater runoff and potential increase in soil erosion. Planting of native and/or non-invasive vegetation, including plants attractive to pollinators, within the limits of disturbance, along with use of BMPs identified in Section 2.3, would minimize the potential for increased soil erosion and runoff. Following construction, implementation of soil stabilization and vegetation management measures would reduce the potential for erosion effects during site operations. No adverse cumulative impacts to soils are anticipated.

During operation and maintenance of the BESS, minor disturbances could occur to soils. Selective spot applications of herbicides may be employed around the facility and structures to control weeds. Herbicides would be applied by a professional contractor or a qualified project technician. These maintenance activities would not result in any adverse effects to soils on the project site during operations.

Prime Farmland
Based on soils data obtained from the USDA Web Soil Survey, there are no soils classified as prime farmland with the potential to be impacted by the proposed 100-MW BESS or associated transmission line connections. Effects on nearby prime farmland soils would be reduced using appropriate BMPs to control erosion and limit sediment and soil from leaving the 100-MW BESS sites and transmission line connections footprint.

3.5.1.2.2.4 On-site Transmission Upgrades

Geology, Paleontology, and Geologic Hazards
Under Alternative A, minor effects to geology could occur. Transmission structures are typically driven or drilled into the ground to shallow depths. Minor excavations would also be required for construction of a substation and other transmission components. Due to the small sizes of the subsurface disturbances, only minor direct effects to potential subsurface geological resources are anticipated.

Should paleontological resources be exposed during site construction (i.e., grading and foundation placement) or operation activities, a paleontological expert would be consulted to determine the nature of the paleontological resources, recover these resources, analyze the potential for additional effects, and develop and implement a recovery plan/mitigation strategy.

Geologic Hazards
Under Alternative A, TVA would construct a double-breaker 161-kV station for the proposed CC/Aero CT Plant and reroute all existing transmission lines from KIF and re-terminate them into the new station. TVA would install one mile of OPGW, relaying, digital fault recorders, and redundant metering for the proposed plants. Based on regional data, the potential for minor seismic activity exists due to the proximity of the proposed OPGW, as well as existing transmission lines that would be upgraded under Alternative A, to both the Eastern Tennessee and the New Madrid Seismic Zones. The OPGW construction and transmission line upgrades would be designed to comply with applicable seismic standards. In the unlikely event of seismic activity, it would likely cause minor effects to the sites. No other geologic hazards are anticipated.

Hazards resulting from geological conditions may be encountered in the case of sinkholes. Tennessee's Appalachian Ridge and Valley Region is located over limestone bedrock that is susceptible to erosion and the creation of sinkholes. Based on the finalized location of the transmission corridor, sinkholes could be a minor to moderate risk.

Soils

Transmission line upgrades may require improvements to existing access roads and may also require replacing transmission line structures, which would result in temporary, minor ground disturbance. Some areas may require permanent vegetation clearing and/or maintenance, potentially resulting in habitat conversion (such as from early successional forested areas or larger shrubs to early successional herbaceous habitat), which could also result in soil disturbances. Disturbed areas would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed to minimize the potential for increased soil erosion and runoff. No adverse cumulative impacts to soils are anticipated.

Prime Farmland

Based on soils data obtained from the USDA Web Soil Survey, there are no soils classified as prime farmland with the potential to be impacted by the on-site transmission line upgrades or Battery Transmission Corridor. Effects on nearby prime farmland soils would be reduced using appropriate BMPs to control erosion and limit sediment and soil from leaving the Alternative A site.

3.5.1.2.2.5 Off-Site Transmission Upgrades

3.5.1.2.2.5.1 Eastern Transmission Corridor

3.5.1.2.2.5.1.1 Geology, Paleontology, and Geologic Hazards

The geology, paleontology, and geological hazards associated with off-site transmission upgrades proposed for the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) under Alternative A are the same as provided in Section 3.5.1.1.1. Should the proposed upgrades to the existing transmission lines require the installation of a new transmission structure, it would typically be driven or drilled into the ground to shallow depths. Most poles would be directly imbedded in holes augured into the ground to a depth equal to 10 percent of the pole's length plus an additional two feet. Normally, the holes would be backfilled with the excavated material, but, in some cases, gravel or a concrete-and-gravel mixture would be used, depending on local soil conditions. Due to the small size of the subsurface disturbances, only minor direct effects to potential subsurface geological resources are anticipated. No adverse cumulative impacts to geological resources are anticipated.

3.5.1.2.2.5.1.2 Soils

The 1,609-acre Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) proposed for transmission line upgrades would likely require improvements to existing access roads and may also require replacing transmission line structures. Minor ground disturbance is expected in these areas, but if the ground is disturbed, the access road area would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed to minimize the potential for increased soil erosion and runoff (TVA 2022a). Effects to soils associated with transmission line upgrades would be minor, temporary, and mitigated through BMPs identified in Section 2.3. No adverse cumulative impacts to soils are anticipated.

3.5.1.2.2.5.1.3 Prime Farmland

Approximately 50.8 acres (3.2 percent) of the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) proposed for transmission line upgrades are designated as prime farmland. This represents less than 0.1 percent of prime farmland in Anderson and Roane counties, combined (USDA 2019b). Ground disturbance would be minimal, temporary, and mitigated through BMPs identified in Section 2.3 and TVA's BMP Manual (TVA 2022a). Therefore, no impacts to prime farmland would occur as a result of transmission line upgrades. No adverse cumulative impacts to prime farmland are anticipated.

3.5.1.2.2.5.2 Western Transmission Corridor – (L5383)

3.5.1.2.2.5.2.1 *Geology, Paleontology, and Geologic Hazards*

The geology, paleontology, and geological hazards associated with off-site transmission upgrades are the same as provided in Section 3.5.1.1.1. Transmission structures are typically driven or drilled into the ground to shallow depths. Due to the small size of the subsurface disturbances, only minor direct effects to potential subsurface geological resources are anticipated. No adverse cumulative impacts to geological resources are anticipated.

3.5.1.2.2.5.2.2 Soils

The 332-acre L5383 corridor proposed for transmission line upgrades may require improvements to existing access roads and may also require replacing transmission line structures. Minor ground disturbance is expected in these areas, but if the ground is disturbed, the access road area would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed to minimize the potential for increased soil erosion and runoff (TVA 2022a). Effects to soils associated with transmission line upgrades would be minor, temporary, and mitigated through BMPs identified in Section 2.3. No adverse cumulative impacts to soils are anticipated.

3.5.1.2.2.5.2.3 *Prime Farmland*

Approximately 54.5 acres (16.4 percent) of the L5383 corridor proposed for transmission line upgrades are designated as prime farmland. This represents less than 0.1 percent of prime farmland in Cumberland County (USDA 2019b). Ground disturbance would be minimal, temporary, and mitigated through BMPs identified in Section 2.3 and TVA's BMP Manual (TVA 2022a). Therefore, no impacts to prime farmland would occur as a result of transmission line upgrades. No adverse cumulative impacts to prime farmland are anticipated.

3.5.1.2.2.6 Construction and Operations of Natural Gas Pipeline

Geology and Paleontology

Under Alternative A, minor effects to geology could occur. The 122 miles of the proposed natural gas pipeline would be buried through a combination of trenching, boring, and directional drilling. Most of the proposed pipeline would be constructed within the existing ETNG Pipeline ROW. Minor direct effects to potential subsurface geological resources are anticipated. Should paleontological resources be exposed during site construction (i.e., grading, directional drilling, trenching, and foundation placement) or operation activities, ETNG would follow an Unanticipated Discoveries Plan (submitted to FERC as Appendix 4D of Resource Report 4) that establishes procedures if previously unidentified cultural resources, such as archaeological sites, historic features, or human remains, are encountered during Project construction.

ETNG has prepared a draft Blasting Plan Procedures for the Project, which is included as Appendix 6B in Resource Report 6 (ETNG 2022g). The Blasting Plan would be utilized for locations where solid rock is encountered as part of the pipeline trench excavation, the grading to prepare a level linear workspace, or the excavation at aboveground facilities. When the Blasting Plan is implemented, the contractor would analyze the rock type and hardness, and consider all other contributing factors such as location, surrounding environment, nearby facilities, residences, wells or springs, and/or other resources.

According to the USDA Web Soil Survey, the depth to bedrock is anticipated to be less than 78 inches below ground surface for approximately 48 miles of the proposed pipeline route (USDA 2019b). ETNG would attempt to remove rock in the proposed route using conventional ripping, hammering, and trenching techniques but anticipates that blasting would be necessary in these areas of shallow bedrock. Regarding potential blasting activities, ETNG states in Resource Report 6 (ETNG 2022g) that:

> [ETNG] will conduct its construction activities in accordance with the Blasting Plan and state blasting codes. All blasting operations will be performed according to guidelines designed to control energy release and protect personnel and property in the vicinity of the blast zone. These guidelines will be consistent with all federal and state regulations that apply to controlled blasting and blast vibration limits in the vicinity of structures and underground utilities.
>
> Charges will be kept to the minimum required to break up the rock, and the release of charges will be timed to stagger the blasts. Blasting mats consisting of cable weaved used tires or other materials will be used, as necessary, to prevent the scattering of rock and debris and keep blasting debris within the construction [ROW]. Special care will be taken to monitor and assess blasting within 150 feet of buildings, other utilities, water supply wells, and springs. This includes conducting preconstruction surveys of homes, businesses, other structures, wells and springs, as approved by the landowner. Additionally, a preconstruction survey of adjacent utilities will be completed with the utility owner's approval. Seismographs will be deployed to monitor the effects of blasting on adjacent structures, where appropriate.
>
> Large rock not suitable for use as backfill material will be crushed, windrowed along the edge of the ROW in upland areas (with landowner permission), or hauled off to an approved gravel operation, landfill, mine reclamation site, or recycling facility. The remaining rock will be mixed with any overlying subsoil that might have been removed to access the rock and used to backfill the trench to the original contour.
>
> TVA has independently reviewed and concurs with the geology-related findings in Resource Report 6 (ETNG 2022g).

Geologic Hazards

Based on regional data, the potential for minor seismic activity exists due to the proposed pipeline's proximity to both the Eastern Tennessee and the New Madrid Seismic Zones. The pipeline would be designed to comply with applicable seismic standards. In the unlikely event of seismic activity, it would likely cause minor effects to the project site and equipment on the site based on construction compliance with state and federal earthquake/seismic guidelines.

The USGS Seismic Hazard Maps indicate there is a 2 percent probability of reaching a 6 to 35 precent "g" in 50 years.[13] Based on a review of the USGS Peak Ground Acceleration Map (USGS 2020), the risk for seismic ground motion (earthquakes) to cause damage to structures in the Study Area is low to moderate. From this, occurrence of earthquakes and seismic hazards in the Study Area are low probability. The low to moderate seismic hazard areas of the proposed pipeline areas are as follows:

- Between MPs 0.0 and 84.0, there is a 2 percent probability of a 0.06 to a 0.14 "g" exceedance in 50 years;
- Between MPs 84.0 and 117.0, there is a 2 percent probability of a 0.14 to 0.26 "g" exceedance in 50 years; and

[13] The USGS produces probabilistic Seismic Hazard Maps for the United States with peak horizontal acceleration values represented as a factor of "g". The factor "g" is equal to the acceleration of a falling object due to gravity (USGS 2020).

- Between MPs 117.0 and 122.5, there is a 2 percent probability of a 0.26 to 0.35 “g” exceedance in 50 years.

It should be noted that O’Rourke and Palmer (1994) performed a review of the seismic performance of gas transmission lines in southern California. The authors found that electric arc-welded pipelines constructed post-World War II in good repair have never experienced a break or leak because of either traveling ground waves or permanent ground deformation during a southern California earthquake. The authors further concluded that modern electric arc-welded gas pipelines in good repair are generally highly resistant to traveling ground wave effects and moderate amounts of permanent deformation.

In addition, given the low potential for earthquakes to occur in the vicinity of the Study Area, the potential for soil liquefaction to occur in the Study Area is low.

Subsurface karst terrain could affect portions of the pipeline but is unlikely to affect the entire corridor. Ground subsidence, involving the localized or regional lowering of the ground surface, may be caused by karst dissolution, sediment compaction, oil and gas extraction, underground mines, and groundwater pumping. In many areas of Middle Tennessee, the bedrock is limestone and is usually exposed at the surface, forming rocky ledges and barrens. These areas also develop into karst landscapes. The Study Area crosses areas with high sensitivity to karst and a high incidence of sinkhole and cave development (UTIA 2018 and Tennessee Cave Survey 2001). Based on the presence of carbonate rocks at or near the land surface, the Project would cross karst areas in Trousdale, Smith, Jackson, Putnam, Overton, and Roane counties. According to the USGS (2020), approximately 55 miles of the pipeline would be constructed in karst terrain classified as areas where carbonate rocks exist at or near the ground surface in a humid climate. The shortest such crossing of karst terrain is one mile and located in Jackson County, and the longest such crossing being over 18 miles in Trousdale and Smith counties. An estimated 1,515 acres, or 51 percent of the Study Area, contains geology favorable for karst terrain (ETNG 2022g).

ETNG also evaluated a list of known sinkholes in Tennessee along with their geographic locations, which revealed that ten of the deepest sinkholes in the state are located in Putnam and Overton counties. Two notable sinkholes are located near the Project: The Walkers Hollow sinkhole in Overton County near milepost 60.5 is located approximately 0.7 miles south of the proposed pipeline, and the Cane Hollow sinkhole in Putnam County near milepost 62.0 is located approximately 1.75 miles north of the pipeline (ETNG 2022g).

As stated by ETNG in Resource Report 6 (ETNG 2022g):

> Due to the presence of the sinkholes in proximity to other karst terrain, ETNG selected an approximately five-mile-long segment of the pipeline alignment for site reconnaissance to visually confirm the presence of karst terrain or sinkholes. The area subject to the site reconnaissance extended from MP 58.0 to MP 63.0. During the site reconnaissance, ETNG completed targeted pedestrian surveys within the Project area for site conditions and surficial features typically indicative of karst geology. These indicative features include depressions, water ponding, signs of surface water runoff, and intake cavities. Observed karst features were designated with an observation location (OL) number, indicative features and location was recorded and photographs were collected.

Approximately 18 OLs were documented within the pipeline ROW. Potential karst conditions including surface water runoff, potential sinkholes, and water intake features were documented. Several of the OLs had more than one indicator of karst conditions.

ETNG is currently conducting two additional field assessments for the observed karst features, a karst risk reduction assessment, and an aquifer impact assessment. The karst risk reduction scope will consist of a comprehensive site-wide karst assessment by a Qualified Karst Professional that will include confirming and combining all the assessments performed to-date with a project-wide site reconnaissance. The aquifer impact risk assessment will consist of a site-wide study of the aquifer conditions and the potential impact that the construction may have, particularly in the areas of trenchless crossings and other structures requiring deep disturbance and excavations. Results of the additional assessments will be provided in the Project Application.

ETNG will also complete geophysical investigations in areas considered high-risk for karst as indicated by field investigation and future environmental studies. The geophysical investigation would be used to identify voids in the bedrock, indicating the potential for karst features.

In all work areas, buffer zones of 300 feet will be established around known and potential karst features (including sinkholes, caves, sinking or losing streams, swallow holes, and springs). During all construction earthwork activities, these zones will be clearly marked in the field with signs and safety fencing or similar barriers depending on the feature.

Excavation activities will be completed to minimize alteration of the existing grade and stormwater flow to the karst features. In linear excavations adjacent to karst features, spoils will be placed on the opposite side of the karst feature. In the event of stormwater erosion during construction, the soil will flow into the excavation and not toward the karst feature. Stormwater control measures outlined in the Project’s Erosion & Sedimentation Control Plan (E&SCP) include detention, diversion, or containerization to prevent construction influenced stormwater from flowing to the karst feature drainage point (or throat). Drainage points in karst features will not be used for the disposal of water.

Hydrostatic test water from a new pipe will not be discharged directly into the buffer zone of a karst feature. This water will be discharged downgradient of the karst feature. If site conditions prevent a downgradient discharge, the water will be discharged as far from the karst feature buffer zone as is practicable with a filtered discharge and sediment and erosion control features detailed in the [gas pipeline] Project E&SCP. Post-construction monitoring will ensure proper re-vegetation and restoration of these areas.

Where practical, [ETNG] would route the pipeline around sinkholes or significant karst topography. Where the pipeline crosses karst features, ETNG would implement mitigation measures that may include surface water control measures and installation of thicker wall pipe.

Geotechnical investigations would also be completed at HDD locations and the compressor station site. As part of the geotechnical investigation for an HDD, boreholes would be drilled near the entry and exit points to characterize the soil and rock along the drill path.

[ETNG] will conduct karst awareness training during environmental training, including buffer zone requirements for known karst features. The Chief Inspector, Craft Inspectors, Safety Inspector, Lead Environmental Inspector and Environmental Inspectors will be aware of the potential for sinkhole formation during construction and trained to identify the signs of sinkhole formation.

Signs of sinkhole formation and the presence of sinkholes will be immediately and clearly marked, and a 300-foot karst buffer zone established. Evaluation of the area will be conducted by appropriate engineering and construction staff. Avoidance of the area may be possible by a minor route variation or by prohibiting equipment from working in this portion of the temporary workspace. Should unknown sinkholes be encountered during construction, the following mitigation measures may be undertaken:

- Use a thicker walled pipe;
- Remediate the sinkhole; or
- Route the pipeline away from sinkholes.

As detailed in ETNG's Resource Report 6 (ETNG 2022g), the options for remediation/mitigation of sinkholes and depressions encountered during construction of the ETNG gas pipeline project are outlined below.

Inverted Filter Approach for Pipeline Excavation Structural Zones:

The sinkhole would be excavated until the throat of the underlying bedrock is encountered. On occasion, the throat may not be fully identified. It is often advantageous to inject water into the excavation to further identify and clean the throat location. At which point, a field decision regarding the more suitable repair method would be developed. This approach is anticipated for those cases in which the pipeline traverses directly across the bottom or near the throat of a sinkhole.

If the inverted filter approach is selected, a non-woven geotextile fabric and large (typically one to two feet diameter size) rock would be initially placed to establish a working base and fill the sinkhole bottom and/or throat. Layers of progressively smaller size rock would then be placed at an appropriate elevation to allow placement of well-compacted structural soil fill. After placement of stone is complete, the stone filter backfill would be wrapped with the geotextile and the excavation capped with well-compacted soil fill to achieve proposed subgrade elevation.

Concrete Plug Approach for Pipeline Excavation Structural Zones:

This approach would initially consist of excavating and cleaning out the throat or open void to allow placement of a concrete plug consisting of flowable fill. Depending on the size and shape of the throat opening, it may be prudent to initially place graded stone within the throat area. The concrete plug would be installed such that it is bonded to adjacent bedrock. The thickness of the concrete plug would be based on field observations, but in general, the thickness should be at a minimum of two times the width of the plug. Large rock fill may be incorporated into the flowable fill to reduce the overall volume of flowable fill material.

After curing, the remaining site area will be filled with well-compacted soil if required to achieve proposed subgrade elevation. This approach is anticipated for those cases in which the pipeline traverses directly across a sinkhole void/opening in a non-closed depression areas that typically do not receive normal storm water flow (i.e., along a hillside for example) or if an unanticipated opening is identified during pipeline excavation or construction of aboveground facilities.

Large Rock Placement in Cave or Opening:

In cases where the pipeline will traverse a large open void or cave feature, stabilizing and filling the large opening could be implemented to minimize disturbance of the underlying cave feature or large open void. Initially, large rock (several feet in diameter) will be securely placed and wedged into the opening or cave feature. Additional angular rock (up to two feet in size) may be placed prior to placement of a nonwoven filter fabric. The remaining depth may be capped with No. 1 stone, suitable graded rock, and soil backfill to achieve proposed subgrade elevation. This option may not be suitable for caves inhabited by bats or containing other sensitive environmental features.

General Site Filling Approach:

In some cases, pipeline construction will necessitate the backfilling of certain site features (i.e., closed depressions without visible openings/voids at the ground surface and depressions with karst voids or openings exposed to ground surface) to facilitate construction and installation of the pipeline. These closed depressions or karst features will typically be located within the construction right of way of the Project but not within the actual pipeline excavation zone or pipe non-structural zone. Backfill activity for both situations would consist initially of vegetation removal and placement of a geogrid and non-woven filter fabric across the footprint of the site feature to be backfilled. Large angular rock (up to two feet in diameter) may be placed over the geogrid and geotextile. Placement of a layer of No. 1 size stone over the large angular rock may be utilized (if required) and will be based on field decision at the time of construction. The goal of this remediation approach will be to minimize the overall impact to natural/existing storm water infiltration/recharge rates and flow direction.

As required by 49 Code of Federal Regulations §192.613, [ETNG] will conduct route surveillance during operation of the facilities, along with training of surveillance personnel, to monitor the pipeline ROW for evidence of subsidence, surface cracks, or depressions which could indicate sinkhole formation. Should either be identified, the Project geotechnical engineer will be notified. Mitigation measures may include backfilling the sinkhole with fill material, injecting grout into the sinkhole to seal the hole and prevent further collapse, or a combination of grouting and backfilling. In extreme instances, the affected pipeline segment will be excavated, repositioned, or replaced to a stress-free state, and properly bedded and backfilled to pre-construction contours.

> The proposed [ETNG Construction ROW] may transverse steep slopes and rugged natural areas as it crosses from the Valley and Ridge Physiographic Province into the Cumberland Plateau and may do so again as it crosses from the Eastern Highland Rim Physiographic Province into the Nashville Basin. Therefore, landslides could be a potential risk along the proposed [ETNG Construction ROW]. Landslides have a higher likelihood in areas with steeper slopes. ... Landslides can be initiated by rainfall, snowmelt, changes in water level, stream erosion, changes in groundwater, earthquakes, disturbance by human activities, or any combination of these activities.
>
> Approximately 35 miles of the proposed pipeline route are in location areas classified by the USGS as highly susceptible to landslides with a moderate rate of landslide incidence. [ETNG] evaluated the current ground slope along the pipeline route, approximately four miles (3%) of the proposed route crosses steep slopes (greater than 30%). The desktop review identified 12 locations where slopes along the pipeline will exceed 50%, with the longest section of such slopes being approximately 400 feet long and located just west of Flynn Creek near milepost 38.0.
>
> No other geologic hazards are anticipated.

TVA has independently reviewed and concurs with the geology-related findings in Resource Report 6 (ETNG 2022g).

Soils
Construction activities associated with the pipeline such as clearing, grading, trench excavation, installation, backfilling, and the movement of construction equipment along its route have the potential to disturb soil stability and increase erosion.

Effects to soils associated with grading and site preparation activities would be temporary and mitigated through BMPs identified in Section 2.3. Stockpiled soils from the area where vegetation clearing and grading occurs, including topsoil, would be appropriately replaced following cut-and-fill activities to the extent practical and, therefore, would not require any off-site or on-site hauling of soils. However, some minor off-site or on-site hauling may be necessary. Operation of the pipeline would not impact soils. No adverse cumulative impacts to soils are anticipated. “Soils that are poorly or somewhat poorly drained or have a high rate of seedling mortality were considered areas for revegetation concerns. [ETNG] would promote revegetation through implementation of its [Erosion and Sediment Control Plan], which incorporates measures from FERC’s Plan and FERC’s Procedures. […] [ETNG] is currently coordinating with local NRCS offices for appropriate and regionally specific seed mixes” (ETNG 2022h).

TVA has independently reviewed and concurs with the soil-related findings in Resource Report 7 (ETNG 2022h).

Prime Farmland
Based on soils data obtained from the USDA Web Soil Survey, approximately 586 acres, or 30 percent, is classified as prime farmland with the potential to be impacted by the proposed natural gas pipeline (Appendix D-2). Prime farmland soils are classified as those best suited for production of food, feed, fiber, and oilseed crops. These soils generate the highest yields with the least amount of expenditure.

Within a five-mile radius of the Kingston Reservation, approximately 4,619 acres (6.3 percent) have soils classified as prime farmland. Any minor loss of on-site prime farmland soils is not significant when compared to the amount of prime farmland within the surrounding region. Effects on prime farmland soils would be reduced using appropriate BMPs to control erosion and limit sediment and soil from leaving the project sites. Potential impacts on active agricultural soils would be minimized and mitigated in accordance with FERC's Plan and associated special construction procedures. In accordance with FERC's Plan and in coordination with landowners, ETNG would segregate a minimum of 12 inches of topsoil in areas of deep topsoil (more than 12 inches) for construction of the pipeline facilities in agricultural land. In areas where the topsoil is less than 12 inches thick, ETNG would segregate all the topsoil where practicable. Topsoil would be stockpiled separately from the subsoil on the construction ROW. Following construction, the ROW would be restored to pre-construction conditions and crop production could resume within the permanent easement.

The construction of the natural gas pipeline combined with RFFAs in the vicinity of the Kingston Reservation and proposed ETNG Construction ROW, listed in Table 3.1-1, could remove current prime farmland in the area, resulting in minor cumulative impacts on prime farmland.

TVA has independently reviewed and concurs with the farmland-related findings in Resource Report 7 (ETNG 2022h).

3.5.1.2.2.7 Summary of Alternative A

TVA Actions

Minor direct effects to potential subsurface geological resources are anticipated from the construction of the CC/Aero CT Plant due to subsurface activities. Vegetation clearing, grading and other site preparation activities associated with the construction of the CC/Aero CT Plant have the potential to disturb soil stability and increase erosion. The revised design of the CC/Aero CT Plant and associated off-site transmission system upgrades would result in temporary or permanent impacts to 191.5 acres. Fifty-five of those acres are permanent fill impacts associated with the CC/Aero CT Plant, 8.5 acres are permanent fill impacts associated with the switchyard, and 128 acres are temporary impacts from vegetation clearing of existing and maintained transmission ROW and existing access roads and permanent habitat conversion impacts associated with tree clearing anticipated to be needed along margins of new access roads. The proposed 3- to 4-MW solar facility would result in permanent impacts to 35 acres. The proposed 100-MW BESS and associated transmission line connections would result in permanent impacts to 71-81 acres, depending on which battery site is selected. Between 30 and 40 of those acres are permanent fill impacts associated with the battery site and 41 acres are permanent habitat conversion associated with transmission line connections.

ETNG Actions - Natural Gas Pipeline and Associated Structures

No mineral resources identified within 0.25-mile of the pipeline workspaces would be impacted. Mitigation measures would be utilized in karst-prone or sloped areas to reduce the risk of geologic hazards and impacts during pipeline construction. Effects to soils associated with grading and site preparation activities from pipeline construction would be temporary and mitigated through BMPs identified in Section 2.3.

3.5.1.2.2.8 Environmental Justice Considerations

TVA Actions

Effects to soils resulting from the proposed CC/Aero CT Plant and other activities proposed on the Kingston Reservation would be minor. Further, no residential populations are present within the Kingston reservation. Effects occurring as a result of the proposed transmission system upgrades would primarily be outside of the TVA-owned reservation within transmission ROWs and may result in increased runoff and erosion, which TVA would minimize through implementation of standard BMPs. Increased runoff and erosion may result in amplified effects towards EJ populations who may rely on impacted soils for their livelihood or sustenance.

ETNG Actions - Natural Gas Pipeline and Associated Structures

The natural gas pipeline and transmission line activities are associated with certain geologic hazards, such as those presented by karst features, which are distributed across the ETNG Construction ROW EJ Study Area. These hazards would be minimized as much as feasible though amplified effects may occur to EJ populations.

Effects to prime farmland resources resulting from construction of the ETNG Construction ROW may have temporary, minor amplified effects on populations that currently farm the corridor where the pipeline would be constructed. This is especially true in areas where farming populations and prime farmland soils co-exist. CT 9603 BG 4, CT 9653 BG 4, CT 9653 BG 1, and CT 9653 BG 2 have greater amounts of prime farmland relative to other BGs near the pipeline. Because of this, these groups, may experience amplified effects to prime farmland, especially if farming these areas is the primary livelihood of people in these communities. Although TVA has assessed these impacts to be minor and temporary, and potentially amplified to identified EJ populations, ETNG is still evaluating effects of their proposed project and resulting changes will be incorporated into TVA's final EIS.

3.5.1.2.3 Alternative B

3.5.1.2.3.1 Construction and Operations of Solar and Storage Facilities

Geology and Paleontology

Under Alternative B, minor effects to geology could occur from the construction of solar and storage facilities. Minor excavations would be required for construction of the facility substations, medium voltage transformer, and concrete pads for the storage systems. Solar arrays would be supported by steel piles, which would either be driven or drilled into the ground to a depth between seven and 15 feet below grade. The PV panels would be connected with underground wiring placed in trenches approximately three- to four-feet deep. If needed, on-site sedimentation basins would be shallow and, to the extent feasible, utilize the existing terrain without requiring extensive excavation. Minor excavations would also be required for construction of the facility substations, medium voltage transformer, and the concrete pads for the storage systems.

Geologic Hazards

Landslides are possible in areas of steeper slopes. Landslide potential would be evaluated prior to construction of Alternative B, and its components would not be built in areas subject to landslides. Hazards resulting from geological conditions may be encountered in the case of sinkholes. Tennessee's Appalachian Ridge and Valley Region is located over limestone bedrock that is susceptible to erosion and the creation of sinkholes. Based on the finalized location of the solar and storage facilities and associated transmission lines, sinkholes could be a minor to moderate risk.

Based on regional data, the potential for minor seismic activity exists due to Alternative B's proximity to both the Eastern Tennessee and the New Madrid Seismic Zones. The solar and storage facilities and transmission lines would be designed to comply with applicable seismic standards. In the unlikely event of seismic activity, it would likely cause only minor effects to the

Project sites and equipment on the sites based on construction compliance with state and federal earthquake/seismic guidelines.

Soils

Under Alternative B, the construction and operation of 1,500 MW of solar and 2,200 MW of battery storage at various sites within portions of the East Tennessee region would result in minor effects to soils. Since the exact project locations for solar and/or storage projects are not known at this time, according to the analysis described in Section 3.2, an average of 7.3 acres (ranging from 2.00 to 17.95 acres per MW) are typically required for PV projects. Based on this average acreage requirement, the 1,500 MW of solar generating capacity would occupy about 10,950 acres. Soil impacts would be spread across 15 or more solar sites within portions of the East Tennessee region, based on the assumption that each site is 100 MW. Approximately 10 to 15 acres per 40 MW would be required for the storage facilities. Based on this requirement, the 2,200 MW of battery storage would occupy about 425 to 638 acres.

Grading and clearing activities associated with the construction of the solar and BESS sites would cause minor, localized increases in erosion and sedimentation, resulting in minor effects to soils. Effects to soils associated with grading and clearing activities would be temporary and mitigated through BMPs identified in Section 2.3. Soils would be temporarily affected due to construction activities and tree-trimming and other maintenance activities during operation. Any stockpiled soils from the area where vegetation clearing and grading occurs, including topsoil, would be appropriately replaced following cut-and-fill activities to the extent practical and, therefore, would likely not require any off-site or on-site hauling of soils. However, some minor off-site or on-site hauling may be necessary.

Although not anticipated, should borrow material be required for project site activities, sand and gravel aggregate may be obtained either from established local, permitted, off-site sources. The creation of new impervious surface, in the form of the foundations for the central inverters, BESS, and other associated components, would result in a minor increase in stormwater runoff and potential increase in soil erosion. Planting of native and/or non-invasive vegetation, including plants attractive to pollinators, within the limits of disturbance, along with use of BMPs identified in Section 2.3, would minimize the potential for increased soil erosion and runoff. Following construction, implementation of soil stabilization and vegetation management measures would reduce the potential for erosion effects during site operations. No adverse cumulative impacts to soils are anticipated.

During operation and maintenance of the solar facilities, minor disturbance could occur to soils. Routine maintenance would include periodic motor replacement; inverter air filter replacement; fence repair; vegetation control; and periodic PV array inspection, repairs, and maintenance. The individual solar facilities could utilize mowing or grazing sheep to manage vegetation within portions of the fenced-in, developed areas not limited by other constraints. Additional fencing for the sheep would be used to limit their movement and manage vegetation growth. Selective spot applications of herbicides may be employed around facilities and structures to control weeds. Herbicides would be applied by a professional contractor or a qualified project technician. These maintenance activities would not result in any adverse effects to soils on the project sites during operations.

Prime Farmland

Under Alternative B, the construction and operation of 1,500 MW of solar and 2,200 MW of battery storage at sites within portions of the East Tennessee region could result in temporary moderate effects to prime farmland. TVA typically utilizes 15- to 20-year PPAs with third-party developers for its solar and BESS facilities, but also has the option to “self-build” solar and BESS facilities. At the end of a PPA, the developer would assess whether to cease operations at the solar and/or BESS facility or to replace equipment, if needed, and attempt to enter into a new PPA with TVA or make some other arrangement to sell the power. When operations cease, the facilities would be decommissioned and dismantled, and the Project sites would be restored per Project decommissioning requirements. Following decommissioning of the solar facilities, the majority of the sites could be returned to agricultural use with little reduction in soil productivity or effect to prime farmland/farmland of statewide importance.

Approximately 11 percent of the East Tennessee TVA PSA is classified as prime farmland (USDA 2019a). An additional 0.6 percent would be classified as prime farmland if drained or protected from flooding. Most previously constructed TVA solar facilities have occupied prime farmland (Table 3.2-1). Because solar facilities are typically located on flat or gently sloping land that is more likely to be prime farmland than steeper areas, a large portion of the approximately 10,950 acres occupied by the proposed solar facilities is likely to be prime farmland. Prime farmland effects would be spread across 15 or more solar sites within portions of the East Tennessee region, based on the assumption that each site is 100 MW. A portion of the 425 to 638 acres occupied by the storage facilities is also likely to be prime farmland. Within a five-mile radius of the Kingston Reservation, approximately 4,619 acres (6.3 percent) have soils classified as prime farmland. Minor loss of on-site prime farmland soils would not be significant when compared to the amount of prime farmland within the surrounding region. However, the loss of farmland may result in moderate effects at a more local or county level. Most ground-mounted PV facilities have been constructed on previously cleared, frequently pasture, hayfield, or crop land, and most have required little grading to smooth or level the site. Although construction and operation of the PV facility usually eliminates agricultural production on the site, it typically does not adversely affect soil productivity or the ability to resume agricultural production once the PV facilities are removed. In some cases, the solar site is grazed by sheep or other livestock as a means of managing vegetation growth and is therefore maintained in agriculture. Effects on prime farmland soils would be reduced using appropriate BMPs to control erosion and limit sediment and soil from leaving the project sites. When project locations for solar and/or storage projects are determined, site-specific analyses would consider the potential effects on prime farmland and would be included in future NEPA reviews.

Future projects in the geographic area of analysis could result in prime farmland conversion. In addition to the 1,500 MW of solar facilities, TVA is proposing to add 10,000 MW of solar by 2035 to meet customer demands and system needs. This would also change undeveloped or agricultural sites, which could include prime farmland, to industrial uses. These future actions combined with the construction of the solar and storage facilities would likely result in prime farmland conversion. However, in view of the relatively large amounts of rural and undeveloped lands within the counties selected, cumulative impacts on prime farmland are anticipated to be moderate.

3.5.1.2.3.2 Transmission and Other Components

Geology and Paleontology

Under Alternative B transmission corridor installation, minor effects to geology could occur. Transmission structures are typically driven or drilled into the ground to shallow depths. Minor excavations would also be required for construction of a substation and other transmission components. Due to the small sizes of the subsurface disturbances, only minor direct effects to potential subsurface geological resources are anticipated. Transmission structures associated with Alternative B are similar to those transmission lines constructed for Alternative A, although interconnection for solar facilities would typically be shorter. Due to the small sizes of the subsurface disturbances, only minor direct effects to potential subsurface geological resources would be anticipated.

Should paleontological resources be exposed during site construction (i.e., grading and foundation placement) or operation activities, a paleontological expert would be consulted to determine the nature of the paleontological resources, recover these resources, analyze the potential for additional effects, and develop and implement a recovery plan/mitigation strategy.

Soils

Under Alternative B, the transmission line upgrade activities would also result in minor effects to soils. Minor ground disturbance is expected in these areas, but if the ground is disturbed, the access road area would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed to minimize the potential for increased soil erosion and runoff. Since the exact project locations for solar and/or storage projects and associated transmission line upgrade activities are not known at this time, according to the analysis described in Section 2.1.5.2, an average of 17.73 acres could be impacted due to transmission and electrical system components per solar site. Based on the assumption of fifteen 100-MW solar sites, Alternative B would result in approximately 266 acres of impacts to soils for construction of transmission components. However, effects to soils associated with transmission line upgrades would be temporary and mitigated through BMPs identified in Section 2.3. No adverse cumulative impacts to soils are anticipated.

Prime Farmland

Under Alternative B, the transmission line upgrade activities could result in minor effects to prime farmland. Since the exact project locations for solar and/or storage projects and associated transmission line upgrade activities are not known at this time, TVA compiled a list of typical effects from construction activities related to transmission projects in the 2019 IRP EIS. A total of 298 projects were included in the review. The review determined that transmission line construction did not result in prime farmland conversion, while 64 percent of new substation and switchyard construction resulted in prime farmland conversion. Transmission line upgrade activities resulted in no prime farmland conversions and an average of 6.9 acres (ranging from zero to 29.1 acres) of prime farmland were used for new substation and switchyards. Based on an assumption of fifteen 100-MW solar sites that have new substation and switchyard construction, approximately 10 sites would result in prime farmland conversion and a total of 69 acres of prime farmland conversions would occur. No adverse cumulative impacts to prime farmland are anticipated.

3.5.1.2.3.3 Environmental Justice Considerations

Effects to geology and soil resources that would occur as a result of the proposed solar facilities and transmission line activities are anticipated to be minor and mitigated with BMPs. Project activities do have the potential to result in amplified effects towards EJ populations, but these would depend on the exact facility location. Temporary or permanent loss of prime farmland resources as a result of construction of the solar facilities and the transmission line activities would likely have effects on EJ populations that currently farm the sites where the facilities would be constructed. These effects may result in amplified effects on EJ populations, who may depend on this land for their livelihoods.

3.5.2 Floodplains

3.5.2.1 Regulatory Framework for Floodplains

TVA adheres to the requirements of EO 11988, Floodplain Management. The objective of EO 11988 is "to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative" (EO 11988, Floodplain Management). The EO is not intended to prohibit floodplain development in all cases, but rather to create a consistent government policy against such development under most circumstances (U.S. Water Resources Council 1978). The EO requires that agencies avoid the 100-year floodplain unless there is no practicable alternative.

For "Critical Actions," the minimum floodplain of concern is the 500-year floodplain. The U.S. Water Resources Council defines "critical actions" as "any activity for which even a slight chance of flooding would be too great" (U.S. Water Resources Council 1978). Critical actions can include facilities producing hazardous materials (such as liquefied natural gas terminals), facilities whose occupants may be unable to evacuate quickly (such as schools and nursing homes), and facilities containing or providing essential and irreplaceable records, utilities, and/or emergency services (such as large power-generating facilities, data centers, museums, hospitals, or emergency operations centers) (TVA 2019b).

TVA reservoirs have either power storage or flood storage or both. Power Storage is allocated to a range of elevations and water occupying space in that range is used to generate electric power through a dam's hydroturbines. Flood Storage is allocated to a range of elevations and water occupying space within that range is used to store flood water during a flood or high-flow rain event. Some of TVA's dams are able to be surcharged. Surcharge is the ability to raise the water level behind the dam above the top-of-gates elevation. Surcharge can be sustained only for a short period of time during a flood. To control flood-damageable development on TVA lands, TVA uses a concept known as the Flood Risk Profile (FRP). The FRP is the elevation of the 500-year flood that has been adjusted for surcharge at the dam.

It is necessary to analyze proposed actions against both EO 11988 and the TVA Flood Storage Loss Guideline to ensure that development is consistent with them.

EO 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input, was reinstated in May 2021. However, implementation of EO 13690 is still in development at the national level. TVA is working with other federal agencies to develop consistent implementing plans for these requirements. When those implementing plans are finalized, TVA would incorporate floodplain analysis with respect to EO 13690, in addition to EO 11988. Depending upon the results of these inter-agency efforts, TVA may update the floodplain implementing plan in subsequent NEPA analysis.

3.5.2.2 Affected Environment

A floodplain is the level land area along a stream or river that is subject to periodic flooding. The area subject to a 1 percent chance of flooding in any given year is normally called the 100-year floodplain. The area subject to a 0.2 percent chance of flooding in any given year is normally called the 500-year floodplain.

3.5.2.2.1 Kingston Reservation (No Action and D4 Activities)

Kingston is located adjacent to both the Clinch River and Emory River on the Watts Bar Reservoir. The Clinch River surrounds the eastern and southern sides of the KIF Plant while the

Emory River borders the northern side. The KIF Reservation is situated between approximately Clinch RM 3 and Emory RM 3 (USACE 2022a).

Based on Clinch River Profile 08P in the Roane County Flood Insurance Study, revised 11/18/2009 (FIS), the 100- and 500-year flood elevations on the Clinch River are constant at 746.8 and 748.1 from its mouth to the Emory River confluence at Clinch River Mile (RM) 4.4. The KIF intake is located on a channel entering the Emory River at about Emory RM 1.9. At that location and based on Emory River Profile 12P in the Roane County FIS the 100- and 500-year flood elevations at the intake would be 747.5 and 750.0 feet, respectively. Flood elevations are referenced to NAVD 1988. Flood zones and the KIF Plant Reservation are shown in Figure 3.5-9.

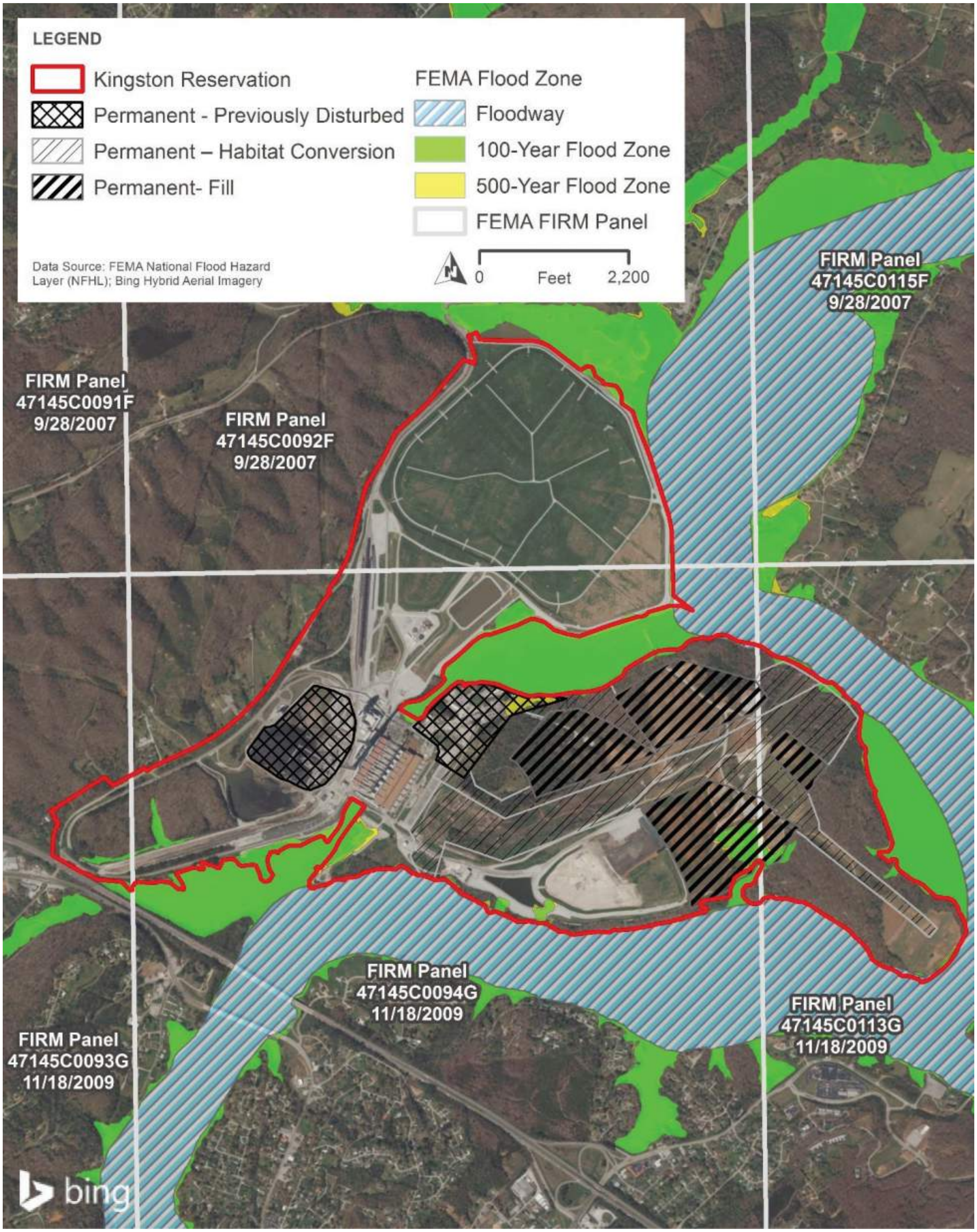

Figure 3.5-9. Flood Zones in the Vicinity of the Kingston Reservation

3.5.2.2.2 Alternative A

3.5.2.2.2.1 Construction and Operation of CC/Aero CT Plant and Switchyard on Kingston Reservation

Approximately 8.4 acres of the CC/Aero CT Plant site would be located within the 100-year floodplain of the Clinch River (Figure 3.5-9).

3.5.2.2.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

As shown in Figure 3.5-9, the land where the proposed solar facility would be located is outside 100- and 500-year floodplains.

3.5.2.2.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Battery Sites 2 and 3 would be located outside 100- and 500-year floodplains (Figure 3.5-9) and approximately 0.15 acre of the proposed Battery Site 1 would be located within the 100-year floodplain of the Emory River.

3.5.2.2.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT facilities and switchyard. As shown in Figure 3.5-9, small portions of the transmission ROW would be located within the 100-year floodplain of multiple waterbodies, consisting of approximately 0.58 acre (total) within the on-site transmission line corridor and 0.68 acre (total) within the Battery Transmission Corridor.

3.5.2.2.2.5 Off-site Transmission Upgrades

3.5.2.2.2.5.1 Eastern Transmission Corridor

The Eastern Transmission Corridor crosses over a total of 18.1 acres of floodways, 59.7 acres of 100-year floodplains, and 14.1 acres of 500-year floodplains. Specific water resources that are crossed with floodways/floodplains are provided below for each line proposed for upgrades.

L5108 and L5302 extend eastward from Kingston Reservation and terminates in the city of Oak Ridge. Several existing and new access roads (largely along routes that have previously been cleared) would be used and may require maintenance for equipment transport. The corridor crosses the floodways of the Emory River, East Fork Poplar Creek, Brushy Fork, and an unnamed tributary of East Fork Poplar Creek and 100-year floodplains of these and other streams in Roane and Anderson counties (Figure 3.5-10a through Figure 3.5-10d).

L5116 extends eastward from the current Kingston reservation and terminates at the Bethel Valley switching station. Several existing and new access roads (largely along routes that have previously been cleared) would be used and may require maintenance for equipment transport. The corridor crosses the 100-year floodplains of Grassy Creek and several unnamed tributaries, Bear Creek and several unnamed tributaries, and Whiteoak Creek and several unnamed tributaries (Figure 3.5-10a-d).

L5280 and L5381 extend eastward from the Bethel Valley switching station and terminate at the Oak Ridge National Laboratory (ORNL) switching station. Several existing and new access roads (largely along routes that have previously been cleared) would be used and may require maintenance. The corridor crosses the 100-year floodplains of Bearden Creek and several unnamed tributaries, and Whiteoak Creek (Figure 3.5-10a-d).

3.5.2.2.2.5.2 Western Transmission Corridor

L5383 extends southeast from the Plateau TN 500-kV substation in Crossville on Plateau Road and terminates north of the Crossville city limits at the Peavine TN 161-kV switching station. Several access roads would be used along the route in agricultural areas. The corridor crosses a combined 1.9 acres of the 100-year floodplains of two streams (Figure 3.5-11).

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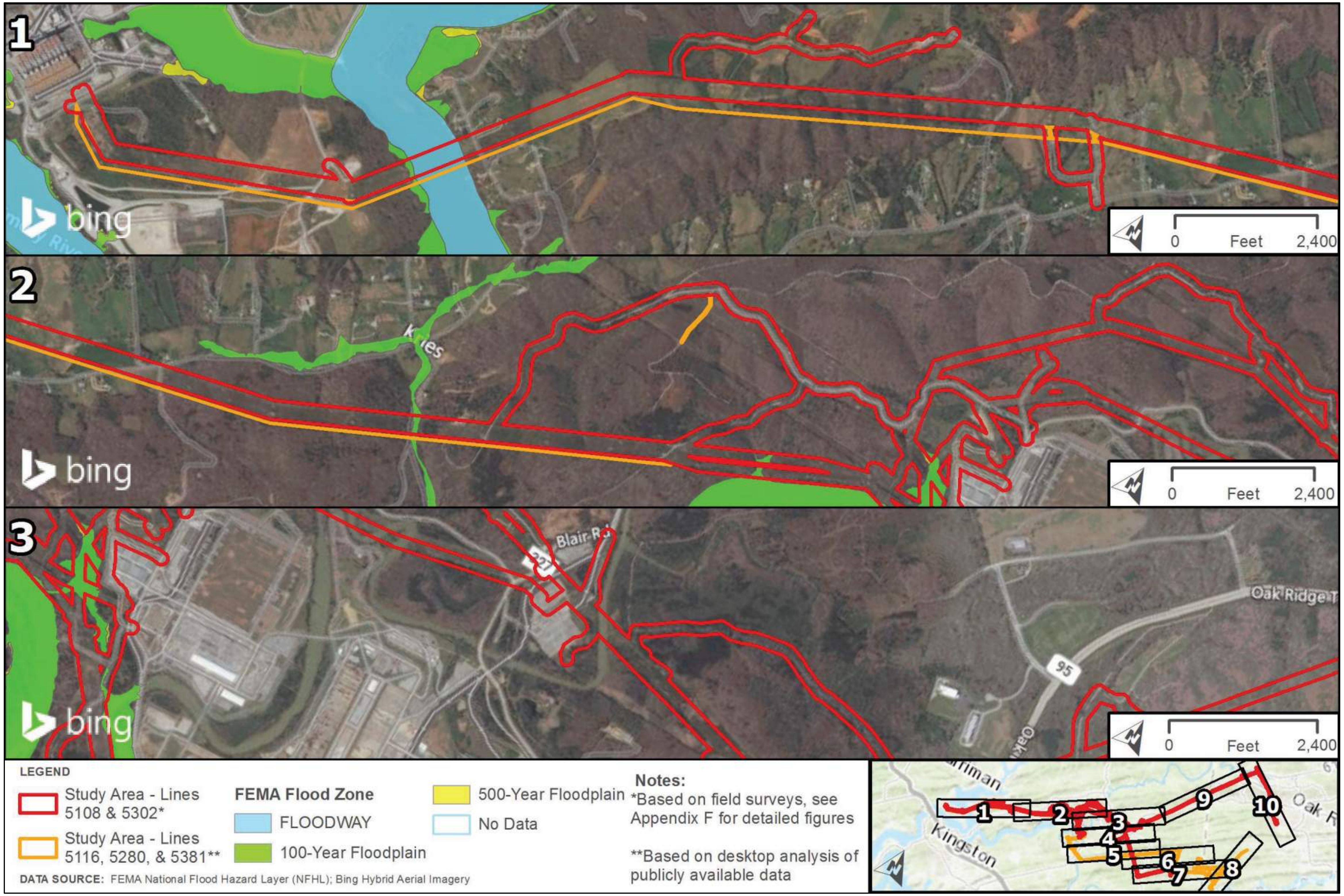

Figure 3.5-10a. Flood Zones Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

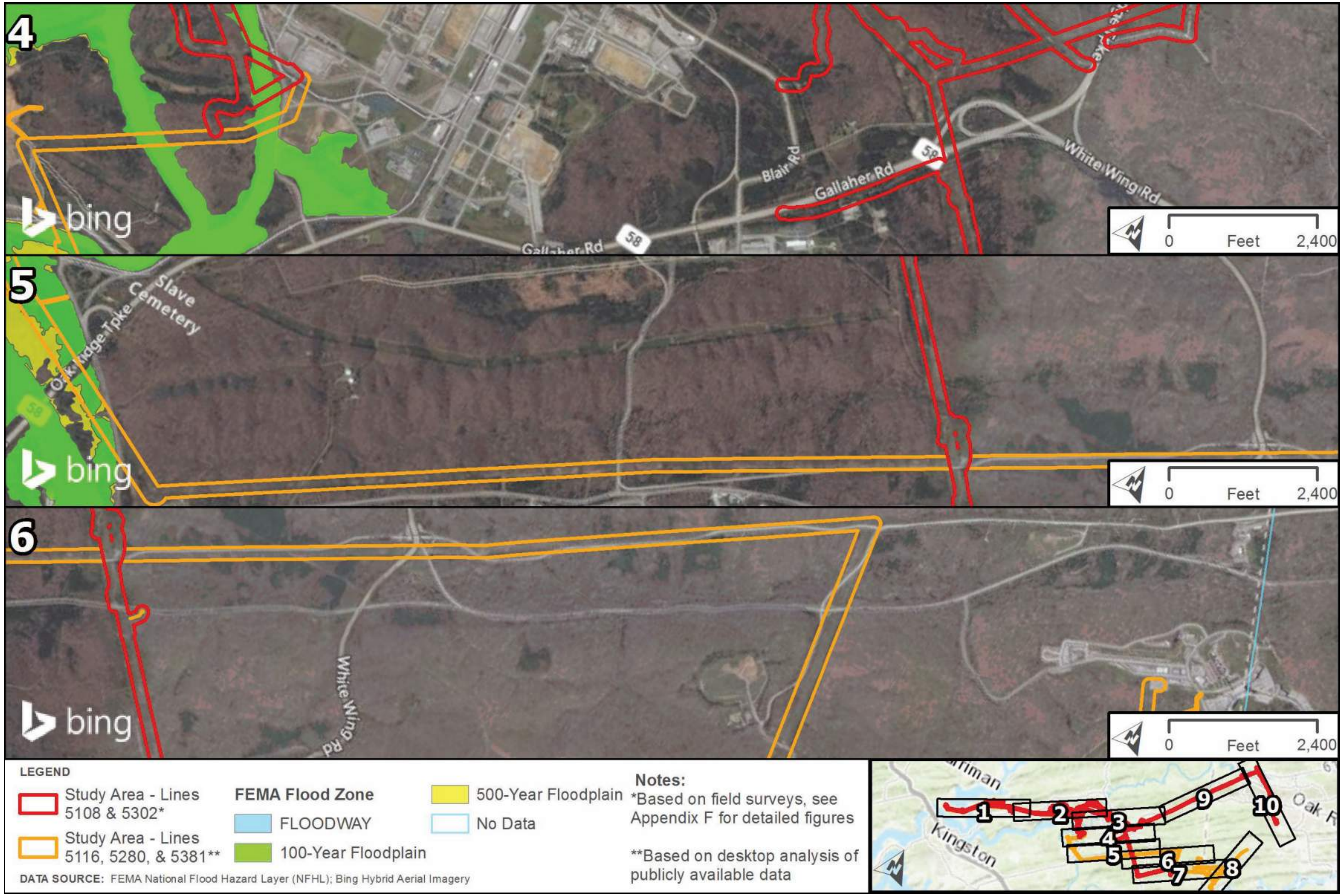

Figure 3.5-10b. Flood Zones Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

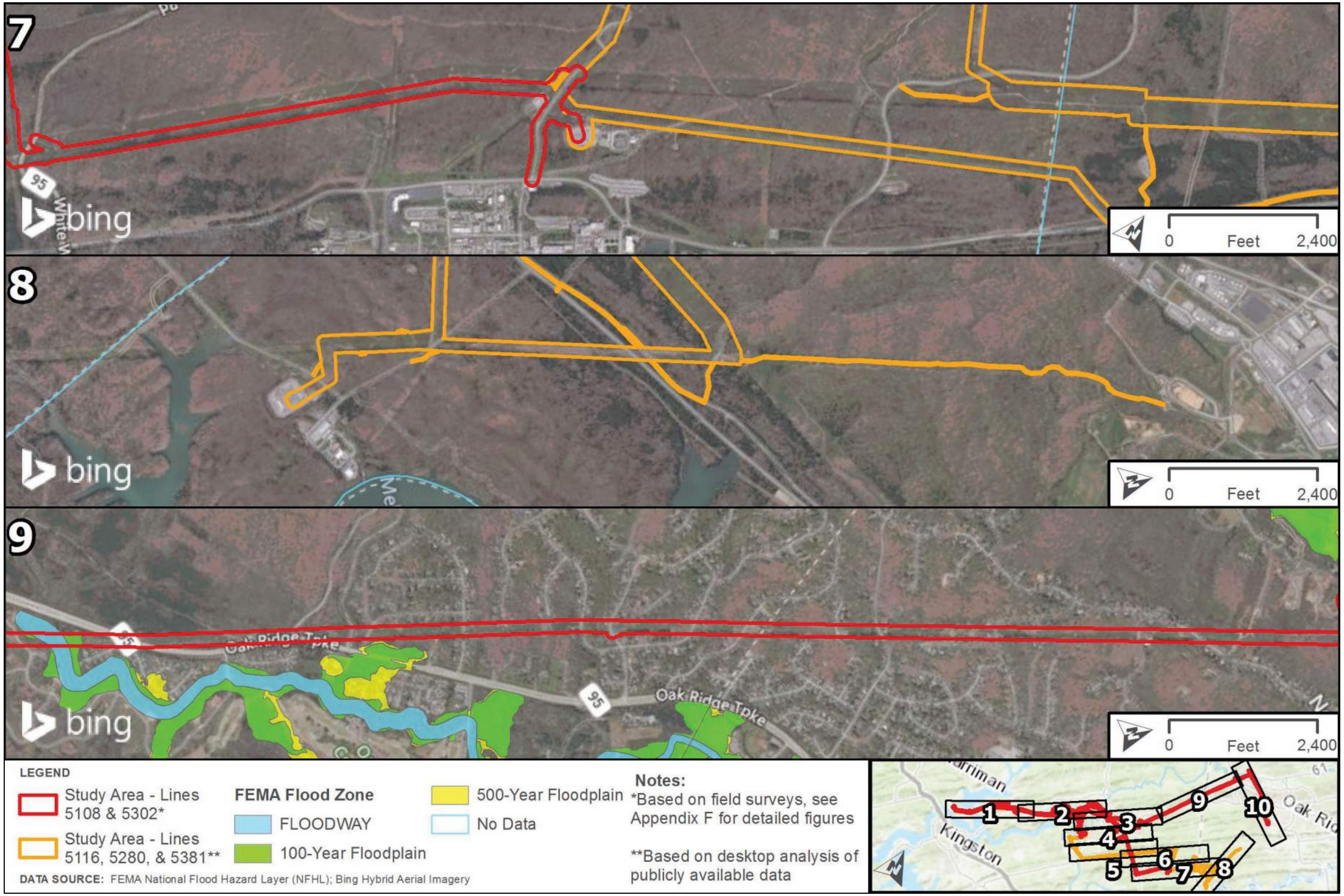

Figure 3.5-10c. Flood Zones Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

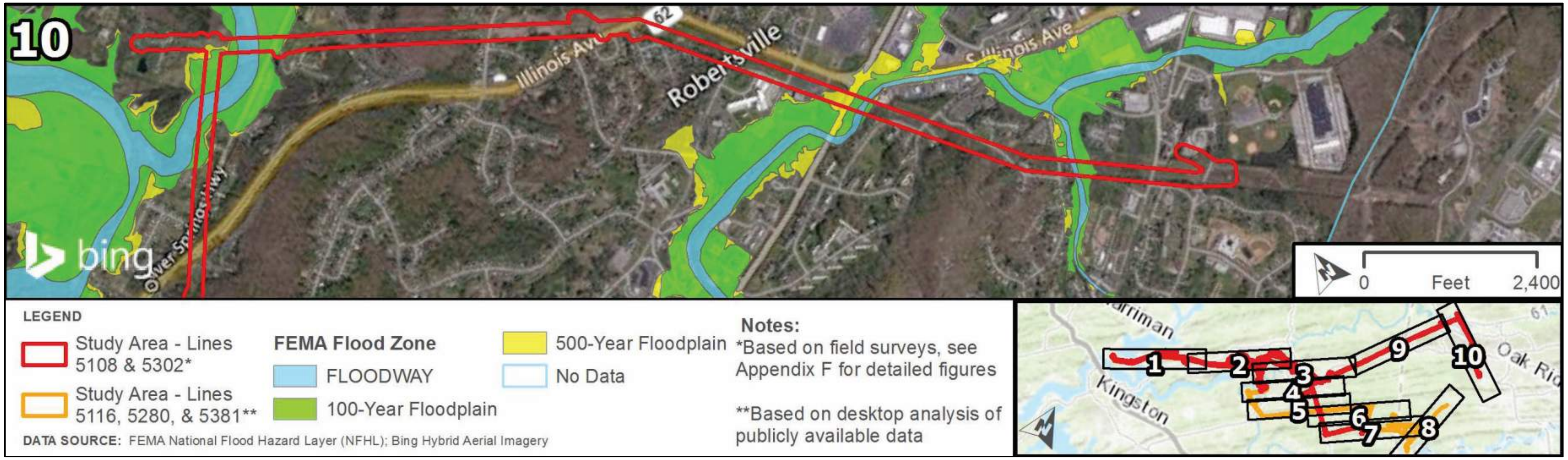

Figure 3.5-10d. Flood Zones Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

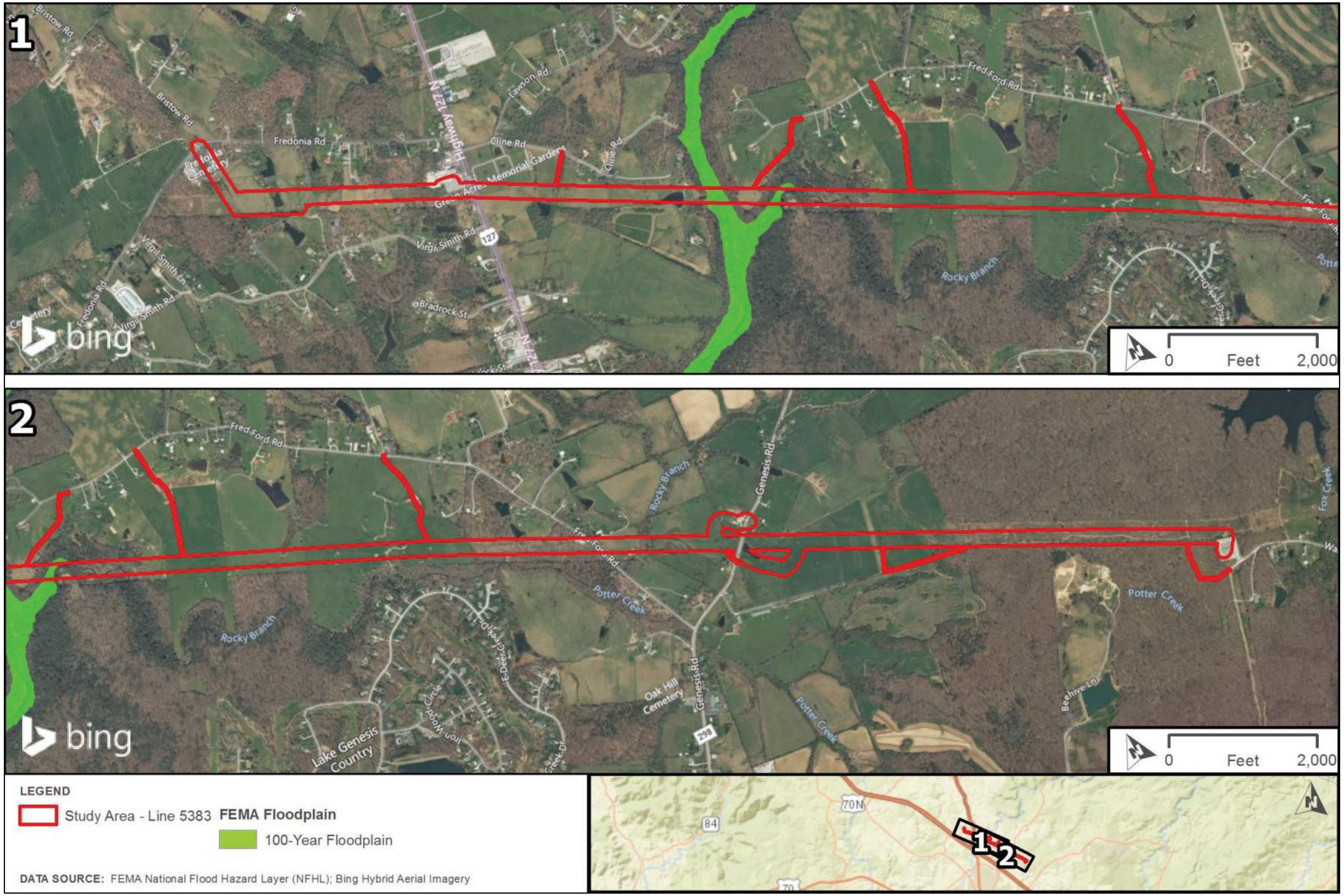

Figure 3.5-11. Flood Zones Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Western Transmission Corridor

3.5.2.2.2.6 Construction and Operation of a Natural Gas Pipeline
ETNG's proposed natural gas pipeline facilities would consist of about seven miles of new pipeline ROW between KIF plant and the existing pipeline ROW. The remaining new gas pipeline would be primarily located within or adjacent to the ROW of an existing gas pipeline. The proposed pipeline would cross the floodplains of multiple streams in Roane, Morgan, Fentress, Overton, Putnam, Jackson, Smith, and Trousdale counties, Tennessee. See Appendix D-3 for FEMA mapping along the ETNG Construction ROW.

3.5.2.2.3 Alternative B
3.5.2.2.3.1 East Tennessee TVA Power Service Area
TVA anticipates that the solar facilities proposed under Alternative B would be located within portions of East Tennessee to offset transmission system upgrades that may be required following the retirement of KIF as described in further detail in Section 2.1.5. The Tennessee River is the main river in East Tennessee. Major tributaries of the Tennessee River in East Tennessee include the Hiwassee River, Clinch River, Little Tennessee River, Holston River, and French Broad River.

3.5.2.3 Environmental Consequences
3.5.2.3.1 The No Action Alternative
Under the No Action Alternative, TVA would continue current plant operations. TVA would implement all of the planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be in subsequent NEPA analysis. There would be no direct or indirect impacts to floodplains because there would be no physical changes to the current conditions.

3.5.2.3.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant
Most of the Kingston reservation where the existing plant would be decommissioned, decontaminated, and deconstructed is located outside of the 100-year floodplain. Portions of Kingston around the boundaries of the site are located within the Clinch and Emory River floodplains (Figure 3.5-9). Structures and facilities, such as laydown areas, haul roads, and staging areas, would be constructed and sited, where practicable, outside of the 100-year floodplain. If decommissioning and deconstruction activities or structures must be located in floodplains, these activities would be considered temporary uses of the 100-year flood zone and, therefore, would have no permanent impacts on floodplains or floodplain resources. Also, standard BMPs would be employed to minimize adverse impacts during construction activities. To further minimize adverse impacts, decommissioning and deconstruction debris would be disposed of outside 100-year floodplains. Additionally, any flood-damageable equipment or materials located within the 100-year floodplain would be relocated outside the floodplain during a flood. No cumulative impacts to floodplains would occur, as anticipated CCR management activities on the KIF Reservation would avoid and minimize impacts to floodplains and adhere to federal and local floodplain management guidelines.

3.5.2.3.2.1 Environmental Justice Considerations
Effects to floodplains that would occur as a result of the Kingston coal facility retirement and D4 activities would be minor and limited to the immediate Kingston Reservation. These impacts are not anticipated to have amplified or lasting effects on EJ populations because no residential populations are present on the TVA-owned Kingston reservation.

3.5.2.3.3 Alternative A

3.5.2.3.3.1 Construction and Operation of CC/Aero CT Plant and Switchyard on Kingston Reservation

Approximately 8.4 acres of the proposed CC/Aero CT Plant site would be located within the 100-year floodplain of the Clinch River (Figure 3.5-9). The plant would be constructed on fill to a grade of 763 feet. About 0.7 acre-foot of net fill would be placed within the 100-year floodplain; about 1.0 acre-foot of net fill would be placed within the Watts Bar Flood Storage Zone (FSZ); and about 0.02 acre-foot of net fill placed within the Watts Bar Power Storage Zone.

Permanent fill to construct a CC/Aero CT Plant would not be considered a repetitive action in the 100-year floodplain or TVA Flood Storage Zone. The proposed site was selected based on the evaluation presented in Section 2.1.3.2.1. Plant design and construction is being planned to avoid the 100-year floodplain as much as possible. Alternative layouts for the proposed plant site analyzed in this EIS were investigated; however, the layout is constrained by the existing landfill to the west; steep slopes and existing access road to the north, a heavily forested area with suitable habitat for federally listed bat species on the north side of the access road as well as challenging terrain; cultural resources; the Clinch River to the south; and existing transmission line corridor to the east. For these reasons, there is no practicable alternative to locating fill for a portion of the CC/Aero CT Plant within the Clinch River 100-year floodplain and Watts Bar FSZ. To minimize adverse impacts, fill would be added to the site to bring the plant grade to elevation 763, which would be well above both the 100-year flood elevation 746.8 and 500-year flood elevation 748.1. Additionally, to minimize fill within the 100-year floodplain and FSZ, a retaining wall rather than riprap would be used to stabilize the side slopes of the CC/Aero CT Plant building pad, if required. Therefore, the fill for the CC/Aero CT Plant would be consistent with EO 11988 and TVA Flood Storage Loss Guideline (FSLG) and impacts would be minor.

A process pond and detention pond would be constructed within the CC/Aero CT Plant footprint. The bottom elevations of the ponds would be 752 and 755 feet, respectively, which would be higher than the 100- and 500-year flood elevations, which would be consistent with EO 11988 and the FSLG. Remaining proposed structures, activities, and facilities within the CC/Aero CT Plant footprint would be located at or above elevation 763, which would be consistent with EO 11988 and the FSLG.

The switchyard (shown in Figure 2.1-5) would be located on existing ground that is at least elevation 797, which would be outside both 100- and 500-year floodplains. Therefore, the switchyard would be consistent with EO 11988 and the FSLG.

Structures and facilities, such as laydown areas, haul roads, and staging areas, would be constructed and sited, where practicable, outside of the 100-year floodplain. If these activities must be located in the floodplain, they would be considered temporary uses of the 100-year floodplain and, therefore, would have no permanent impacts on floodplains or floodplain resources. Also, standard BMPs would be employed to minimize adverse impacts during construction activities. Additionally, to minimize adverse impacts, any flood-damageable equipment or materials located within the 100-year floodplain would be relocated by the equipment owner to an area above elevation 750 during a flood. No cumulative impacts to floodplains would occur.

3.5.2.3.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

As shown in Figure 3.5-9, the proposed solar facility would be located outside 100- and 500-year floodplains, which would be consistent with EO 11988 and the FSLG. Therefore, no impacts to floodplains would occur as a result of construction or operation.

3.5.2.3.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The final location for the battery site is not yet known. Battery Sites 2 and 3 would not be located within 100- or 500-year floodplains; therefore, no impacts to floodplains would occur as a result of construction or operation if one of these sites were to be selected.

As mentioned in Section 3.5.2.2.1, the 100- and 500-year flood elevations of the Emory River at Battery Site 1 would be 747.5 and 750.0 feet. Approximately 0.15-acre of Battery Site 1 would potentially be located within 100-year floodplains, should the construction boundary be located near the shoreline. The Battery 1 Site is considered a previously disturbed area and is currently developed with structures, paved parking areas, roadways, and manicured lawn. Development occurring in the disturbed areas of the Battery 1 footprint, however, would likely be located on ground that is at about elevation 760. This potential battery site is likely to be configured similarly to the CC/Aero CT Plant: fill would be placed at the battery site to increase the surface elevation, followed by grading, and then associated structures would be located on the battery site pad. The following issues would be addressed in a subsequent environmental review if Battery Site 1 is chosen, when plans are available:

- For non-repetitive actions proposed within the 100-year floodplain, the floodplains No Practicable Alternative analysis would be performed and submitted for public comment;
- To minimize adverse impacts to the 100-year floodplain and Watts Bar FSZ, net fill quantities would be reduced to the extent practicable;
- To minimize adverse impacts to battery site facilities, fill would be placed to elevate the grade of the battery site pad to or above elevation 752.0, which is two feet above the 500-year flood elevation, and would also meet TVA's Flood Risk Standard for flood-damageable development along TVA reservoirs; and
- Flood-damageable equipment and structures associated with the battery site would be located within the battery site footprint.

Structures and facilities, such as laydown areas, haul roads, and staging areas, associated with the construction of Battery Site 1 would be constructed and sited, where practicable, outside of the 100-year floodplain. If these activities must be in the floodplain, they would be considered temporary uses of the 100-year floodplain and, therefore, would have no permanent impacts on floodplains or floodplain resources. Also, standard BMPs would be employed to minimize adverse impacts during construction activities. Additionally, to minimize adverse impacts, any flood-damageable equipment or materials located within the 100-year floodplain would be relocated by the equipment owner to an area above elevation 750 during a flood. Overall, impacts to the floodplain for the development of Battery Site 1 would be minor, or completely avoided as possible. No cumulative impacts to floodplains would occur.

3.5.2.3.3.4 On-site Transmission Upgrades

The proposed area for the on-site transmission line corridor exists within 1.5 acres of the 100-year floodplain. As such, minor temporary impacts would result during construction, but floodplain capacity would be restored after construction of the transmission line is complete.

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT facilities and switchyard. Approximately 0.58 acre of the area in which the transmission line upgrades and transmission system components is within the 100-year floodplain (Figure 3.5-9).

Consistent with EO 11988, transmission lines are considered repetitive actions in the 100-year floodplain that should result in minor impacts. The conducting wires of the transmission lines would be located well above the 100-year flood elevation. The support structures for the transmission lines would not be expected to result in any increase in flood hazard from increased flood elevations or from changes in flow-carrying capacity of the streams being crossed. Construction in the floodplain would be consistent with EO 11988 provided the TVA subclass review criteria for transmission line locations in floodplains are followed. Modifications to existing transmission line structures in the 100-year floodplain would likely occur well above the 100-year flood elevation, which would be consistent with EO 11988. To minimize adverse impacts, standard BMPs would be used during construction.

Approximately 0.68 acre of the land proposed for the battery transmission line connections would be located within the floodplain (Figure 3.5-9). As such, minor temporary impacts would result during construction with permanent habitat conversion (forested areas converted to shrub or herbaceous habitats), but floodplain capacity would be restored after construction of the transmission line is complete.

The CC/Aero CT Plant switchyard (shown in Figure 2.1-5) would be located on existing ground that is at least elevation 797, which would be outside both 100- and 500-year floodplains. Therefore, the switchyard would be consistent with EO 11988 and the FSLG. No cumulative impacts to floodplains would occur.

3.5.2.3.3.5 Off-site Transmission Upgrades

Portions of the Eastern Transmission Corridor (Figure 3.5-10a through Figure 3.5-10d) and Western Transmission Corridor (Figure 3.5-11) where upgrades are proposed are located within 100-year floodplains. Upgrades to existing transmission lines would not result in impacts to floodplains because the transmission lines are already present and many upgrades would be performed at the tops of the structures, well above the 100-year flood elevation, which would be consistent with EO 11988.

To minimize adverse impacts, construction within the floodplain would be limited to that necessary to achieve project objectives, and standard BMPs would be used during construction. For access roads located in floodplains but not floodways, any road construction or modifications would be done in such a way that upstream flood elevations would not increase more than 1.0 foot. For access roads located in floodways, in order to prevent an obstruction in the floodway: (1) any fill, gravel, or other modifications in the floodway that extend above the pre-construction road grade will be removed after completion of the project; (2) this excess material will be spoiled outside of the published floodway; and (3) the area will be returned to its pre-construction condition. Furthermore, transmission line infrastructure would be elevated above the 100-year flood elevation for a regular action. Cumulative impacts to floodplains would be minor.

3.5.2.3.3.6 Construction and Operations of Natural Gas Pipeline

As shown in Appendix D-3, ETNG's proposed natural gas pipeline would consist of about seven miles of new pipeline ROW between the KIF plant and the existing pipeline ROW. The remaining new gas pipeline would be located within or adjacent to the ROW of an existing gas pipeline. The proposed pipeline would cross the floodplains of many streams in Roane, Morgan, Fentress, Overton, Putnam, Jackson, Smith, and Trousdale counties; however, no aboveground facilities are proposed in the identified floodplain areas (ETNG 2022g).

Consistent with EO 11988, gas pipelines are repetitive actions in the 100-year floodplain that should result in minor effects (TVA 1981). The pipeline would be "constructed below ground with no impervious cover and therefore will not impact or diminish floodplain functionality" (ETNG 2022g).

According to ETNG Resource Report 6 (ETNG 2022g):

> For temporary construction workspaces that are located in mapped floodplains, [ETNG] will limit long-term parking of equipment in floodplains to that which is necessary, limit equipment refueling and fuel storage in floodplains where feasible and ensure equipment can handle waterbody flow increases during pipeline installation activities. This includes measures such as having additional pumps on standby for dam-and-pump crossings, monitoring dam and pumps continuously while pumps are running, and appropriately sizing flumes to handle storm flows for flume crossings. In addition, temporary equipment bridges will be designed to manage higher flow volumes from storm events and flooding situations.
>
> […] Surface contours and drainage patterns within construction workspaces will be returned as nearly as possible to original conditions, where necessary, and all disturbed grounds that are not encumbered by aboveground facilities, roads, or gravel (except wetlands) will be seeded and mulched to encourage revegetation.
>
> TVA has independently reviewed and concurs with the floodplain-related findings in Resource Report 6 (ETNG 2022g).

3.5.2.3.3.7 Summary of Alternative A

TVA Actions

Construction of the CC/Aero CT Plant would result in 1.0 acre-foot or less of net fill within the Clinch River 100-year floodplain and Watts Bar Flood Storage Zone. The new structures and upgrades to the existing on-site transmission corridor would cause minor temporary impacts during construction with floodplain capacity being restored after completion. Battery Site 1 option, if selected, would result in minor permanent impacts within the 100-year floodplain.

ETNG Actions – Natural Gas Pipeline and Associated Structures

The proposed pipeline would cross the floodplains of many streams in Roane, Morgan, Fentress, Overton, Putnam, Jackson, Smith, and Trousdale counties; therefore, temporary minor effects to 100-year floodplains and floodways may occur because of pipeline construction. Since no aboveground facilities are proposed in the identified floodplain areas, no permanent impacts are anticipated to floodplain functionality.

3.5.2.3.3.8 Environmental Justice Considerations

TVA Actions

Effects to floodplains due to construction of the CC/Aero CT Plant are not anticipated to impact EJ communities due to the distance from floodplain impacts to human populations nearby.

ETNG Actions – Natural Gas Pipeline and Associated Structures

Effects to floodplains due to construction of the natural gas pipeline and compressor station may have temporary, minor adverse effects on human populations where the pipeline would be constructed. While certain actions would be taken to minimize risks, such effects would occur where human populations and floodplains co-exist. These effects may be amplified in areas where potentially impacted floodplains occur in EJ areas. Low-income and minority populations may be more vulnerable to temporary effects that cause minor flood loss or effects to human safety, health, and welfare. In particular, CT 901 BG 1, CT 901 BG 3, CT 902 BG 2, CT 9750 BG 1, CT 9750 BG 3, CT 9601 BG 2, CT 9602 BG 2, CT 9603 BG 4, CT 201 BG 2, and CT 1103 BG 1 are intersected by at least one large floodplain and may be at risk for amplified effects. Although TVA has assessed these impacts to be minor and temporary, and potentially amplified to identified EJ populations, ETNG is still evaluating effects of their proposed project and resulting changes will be incorporated into TVA's final EIS.

3.5.2.3.4 Alternative B

3.5.2.3.4.1 Construction and Operations of Solar and Storage Facilities

Under the Proposed Alternative B, KIF would be retired and demolished, and a combination of solar and storage facilities would replace the KIF units. As specific sites have not yet been determined for evaluation under this alternative, typical impacts of solar projects have been listed in Table 3.2-1. The solar and storage facilities would be sited in a manner to avoid floodplains to the extent feasible. If avoidance is not feasible, the flood-damageable components of the solar panels, as well as other flood-damageable structures and facilities sited in floodplains would be located at least one foot above the 100-year flood elevation at that location, and otherwise consistent with local floodplain regulations. Based on a review of typical impacts of solar facility construction activities, approximately 0.02 acre of floodplains are impacted per MW of solar facilities, with a range of 0 to 1.8 acres per MW (Table 3.2-1). Floodplain impacts are not anticipated for storage facilities as they are typically sited to avoid floodplains. For any roads proposed within 100-year floodplains but not floodways, the roads would be constructed such that flood elevations would not increase more than 1.0 foot. For any roads proposed within 100-year floodways, and to prevent an obstruction in the floodway, (1) any fill, gravel, or other modifications in the floodway that extend above the pre-construction road grade would be removed after completion of the project; (2) this excess material would be spoiled outside of the published floodway; and (3) the area would be returned to its pre-construction condition. If other structures are proposed within 100-year floodplains, they would need to be analyzed in a subsequent environmental review.

Cumulative impacts to floodplains may occur under Alternative B with the addition of solar generation identified in the 2019 IRP throughout the TVA PSA. Cumulative impacts to floodplains would be minimized through proper siting of solar facilities and the use of BMPs, and adherence to local floodplain regulations.

3.5.2.3.4.2 Transmission and Other Components

Final transmission routes have not been determined at this time; however, transmission line corridors have the potential to cross 100-year floodplains. Consistent with EO 11988, transmission lines and related support structures are considered to be repetitive actions in the 100-year floodplain that should result in minor impacts. The conducting wires of the transmission lines would be located well above the 100-year flood elevation. The support structures for the transmission lines would not be expected to result in any increase in flood hazard from increased flood elevations or from changes in flow-carrying capacity of the streams being crossed. Construction in the floodplain would be consistent with EO 11988 provided the TVA subclass review criteria for transmission lines location in floodplains are followed.

For any access roads proposed within 100-year floodplains but not floodways, the roads would be constructed such that flood elevations would not increase more than 1.0 foot. For any roads proposed within 100-year floodways, and to prevent an obstruction in the floodway, (1) any fill, gravel, or other modifications in the floodway that extend above the pre-construction road grade would be removed after completion of the project; (2) this excess material would be spoiled outside of the published floodway; and (3) the area would be returned to its pre-construction condition.

Any new switchyards would, to the extent feasible, be located outside of 100-year floodplains. For switchyards proposed within 100-year floodplains, TVA would evaluate the site(s) under the Floodplain No Practicable Alternative analysis and either alter plans to avoid the floodplain or determine that there would be no practicable alternative to locating within the floodplain. If TVA determines that there would be no practicable alternative to locating the facility within the 100-year floodplain, adverse impacts would need to be minimized. As previously stated above, to minimize adverse impacts, the switchyard(s) would be located a minimum of one foot above the 100-year flood elevation at that location for a regular action as well as be consistent with local floodplain regulations.

Cumulative impacts to floodplains may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA. Transmission lines associated with this expansion would likely result in floodplain crossings. Cumulative impacts to floodplains would be minimized through proper siting of transmission lines, consistency with EO 11988 provided the TVA subclass review criteria, and adherence to local floodplain regulations.

3.5.2.3.4.3 Environmental Justice Considerations

Effects to 100-year floodplains that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to be amplified among EJ populations. Site-specific evaluations of impacts to EJ populations in relation to solar and storage facilities would be conducted as appropriate.

3.6 Water Resources

3.6.1 Groundwater

The Safe Drinking Water Act of 1974 established the sole source aquifer protection program, which regulates certain activities in areas where the aquifer (water-bearing geologic formations) provides at least half of the drinking water consumed in the overlying area. This act also established both the Wellhead Protection Program, a pollution prevention and management program used to protect underground sources of drinking water, and the Underground Injection Control Program to protect underground sources of drinking water from contamination by fluids injected into wells. Several other environmental laws contain provisions aimed at protecting groundwater, including the RCRA, the Comprehensive Environmental Response, Compensation, and Liability Act and the Federal Insecticide, Fungicide, and Rodenticide Act. On April 17, 2015, the USEPA published the Disposal of Coal Combustion Residuals from Electric Utilities final rule (CCR Rule) in the Federal Register to provide a comprehensive set of requirements for the safe disposal of CCRs from coal-fired power plants. The CCR Rule addresses the risks of coal ash contaminants migrating into groundwater. The CCR Rule was revised on August 29, 2018 (USEPA 2018).

3.6.1.1 Affected Environment

3.6.1.1.1 Kingston Reservation (No Action and D4 Activities)

Kingston is located just north of Watts Bar Reservoir on a peninsula at the confluence of the Emory and Clinch rivers. Kingston is located on Quaternary alluvial deposits of silt, sand, and shale ranging in thickness from 20 to 60 feet. Bedrock in the area surrounding the Kingston reservation is primarily carbonate rock including the Ordovician-age Knox Group formations, which are underlain by the Cambrian-age Conasauga Group; the geological characterization of these groups is provided in Section 3.5.1.1.1.1.

Groundwater in the bedrock aquifers of the Valley and Ridge Physiographic Province, where the Kingston Reservation is located, typically is comprised of calcium-magnesium-bicarbonate and high in dissolved solids and hardness. Groundwater flows of the Valley and Ridge Physiographic Province move downward through interstitial pore spaces in the residuum into the consolidated rocks where flow zones occur along fractures, bedding planes, and solution channels (Brahana et al. 1986).

Groundwater in the residuum alluvial deposits of the Kingston Reservation flows radially south toward the Clinch River and farther south and downstream toward the Tennessee River and Watts Bar Reservoir. The alluvial aquifer consists of water-bearing silt, sand, and gravel alluvial deposits (Stantec 2021, 2022, and 2023).

According to the USGS, the primary bedrock aquifer beneath the Kingston Reservation is the Knox Group Dolomite, which is part of the Cambrian-Ordovician carbonate aquifer system. Water within the Cambrian-Ordovician Knox aquifer flows through interconnected solution openings and along bedding planes in the upper two formations of the Knox Group. The Knox aquifer is not typically utilized for public water supply but is used for domestic water supply where other shallow aquifers do not provide sufficient groundwater. The groundwater quality of the Knox aquifer can be affected by fluoride, sulfate, sulfide gases, and dissolved solids (Brahana et al. 1986). The Cambrian-Ordovician aquifer system is generally comprised of extensively faulted limestone, dolomite, sandstone, and shales. Other primary aquifers in this system are carbonate rocks of the Chickamauga Limestone and the Honaker Dolomite of the Conasauga Group (Brahana et al. 1986). In 2000, 41.2 MGD of groundwater from the Cambrian-Ordovician aquifer was utilized for public water supply systems. The water quality is affected by calcium-carbonate, and brines are present at depths below 3,000 feet (USGS 2000).

The Ordovician carbonate aquifer system is composed of limestone and dolomite. Water occurs in solution-enlarged openings within the Bigsby, Carters, Ridley, and Murfreesboro Limestones, which are the principal water-bearing units within the aquifer. Water is unconfined or partly confined near the surface but may be confined at depth. Approximately 3.7 MGD of water is withdrawn from the Ordovician aquifer for public use (USGS 2000). The Ordovician aquifer is connected to the land surface in multiple areas due to karst features (sinkholes, disappearing streams, and caves); as such, groundwater in the aquifer can contain high concentrations of nutrients and bacteria (Brahana et al. 1986; Bradley and Hileman 2006). General groundwater quality of the Ordovician aquifer is often suitable for drinking water supply; variations in water quality have been observed because the system is highly anisotropic and flow within formations is localized (Brahana et al. 1986).

Monitoring wells have been installed at the Kingston Reservation in both the residuum aquifer and the Knox Group bedrock aquifer. In accordance with Tennessee Division of Solid Waste Management Regulations and TVA's Environmental Inspection Plan (TVA 2018a), TVA has monitored existing on-site wells around the East Ball Field Area and the Stilling Pond. TVA has also monitored existing on-site wells in accordance with Tennessee Division of Solid Waste Management Regulations and TVA's Groundwater Monitoring Plan (TVA 2015) around the Kingston Peninsula Disposal Area, Sluice Trench and Area East of Sluice Trench. The locations of groundwater monitoring wells on the KIF Reservation are shown below on Figure 3.6-1a and Figure 3.6-1b.

Figure 3.6-1a. Groundwater Monitoring Wells on the Kingston Reservation

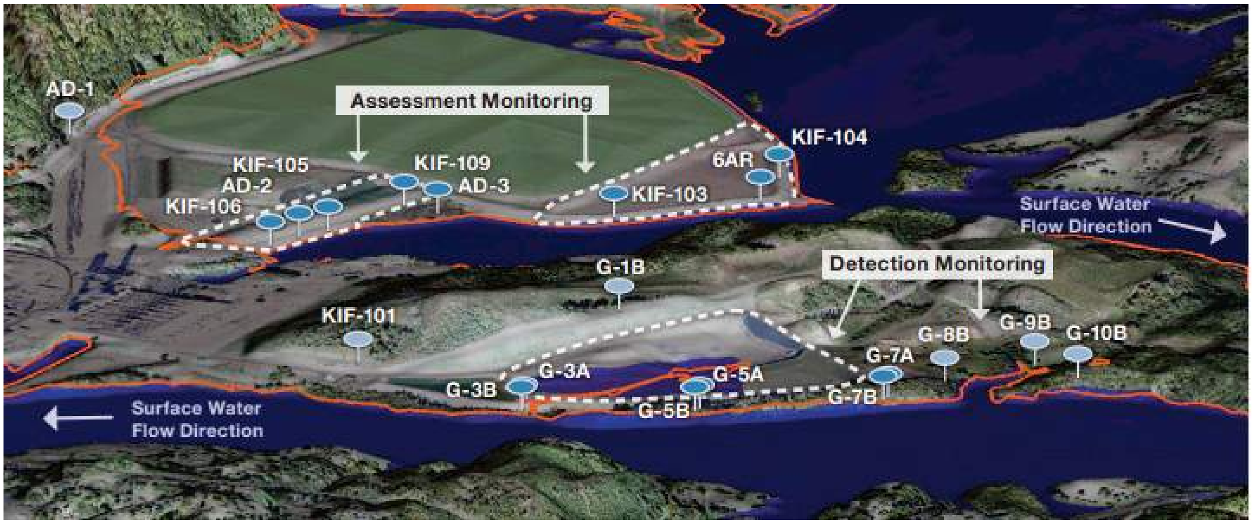

Figure 3.6-1b. Groundwater Monitoring Wells on the Kingston Reservation

During the initial groundwater assessment, Kingston reported statistically significant levels of arsenic, cobalt, lithium, and molybdenum in monitoring wells around the Sluice Trench and Area East of Sluice Trench Vacatur CCR Unit and statistically significant levels of cobalt in several monitoring wells at the Stilling Pond CCR Vacatur Unit. In 2020, Kingston reported statistically significant increases of boron, chloride, and fluoride in one of the wells downgradient of the Peninsula Disposal Area. During the 2021 and 2022 assessment monitoring events, statistically significant levels of cobalt greater than the groundwater protection standard were observed at monitoring wells AD-2 and KIF-105 (Stantec 2021, 2022, and 2023).

Groundwater near the Kingston Reservation is affected by agricultural pumping and local surface water bodies and either flows south toward the Tennessee River or radially from areas of higher elevation to the lower river valleys. Groundwater levels near the Kingston Reservation are largely controlled by the Emory and the Clinch rivers where the surrounding groundwater discharges. During quarterly monitoring events in 2022, water levels in the KIF monitoring wells ranged between approximately 2 to 22 feet below the ground surface elevation. The residuum soil thickness ranges from approximately 20 to 45 feet. The average linear flow velocity in the uppermost aquifer at KIF ranges from approximately 19 to 50 feet per year (Stantec, 2023). According to TDEC, 23 water wells are located within a 1-mile radius from the KIF reservation. The approximate locations of those wells are shown on Figure 3.6-2 below.

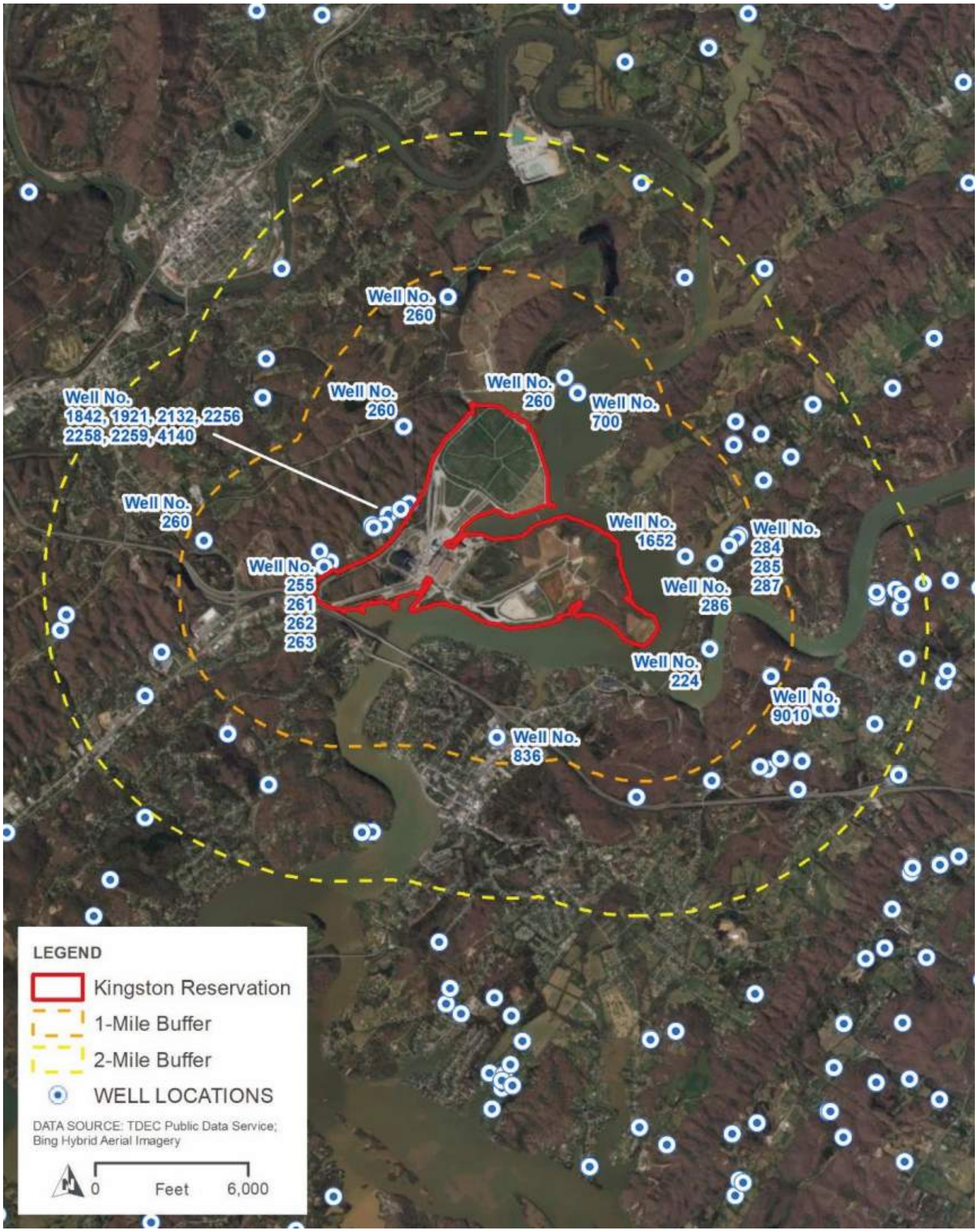

Figure 3.6-2. Water Wells Surrounding the Kingston Reservation

3.6.1.1.2 Alternative A

3.6.1.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

According to the USGS, the proposed CC/Aero CT Plant site and switchyard overlies portions of the Cambrian-Ordovician carbonate aquifer system, which is described above for the Kingston Reservation in Section 3.6.1.1.1.

3.6.1.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.6.1.1.1 apply to the proposed 3- to 4-MW solar facility location on the Kingston Reservation.

3.6.1.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.6.1.1.1 apply to the proposed 100-MW BESS on the Kingston Reservation.

3.6.1.1.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to portions of existing transmission lines located on the Kingston Reservation, including new transmission connections to the proposed CC/Aero CT Plant facilities and switchyard. Therefore, the affected environment for on-site transmission upgrades is described in Section 3.6.1.1.1.

3.6.1.1.2.5 Off-site Transmission Upgrades

Under Alternative A, off-site transmission system improvements would be necessary in the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) and Western Transmission Corridor (L5383). The affected environment for each of the corridors is provided below.

3.6.1.1.2.5.1 Eastern Transmission Corridor

Based on desktop review of 2022 TDEC groundwater data, the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381), which extends northeast from the Kingston reservation and terminates in Oak Ridge, would overlay the Cambrian-Ordovician carbonate aquifer system, as characterized in Section 3.6.1.1.1 (TDEC 2023a).

3.6.1.1.2.5.2 Western Transmission Corridor

The transmission corridor for L5383 extends southeast from a substation in unincorporated Crossville and terminates north of the Crossville city limits and overlays the Pennsylvanian sandstone aquifer system (TDEC 2022a). The Pennsylvanian sandstone aquifer includes sandstone and conglomerate with fractures, faults, and bedding-plane openings within the rock units bearing the majoring of the water produced. In 2000, approximately 0.48 MGD of water was withdrawn from the Pennsylvanian aquifer for public use (Webbers 2003). The groundwater production within this area is highly variable (Brahana et al. 1986; Bradley and Hollyday 1985). General groundwater quality within the Pennsylvanian aquifer is good to excellent and typically has high iron content and some hydrogen sulfide. Water is typically bicarbonate within the aquifer (Brahana et al. 1986).

3.6.1.1.2.6 Construction and Operation of a Natural Gas Pipeline

ETNG's Resource Report 2 (ETNG 2022c), which TVA has independently reviewed, provides the following:

> The project area overlays portions of the Pennsylvanian sandstone aquifer system, the Mississippian carbonate aquifer system, and the Ordovician carbonate aquifer, the Cambrian-Ordovician carbonate aquifer system, or Knox aquifer depending on location along the [ETNG Construction ROW]. These five aquifers are mostly

composed of carbonate rocks with prevalent karst features (caves, fractures, sinking streams). The flow and contaminant transport rates in aquifers with prevalent karst features are high. This is a particular concern for public or private water supplies using wells or springs in karst areas (TDEC 2016).

TDEC maintains information on public water supplies including source water and population served by each entity (TDEC 2003, 2022c). According to the report, all municipal public water systems in the counties crossed by the Project use surface water sources for drinking water. One small water system, Heritage Academy in Putnam County, has a water well, but is located over 2 miles from the Project.

Public and private supply wells and springs within 150 feet of the construction work areas for the Project includes wells and springs that have been identified in the field by landowners, right-of-way (ROW) agents, or civil surveyors associated with the Project, and through review of available geographic information systems (GIS) shapefiles (TDEC 2022b). Prior to construction, [ETNG] will verify the existence of public water supply wells and springs within the vicinity of the construction work areas. ETNG’s Resource Report 2 (ETNG 2022c) identifies the following private wells and springs as being located within a 150-foot-radius of the proposed pipeline and compressor station footprints; as listed in Table 3.6-1.

Table 3.6-1. Water Supply Wells and Springs within the ETNG Construction ROW

County, State	Approximate Milepost	Water Supply Type	Distance and Direction
Overton, TN	64.1	Spring	113 feet south
Overton, TN	64.2	Spring	within construction limits
Overton, TN	65.8	Well	68 feet northwest
Overton, TN	65.8	Well	68 feet northwest
Overton, TN	66.4	Well	3 feet north
Overton, TN	66.4	Well	3 feet north
Overton, TN	70.5	Spring	within construction limits
Overton, TN	71.0	Spring	35 feet south
Fentress, TN	72.3	Well	11 feet south
Fentress, TN	72.4	Well	within construction limits
Fentress, TN	72.4	Well	114 feet north
Fentress, TN	73.2	Spring	within construction limits
Fentress, TN	73.2	Spring	30 feet north
Fentress, TN	73.5	Well	99 feet north
Fentress, TN	78.2	Well	117 feet south

County, State	Approximate Milepost	Water Supply Type	Distance and Direction
Fentress, TN	80.1	Spring	within construction limits
Fentress, TN	81.1	Well	97 feet north
Fentress, TN	81.5	Spring	within construction limits
Fentress, TN	81.8	Well	51 feet northwest
Fentress, TN	82.3	Spring	within construction limits
Fentress, TN	82.3	Spring	24 feet south
Fentress, TN	82.4	Spring	within construction limits
Morgan, TN	86.5	Well	3 feet west
Morgan, TN	89.4	Spring	32 feet south
Morgan, TN	90.0	Well	86 feet northeast
Morgan, TN	90.7	Well	53 feet south
Morgan, TN	90.9	Spring	133 feet northeast
Morgan, TN	91.0	Spring	within construction limits
Morgan, TN	91.5	Spring	65 feet southwest
Morgan, TN	92.5	Spring	11 feet northeast
Morgan, TN	94.2	Spring	within construction limits
Morgan, TN	94.2	Spring	within construction limits
Morgan, TN	99.7	Spring	3 feet southwest
Morgan, TN	101.9	Spring	104 feet west
Roane, TN	115.1	Spring	within construction limits
Roane, TN	115.1	Spring	within construction limits
Roane, TN	116.8	Spring	1 foot west
Roane, TN	117.1	Well	4 feet west
Roane, TN	117.2	Spring	within construction limits

The Mississippian carbonate aquifer system is composed of limestone and dolomite and is confined to partly confined near land surface and may be confined at depth. Water within the aquifer occurs in solution-enlarged openings (fractures, bedding plains, small to large caves). The Ste. Genevieve, Monteagle, St. Louis, and Warsaw Limestones and the Fort Payne Formation are the principal water bearing formations of the Mississippian carbonate aquifer. Approximately 16.63 MGD of water is withdrawn from the Mississippian aquifer for public use. Water obtained from the aquifer contains high levels of calcium carbonate, iron, and sulfate (Burchett and Hollyday 1974; Brahana et al. 1986).

The Ordovician carbonate aquifer, Cambrian-Ordovician Knox aquifer, and Cambrian-Ordovician aquifer are discussed in Section 3.6.1.1.1. The Pennsylvanian aquifer system is summarized in Section 3.6.1.1.2.5.

Total fresh groundwater use for the counties crossed by the pipeline project is estimated at approximately 8.67 million gallons per day and includes public water supply, domestic, industrial, mining and agricultural uses (USGS 2020).

3.6.1.1.3 Alternative B

3.6.1.1.3.1 East Tennessee TVA Power Service Area

The East Tennessee TVA Power Service Area, where Alternative B would be located, overlays the Pennsylvanian sandstone aquifer, the Ordovician carbonate aquifer, Knox aquifer, or Cambrian-Ordovician carbonate aquifer depending on location. As such, the affected environment for Alternative B is as described for Alternative A in Section 3.6.1.1.2.

3.6.1.2 Environmental Consequences

3.6.1.2.1 The No Action Alternative

Under the No Action Alternative, current operations would continue. TVA would implement the planned actions related to the current and future management and storage of CCRs at Kingston, which have either been reviewed or will be reviewed in subsequent NEPA analysis. Groundwater monitoring of CCR impoundments would continue. TVA would continue to work with the state in performing annual monitoring and corrective action reporting as directed by the Kingston Environmental Investigation Plan (TVA 2018a) for monitoring and evaluating groundwater quality data associated with the CCR management facilities.

Under the No Action Alternative, TVA would not retire the nine KIF units. These units would continue to operate as part of the TVA generation portfolio. For the existing units to remain operational, additional repairs and maintenance would be necessary in order to maintain reliability. In addition to repairs and maintenance, new systems and upgrades to current processes and systems would need to be added in order to comply with the current ELG regulations. Under the No Action Alternative, TVA would continue to operate the existing KIF Plant and would not construct new replacement generation.

TVA would implement supplemental mitigation measures required by TDEC's Administrative Order issued in August 2015, as well as the CCR pond closure plan approved by TDEC, which could include additional monitoring, assessment, corrective action programs, or other actions deemed appropriate as specified in the Environmental Investigation Plan (TVA 2018a).

The No Action Alternative would result in the potential for continued impacts to groundwater conditions resulting from ongoing CCR management activities on the Kingston Reservation. There would be a small potential for equipment and material spills from site activities to cause cumulative groundwater effects. Such effects would be considered unlikely as the various projects would employ BMPs such as those detailed in spill prevention, control, and countermeasure plans to control for and clean up any spills of chemicals or hazardous materials that could occur. Therefore, potential cumulative effects associated with groundwater are anticipated to be minor.

3.6.1.2.2 Retirement, Decommissioning, Decontamination, Deconstruction, and Demolition of KIF Plant

Buildings within the deconstruction boundary would be decontaminated and deconstructed to a depth of three feet below grade, which would generate vibrations throughout the course of deconstruction of the buildings and grading and backfilling of the facility. There would be no effects anticipated to the existing groundwater flow pattern.

The deconstruction and demolition activities have the potential to release pollutants into the underlying soil and shallow groundwater table through direct or indirect discharges or other sources of contact during demolition activities. D4 activities would be performed in accordance with applicable state regulations and TVA BMPs to limit potential effects to the soil and groundwater; thus, no effects to groundwater resources are anticipated. With implementation of BMPs, retirement and D4 activities of the KIF plant would be expected to result in temporary and minor impacts to groundwater resources. Once deconstruction and decontamination activities are complete, there would be a permanent beneficial effect to the groundwater system because fewer potential contamination sources would remain on-site.

With ongoing CCR management activities on the Kingston Reservation, there would be a potential for cumulative effects to groundwater due to construction activities and associated vehicles in the area. There would be a small potential for equipment and material spills from site activities to cause cumulative groundwater effects. Such effects would be considered unlikely as the various projects would employ BMPs such as those detailed in spill prevention, control, and countermeasure plans to control for and clean up any spills of chemicals or hazardous materials that could occur. Therefore, potential cumulative effects to groundwater from the proposed retirement and D4 process at Kingston are anticipated to be minor and temporary. No long-term, negative cumulative effects are anticipated as the retirement and D4 of the KIF Plant will be an overall net benefit to the surrounding area.

3.6.1.2.2.1 Environmental Justice Considerations

Effects to groundwater that would occur as a result of the Kingston coal facility retirement and D4 activities would be temporary and minor; such effects would be minimized with implementation of standard BMPs. Minor, adverse effects to EJ-qualifying populations could occur if these groundwater effects migrate off-site.

3.6.1.2.3 Alternative A

3.6.1.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Water and sewer treatment services are anticipated to meet on-site needs during construction and, less so, for operations and maintenance (i.e., primarily for bathroom use). Both water and sewer services are currently available at the Kingston Reservation. Construction-related water use would support site preparation (including dust control) and grading activities. During earthwork for the grading of access roads, foundations, equipment pads, transmission lines, and other components, the primary use of water would be for compaction and dust control. Smaller quantities would be required for preparation of the equipment pads and other minor uses. Equipment washing and any potential dust control discharges would be handled in accordance with BMPs for water-only cleaning. Water needs for dust control would not adversely affect groundwater resources based on the anticipated withdrawal rate for the Knox Group carbonate aquifer by the municipality, and TVA water use equipment washing, and dust control would not be expected to put a strain on municipal resources or require any additional increase in groundwater withdrawal from the municipality.

Water needs for bathrooms would not adversely affect groundwater resources based on the anticipated withdrawal rate for the Knox Group carbonate aquifer by the municipality, and TVA water use for the bathrooms, equipment washing, and dust control would not be expected to put a strain on municipal resources or require any additional increase in groundwater withdrawal from the municipality.

Project construction activities could potentially cause erosion resulting in the movement of sediment into groundwater infiltration zones. BMPs, such as those described in TVA's *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities* (TVA 2022a), would be used to avoid contamination of groundwater from construction activities. The use of BMPs and a SWPPP would reduce the possibility of any on-site hazardous materials reaching the groundwater during construction and operation. Overall, no adverse effects to groundwater would be anticipated.

Proposed construction of a new CC/Aero CT Plant and associated equipment would require excavation below the existing ground surface to establish a sub-base and foundation. Given the proximity of the Project Area to surface waters and the shallow water table, excavated areas may periodically require dewatering during the construction phase. If dewatering is required, TVA would utilize filter bags and BMPs prior to discharging water. Since dewatering would only occur when groundwater is interfering with excavation and construction activities, the overall effects to groundwater would be localized and temporary. No adverse effects to groundwater would be anticipated and dewatering would only be performed to the extent that groundwater is locally lowered within the footprint of the Project Area and not the surrounding areas.

Groundwater resources could potentially be affected by the construction of a new CC/Aero CT Plant and switchyard but are expected to be negligible. No effects are expected for groundwater resources during operation and maintenance. Potential effects would be sufficiently mitigated with the use of appropriate BMPs. As such, effects of Alternative A on groundwater resources are expected to be minor.

With ongoing CCR management activities on the Kingston Reservation, there would be a potential for cumulative effects to groundwater due to construction activities and associated vehicles in the area. There would be a minor potential for spills to cause cumulative groundwater effects. Such effects would be considered unlikely as the various projects would employ BMPs such as a spill prevention, control, and countermeasure plan to control for and clean up any spills of hazardous materials that could occur. Therefore, potential cumulative effects associated with groundwater are anticipated to be temporary and negligible to minor.

3.6.1.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

Effects to water resources within the Kingston Reservation for the construction and operation of a 3- to 4-MW solar facility on the Kingston Reservation would be the same as those listed in Section 3.6.1.2.3.1.

3.6.1.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Effects to water resources within the Kingston Reservation for the construction and operation of a 100-MW BESS on the Kingston Reservation would be the same as those listed in Section 3.6.1.2.3.1.

3.6.1.2.3.4 On-site Transmission Upgrades

Effects to water resources within the Kingston Reservation for transmission improvements would be the same as those listed in Section 3.6.1.2.3.1.

3.6.1.2.3.5 Off-site Transmission Upgrades

3.6.1.2.3.5.1 Eastern Transmission Corridor

Shallow excavation may be required for the transmission system upgrades proposed within the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381). If groundwater is encountered, dewatering activities, similar to methods described in Section 3.6.1.2.1, would be used to control groundwater infiltration into the excavation site and all state and federal requirements relating to groundwater protection would be followed. If dewatering is required, TVA would utilize filter bags and BMPs prior to discharging water. Since dewatering would only occur if and when groundwater is interfering with excavation and construction activities, the overall effects to groundwater would be localized and temporary. No adverse effects to groundwater would be anticipated and dewatering would only be performed to the extent that groundwater is locally lowered within the active construction footprint of the Project Area the surrounding areas. However, because such activities and their effects to groundwater patterns or availability are localized and generally limited to the construction phase, effects from construction are expected to be minor. During revegetation and maintenance activities, negligible effects to groundwater would likely occur given the nature of the activities. Revegetation would require the seeding and initial watering of construction workspaces. Maintenance activities of the construction site and equipment would be in the form of dust control and equipment cleaning. This watering may draw from local groundwater sources. Water used may form into surface water runoff. These effects will be minimized to the extent practicable through the implementation of standard BMPs (TVA 2022a). As such, effects to groundwater associated with the transmission lines would be temporary and minor, if any.

3.6.1.2.3.5.2 Western Transmission Corridor

The environmental consequences for the transmission system upgrades proposed for the Western Transmission Corridor (L5383) are the same as those presented above for lines within the Eastern Transmission Corridor.

3.6.1.2.3.6 Construction and Operation of Natural Gas Pipeline

Water and sewer treatment services are currently not available along the ETNG Construction ROW. Construction-related water use would be needed to support site preparation, dust control, and grading activities. During earthwork for the grading of access roads and construction of the natural gas pipeline lateral, the primary use of water would be for compaction and dust control (ETNG 2022c). Water used during construction would be provided via water uptake from surface waterbodies.

ETNG Resource Report 2 (ETNG 2022c), which TVA has independently reviewed, provides the following regarding potential impacts of pipeline construction activities on groundwater recharge areas:

> The primary impact on groundwater recharge areas from the [gas pipeline] would include vegetation removal and soil disturbance associated with trenching operations,

> and water withdrawals associated with hydrostatic testing and horizontal directional drilling (HDD). Trenching activities along the pipeline route will typically be limited to excavations of less than 8 feet deep. Vegetation and soil disturbance will result in temporary effects on recharge areas and temporary disturbance of the waterbodies that also serve to collect surface water to recharge aquifers. These effects will be minimized through adherence to the [pipeline] Project Erosion & Sediment Control Plan (E&SCP), which includes implementation of erosion and sediment controls such as sediment barrier, dewatering filtration, and trench breakers. The Project E&SCP includes detailed descriptions of the erosion control best management practices (BMPs) proposed as well as typical details that will be followed during construction. Post-construction monitoring will ensure proper re-vegetation and restoration of recharge areas; and the affected area will continue to function as recharge for the aquifer post-construction. Effects from water withdrawals will also be temporary. Where practicable, surface waters withdrawn for the Project will be discharged to a vegetated upland area through a filtration device, within the watershed it is withdrawn from and in accordance with state and federal regulations and the Project E&SCP. [ETNG] will follow detailed measures for oil and hazardous materials storage and spill protection outlined in the Project E&SCP, the FERC Plan, and the FERC Procedures. These spill prevention practices include proper storage, handling and inspection of containers and tanks, minimizing refueling in recharge areas, following the appropriate emergency response procedures, and adherence to all spill prevention and control measures detailed in the Project E&SCP and Spill Prevention, Control, and Countermeasures (SPCC) Plan.

Project construction activities could potentially cause erosion resulting in the movement of sediment into groundwater infiltration zones. As the gas pipeline would be buried, there is a potential that it may come into contact with groundwater. The use of BMPs as described in Section 3.6.1.2.1, implementation of both construction and operational SWPPPs, and adherence to SPCC plans would reduce the potential of any on-site sediment, chemicals, and hazardous materials reaching the groundwater during construction and operation. Overall, effects to groundwater are anticipated to be negligible.

The primary uses of water during construction and maintenance-related activities would be for possible dust control and hydrostatic testing. The internal access roads would not be heavily traveled during normal operations; therefore, water use for dust control during operation is not expected; however, would be needed for drinking water and bathrooms at the compressor station. Water needs during construction, maintenance, and operations would be provided via water trucks and water uptake from surface waterbodies and would not adversely affect groundwater resources. ETNG would provide a detailed analysis of groundwater effects, which would be part of the Environmental Report to be submitted with ETNG’s certificate application that would be filed with FERC for the proposed pipeline. This information would be updated, as appropriate, in the final EIS.

ETNG would attempt to contact landowners with wells, springs, and septic systems to get an inventory of these structures within 150 feet of the proposed construction workspace for the pipeline. ETNG would offer landowners with these structures pre- and post-construction water quantity and quality monitoring to determine whether there were significant changes in water quantity or quality due to pipeline construction activities. In the unlikely event that it is determined that permanent effects have occurred to a well/spring as a result of construction activities, ETNG would repair, replace, or provide alternative sources of potable water (ETNG 2022c).

With RFFAs in proximity to the proposed pipeline, there is potential for cumulative effects to groundwater to occur. There could be a small potential for spills to cause cumulative groundwater effects; however, these effects would be considered unlikely as the various projects would employ BMPs such as those identified in a spill prevention, control, and countermeasure plan to control for and clean up potential spills of chemicals or hazardous materials that could occur. Therefore, potential cumulative effects associated with groundwater due to construction activities and associated vehicles in the area is negligible.

3.6.1.2.3.7 Summary of Alternative A

TVA Actions

The activities and project components proposed under Alternative A would require excavation below the existing ground surface to establish a sub-base and foundation. To avoid impacts to groundwater resources, sink holes and other karst features would be identified prior to excavation and either protected with buffer zones or grouted appropriately. The use of BMPs, SWPPPs, and SPCCs, would reduce the possibility of erosion or on-site sediments due to erosion and/or hazardous materials reaching the groundwater during construction activities or as a result of operation. As such, no adverse or cumulative adverse effects to groundwater are anticipated.

The construction activities required for a new CC/Aero CT Plant could potentially cause erosion resulting in the movement of sediment into groundwater infiltration zones. BMPs, such as those described in TVA's *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities* (TVA 2022a), would be used to avoid contamination of groundwater from construction activities. The use of BMPs and an SWPPP would reduce the possibility of any on-site hazardous materials reaching the groundwater during construction and operation. Overall, effects to groundwater are not anticipated.

ETNG Actions - Natural Gas Pipeline and Associated Structures

The construction and operation of the pipeline is not anticipated to have long-term negative impacts on groundwater quality or supply (i.e., public and private drinking/supply wells) or wellhead protection areas (ETNG 2022c). Effects would be considered unlikely as the various projects would employ BMPs such as those identified in a spill prevention, control, and countermeasure plan to control for and clean up potential spills of chemicals or hazardous materials that could occur. Therefore, potential cumulative effects associated with groundwater are anticipated to be negligible.

3.6.1.2.3.8 Environmental Justice Considerations

TVA Actions

Effects to groundwater that would occur as a result of proposed CC/Aero CT Plant, would be minimized with implementation of BMPs and generally limited to the TVA-owned Kingston Reservation, where no populations are present. Effects also have the potential to be cumulative due to construction activities and vehicle use in the area. Effects to groundwater associated with the off-site transmission activities are expected to be minor with the implementation of BMPs and a SWPPP.

ETNG- Natural Gas Pipeline Actions

Effects to groundwater resulting from ETNG's proposed natural gas pipeline and associated structures are expected to be minor with the implementation of BMPs and a SWPPP. While areas with EJ populations would not be disproportionately affected by any cumulative effects on groundwater as a result of other projects undertaken in the area or due to the minor project-specific effects, EJ populations may experience amplified effects due to their greater susceptibility. ETNG is independently evaluating the potential for the pipeline project to have disproportionate effects on EJ communities and will work to minimize or mitigate impacts as appropriate.

3.6.1.2.4 Alternative B

3.6.1.2.4.1 Construction and Operations of Solar and Storage Facilities

Water and sewer treatment services are often not available at many of the possible solar and storage facility locations, as sites of sufficient size to support solar and storage projects are often in more rural locations and previously undeveloped. However, both are anticipated as on-site needs during construction. Construction-related water use would support site preparation (including dust control) and grading activities. During earthwork for the grading of access roads and construction of the transmission corridor, the primary use of water would be for compaction and dust control.

Water used during construction would be delivered by water trucks. If determined necessary, sewer treatment would be accomplished through use of a pump-out septic collection and holding tanks. If installed, the septic holding tank would be appropriately permitted and constructed to avoid effects to groundwater. The proposed options for water and water-related needs would not be likely to adversely affect available groundwater resources.

Project activities could potentially cause erosion resulting in the movement of sediment into groundwater infiltration zones. TVA's BMPs (TVA 2022a) would be used to avoid contamination of groundwater from Project activities. The use of BMPs and an SWPPP would reduce the possibility of any on-site hazardous materials reaching the groundwater during construction and operation. Overall, effects to groundwater are not anticipated.

The primary uses of water during operation and maintenance-related activities would be for on-site maintenance facilities. Precipitation in the area is typically adequate to minimize the buildup of dust and other matter on the PV panels that would reduce energy production; therefore, no regular panel washing is anticipated. Battery storage sites may require water for sprinkler facilities for fire suppression. Water needs during operations and maintenance would be provided either via the proposed Project wells also used during construction or by delivery via water trucks and would not adversely affect groundwater resources.

Cumulative effects to groundwater associated with the expansion of solar facilities under the 2019 IRP are not anticipated with the use of BMPs.

3.6.1.2.4.2 Transmission and Other Components

Transmission lines associated with solar and BESS facilities would have the same general effects on groundwater as described in Section 3.6.1.2.3.

3.6.1.2.4.3 Environmental Justice Considerations

Effects to groundwater that would occur as a result of construction and operation of the solar and BESS facilities and associated transmission lines would be minimized with the implementation of BMPs. While negative effects are not anticipated, effects on EJ populations related to groundwater effects would be evaluated for individual solar and storage facilities under future NEPA efforts.

3.6.2 Surface Waters and Water Quality

Surface water is any water that flows above ground and includes, but is not limited to, streams, ponds, lakes, and wetlands. Streams can be further classified as perennial, intermittent, or ephemeral (or wet weather conveyance [WWC]) based on the occurrence of surface flow and the agency's definition. TDEC determines features as WWC ("not a stream") or "stream". WWCs are "man-made or natural watercourses, including natural watercourses that have been modified by channelization: that flow only in direct response to precipitation runoff in their immediate locality; whose channels are at all times above the ground water table; that are not suitable for drinking water supplies; and in hydrological and biological analyses indicate that, under normal weather conditions, due to naturally occurring ephemeral or low flow there is not sufficient water to support fish, or multiple populations of obligate lotic aquatic organisms whose life cycle includes an aquatic phase of at least two months" (TDEC 2020). Streams, as defined by TDEC (2020), are surface waters that are not classified as WWCs. The USACE determines waters by the "relatively permanent" test or the "significant nexus" test: if a waterbody provides relatively permanent, standing, or continuously flowing waters connected to traditional navigable waters, the territorial seas, and interstate waters, or a tributary to these waters, then it is considered jurisdictional by the USACE (USEPA 2022c). The USACE defines waters are those exhibiting an ordinary high-water mark (OHWM), which delineates the lateral extent (jurisdictional limits) of streams and lakes (USACE 2022b). Ephemeral streams can vary on jurisdiction between the agencies: ephemeral streams with an OHWM may be jurisdictional by the USACE but may not exhibit the characteristics needed to be classified by a "stream" by TDEC. Wetlands are discussed in Section 3.6.3.

Specific surface waters may be included on the National Rivers Inventory List, which is a list of all rivers that have been identified as potential candidates for listing as Wild and Scenic Rivers. Tennessee also designates certain surface waters as Exceptional Tennessee Waters and Outstanding Resource Waters because of their exceptional qualities. TVA and its partners would coordinate with the National Park Service (NPS) in accordance with Sections 7(a) and 10(a) of the Wild and Scenic Rivers Act (WSRA) for any waters crossed by the proposed project alternatives that are classified as Wild and Scenic Rivers.

Section 7(a) of the WSRA stipulates that federally assisted water resource projects on designated Wild and Scenic Rivers, including natural gas pipelines, may not result in "a direct and adverse effect on the values for which such river was established." Section 7(a) further states that federally assisted water resource projects "below or above a wild, scenic, or recreational river area or on any stream tributary" may not "invade … or unreasonably diminish the scenic, recreational, or fish and wildlife values" of the designated river. Section 10(a) of the WSRA requires that Wild and Scenic Rivers "shall be administered in such manner as to protect and enhance the values" leading to their designation.

The CWA establishes standards for the protection of water quality of surface waters. NPDES permits are required for the discharge of pollutants from point sources (CWA into waters of the United States (Sections 316(a) and 402). NPDES permits also address CWA Section 316(b) requirements for the design, location, construction, and capacity of cooling water intake structures to reflect the best technology available for minimizing adverse environmental impact due to water withdrawals fish impingement and entrainment, as well as Section 316(a) requirements for effluent limitations on thermal discharges to assure maintenance of a balanced indigenous population of fish and wildlife. Section 404 of the CWA further prohibits the discharge of dredge and fill material to waters of the United States, which includes wetlands, unless authorized by a permit issued by USACE. Certification from the State of Tennessee would also be sought required to verify that the federally permitted discharges comply with the state's applicable effluent limitations, antidegradation, and water quality standards. If approved, the TDEC Division of Water Resources would be responsible for issuance of a Section 401 water quality certification, typically in the form of an ARAP.

The CWA requires all states to identify waters where required pollution controls are not sufficient to attain or maintain applicable water quality standards and to establish priorities for the development of limits based on the severity of the pollution and the sensitivity of the established uses of those waters. States are required to submit reports to USEPA with these data. The term "303(d) list" refers to the list of impaired and threatened streams and water bodies identified by the state as not attaining water quality standards for the established use. Under Section 303(d) of the CWA, states are required to assess waters within their boundaries and determine if they meet water quality standards; list waters that do not meet standards and update the list biannually; and conduct total maximum daily load (TMDL) studies to set pollutant-reduction goals needed to restore waters to the extent that they meet water quality standards for designated uses (USEPA 2022d).

Additionally, the seven states within the TVA power service area have enacted their own state laws regulating water quality and implementing the CWA. The USEPA has also established water quality standards for the State of Tennessee; as part of this implementation, the states classify water bodies according to their uses and establish water quality criteria specific to these uses. Each state has also issued an antidegradation statement containing specific conditions for regulated actions and designed to maintain and protect current uses and water quality conditions. In Tennessee, where the project is located, the TDEC Division of Water Resources administers the following state statutes, rules, and regulations (TDEC 2023a):

- Water Quality Control Act – regulates surface waters;
- Tennessee Safe Drinking Water Act – regulates the quality and quantity of drinking water;
- Safe Dams Act – regulates construction of non-federal dams;
- Water Wells Act – regulates the licensing of well drillers and pump setters and establishes rules for water wells; and
- Water Withdrawal Registration Act – requires water withdrawals to be registered with the state.

3.6.2.1 Affected Environment

3.6.2.1.1 Kingston Reservation (No Action and D4 Activities)

3.6.2.1.1.1 Surface Waters

Kingston is situated on a peninsula formed by the confluence of the Clinch and Emory rivers at Clinch RM 2.6. KIF withdraws water from the Emory River and discharges to the Clinch River. The Clinch and Emory rivers at this location also form an arm to Watts Bar Reservoir; a slack-water channel for navigation created by Watts Bar Reservoir extends more than 20 miles up the Clinch River and 12 miles up the Emory River. River flow velocity near the Kingston Reservation is regulated and influenced by Melton Hill Dam on the Clinch River (20.6 RMs upstream of the Kingston Reservation) and the Watts Bar Dam located on the Tennessee River (40.5 RMs downstream and below the confluence of the Clinch and Tennessee rivers).

Field surveys for surface waters (i.e., perennial and intermittent streams and ephemeral channels) were performed by Tennessee Qualified Hydrologic Professionals during summer of

2019 (TVA 2020c; Appendix E). A portion of the site was re-evaluated in spring of 2022 due to permitted disturbances in the area since 2019 (Figure 3.6-3). Waters are labeled with field identification numbers which correspond to photographs and data forms provided in Appendix E.

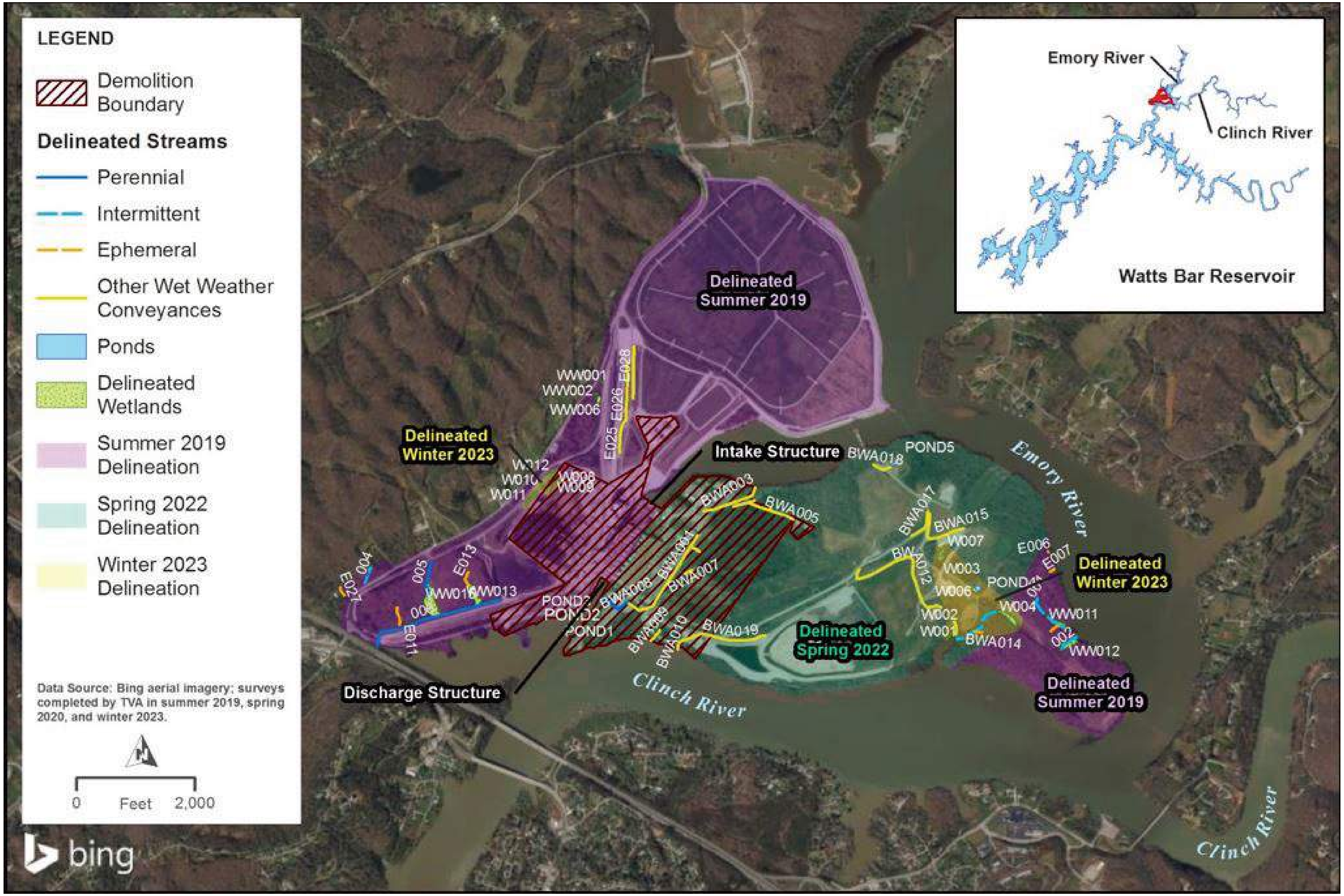

Figure 3.6-3. Surface Water and Wetland Features on the Kingston Reservation

In addition to the Emory and Clinch rivers surrounding the north, east, and southern boundaries of the Kingston Reservation, site surveys documented 3 perennial streams totaling 3,426 LF; 4 intermittent streams (combined 2,336 LF); 7 ephemeral channels (totaling 1,510 LF); 19 other WWCs totaling 13,279 LF; and 6 ponds (totaling 0.39 acre) (Table 3.6-2 and Figure 3.6-3).

Table 3.6-2. Summary of Streams Present on Kingston Reservation

Feature	Field ID	Number of Features	Total Extent
Streams			
Perennial	005, 006, BWA008	3	3,426 LF
Intermittent	001, 002, 004, BWA013	4	2,336 LF
Ephemeral	E006, E007, E008, E011, E013, E027, BWA014	7	1,510 LF
Other Wet-Weather Conveyances (e.g., non-jurisdictional ditches, swales)	BWA001-012, BWA015-019, E025, E026, E028	19	13,279 LF
	Total	*33*	*20,551 LF*
Open Water			
Ponds		6	0.39 acre

The perennial streams on the Kingston Reservation exhibit flowing water year-round within a clearly defined bed and/or bank. One perennial stream is a tributary to Watts Bar Reservoir and another flows through three ponds and into the Emory River; this stream was observed to support aquatic life (TVA 2022b). The intermittent streams on the Kingston Reservation exhibit characteristics of channels with seasonal flow, as indicated by a less-defined bed and/or bank; a dry channel without terrestrial plant growth but containing allochthonous materials; and a lack of aquatic organisms or plants that depend on perennial flow for survival, among other indicators. The perennial and intermittent streams identified on the Kingston Reservation have forested riparian habitat with trees, shrubs, and herbaceous plants that extend 60 feet or more on either side of the streams, except for one perennial stream that is extensively altered but still supports aquatic life. An intact forested buffer provides benefits to water quality, reduces stream bank erosion, and maintains stable stream channels. Ephemeral channels and other waters (both WWCs and non-WWCs) documented during the site surveys represent features observed at the time of the survey (spring 2019 and summer 2022). These types of features can disappear or be created in response to surface runoff from precipitation events and changes to surrounding topography and landcover. Verification of stream jurisdiction would be confirmed by an Approved Jurisdictional Determination (AJD) from the USACE.

Within Kingston Reservation, the demolition boundary encompasses 8 WWCs (totaling 4,029 LF), 1 perennial stream (434 LF), and 1 ephemeral channel (864 LF) (Table 3.6-3). The WWCs within this area consist of roadside ditches, vegetated swales, or other drainage areas. The waters within this boundary are generally man-made or otherwise altered and disturbed areas (Appendix E). Three ponds are also present within the demolition boundary, totaling 0.08 acre.

Table 3.6-3. Summary of Streams Present within the D4 Boundary on Kingston Reservation[1]

Feature	Field ID	Number of Features	Total Extent
Streams			
Perennial	BWA008	1	434 LF
Other Wet-Weather Conveyances (e.g., non-jurisdictional ditches, swales)	BWA001-005, BWA007, BWA009, BWA010, BWA019	9	4,893 LF
	Total	*10*	*5,327 LF*
Open Water			
Ponds	POND1, POND2, POND3	3	0.08 acre

[1] These surface water features are also captured in Table 3.6-2.

Detailed descriptions and field data forms of all water features on Kingston Reservation are provided in Appendix E.

3.6.2.1.1.2 Water Quality

The reaches of the Clinch River and Emory River adjacent to the Kingston Reservation boundary are considered part of the Watts Bar Reservoir. Several surface waters on Kingston Reservation drain to the Clinch River arm of the Watts Bar Reservoir and/or are influenced by the reservoir; however, none drain directly into the Emory River arm of the reservoir. The Emory River arm of the Watts Bar Reservoir borders the north and eastern sides of the Kingston Reservation, while the Clinch River arm of the Watts Bar Reservoir borders the southern sides (Figure 3.6-3). Several surface waters on Kingston Reservation drain to the Clinch River arm of the Watts Bar Reservoir and/or are influenced by the reservoir. The Watts Bar Reservoir adjacent to the Kingston Reservation is listed as impaired on the 303(d) final list for 2022 (TDEC 2022g). Sources of impairment include contaminated sediments (chlordane and polychlorinated biphenyls [PCBs]), mercury (via atmospheric deposition and industrial point-source discharge), and low dissolved oxygen due to impoundment. Additionally, the Emory River arm of Watts Bar Reservoir is also listed as impaired for contaminated sediments (chlordane and PCBs), industrial point-source discharges of mercury and PCBs, and atmospheric deposition of mercury (TDEC 2022g).

The Clinch River from RM 0.0 to RM 4.4 at the confluence with the Emory River is classified for domestic and industrial water supply, fish and aquatic life, recreation, livestock watering and wildlife, irrigation, and navigation uses). The Emory River from RM 0.0 to its origin is classified for use for domestic and industrial water supply, fish and aquatic life, recreation, livestock watering and wildlife, and irrigation uses. Per the TDEC Use Classifications for Surface Waters, all other surface waters that have not been specifically noted (except WWCs) shall be classified for aquatic life, recreation, livestock watering and wildlife, and irrigation (TDEC 2019).

National wild and scenic rivers are protected subject to the Wild and Scenic Rivers Act. No Nationwide Rivers Inventory streams or Wild and Scenic Rivers[14] are located on or adjacent to

[14] Nationwide Rivers Inventory is a listing of more than 3,200 free-flowing river segments that are believed to possess one or more “outstandingly remarkable” natural or cultural values judged to be at least regionally significant. Rivers included in the Nationwide Rivers Inventory are candidates for Wilde and Scenic Rivers, which are protected under the National Wild and Scenic Rivers System created by Congress in 1968 with the goal of “preserving certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations.”

the Kingston Reservation (NWSRS 2022). Per the TDEC Use Classifications for Surface Waters, all other surface waters that have not been specifically noted (except WWCs) shall be classified for aquatic life, recreation, livestock watering and wildlife, and irrigation (TDEC 2019).

KIF withdraws approximately 1,107 MGD from a surface water intake structure on the Clinch River for cooling and plant process water (e.g., sluice water, fire protection, boiler feed water, and other miscellaneous uses). Approximately 99 percent of the water withdrawal (1,096 MGD) is used for cooling, while approximately one percent is used for other uses including process water. The withdrawn water is returned to the river after appropriate treatment via Outfalls 001, 002, 004, and 006, and complies with Kingston's NPDES Permit No. TN0005452.

From Outfall 001of its NPDES permit, KIF is authorized to discharge treated ash pond effluent (including BATW, coal yard run off, utility building drainage area, fire protection flushes), combustion residual leachate, chemical and nonchemical metal cleaning wastes, ammonia storage area runoff, water treatment plant wastes (including reverse osmosis system reject and backwash), drainage from sluice line trench, station sump discharge, stormwater from FGD area sump, and American Air Filter area sump with precipitator wash and raw water leakage (NPDES permit No. TN0005452; TDEC 2021a).

At Outfall 002, KIF is permitted to discharge once-through condenser cooling water (CCW) discharge plus flows from Outfall 001, boiler blowdown, discharge from underflow ponds with fire protection flushes, raw water leakage and transformer/switchyard runoff, intake screen backwash from Outfall 004 and FGD strainers, discharge from FGD stormwater pond IMP 01A, and discharge from Outfall 006 (TDEC 2021a). Due to the discharge of once-through CCW, the Clinch River downstream of Outfall 002 is subject to thermal discharges in this area; the existing NPDES permit states that a thermal variance of 36.1°C is authorized and extended for this permit cycle[15]. Discharges from outfalls 001 and 002 have effluent limitations and monitoring requirements as outlined in the NPDES permit.

Outfall 004 discharges raw river water used for intake screen backwash, and Outfall 006 discharges air conditioning condensate, fire protection flushes, and plant water leakage (TDEC 2021a). None of the discharges from these outfalls have numeric limits or reporting requirements under the current NPDES permit.

On June 7, 1979, regulations implementing section 316(a) were codified in the Code of Federal Regulations. Section 316(a) of the CWA applies to point sources with thermal discharges. It authorizes the NPDES permitting authority to impose alternative effluent limitations for the control of the thermal component of a discharge in lieu of the effluent limited that would otherwise be required under section 301 or 306 of the CWA (USEPA 2008). On August 15, 2014, Section 316(b) of the final CWA rule for existing facilities was published in the Federal Register with an effective date of October 14, 2014 (USEPA 2014). The 2014 CWA Section 316(b) rule applies to facilities that withdraw more than 2 MGD from waters of the United States, use at least 25 percent of that water exclusively for cooling purposes, and have an NPDES permit, which includes KIF. The requirements of the Section 316(b) rule are incorporated into the NPDES permit renewal cycle to allow the NPDES Director a holistic assessment of the impact of KIF operations on the aquatic community, such as impingement and entrainment, from thermal discharge and cooling water intake perspectives and to inform decision making for regulatory compliance with both regulations in the subsequent NPDES permit.

The most recent NPDES permit for KIF was issued on December 1, 2021, and will expire on February 28, 2023. As part of the next permit renewal cycle, TVA is fulfilling Section 316 requirements with a submittal package provided to the Director of TDEC Division of Water Resources on August 30, 2022. In coordination with TDEC Division of Water Resources (DOW), TVA may consequently require installation of new technologies at the KIF cooling water intake structure move forward with KIF's existing technologies or invest in new technologies, or a combination of both, with the goal of reducing impacts to aquatic organisms (further discussed in Section 3.8.3). The addition of new technologies may also be required to meet technology-based effluent limitations for FGD wastewater and BATW, as outlined in the ELGs (see Section 2.1.2.1) facilities.

3.6.2.1.2 Alternative A

3.6.2.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Two WWCs totaling 1,333 LF are present on the proposed CC/Aero CT Plant site (Table 3.6-4; Figure 3.6-4); an AJD has been requested but has not yet been received. Representative photographs and Hydrologic Determination Data Sheets for the two WWCs (BWA011 and BWA012) are provided in Appendix E. No surface waters are present within the switchyard boundary. None of the surface waters within the proposed CC/Aero CT Plant and switchyard boundary are on the National Rivers Inventory for Wild and Scenic Rivers.

See Section 3.6.2.1.1 for details on surface water features located in the vicinity of the proposed CC/Aero CT Plant site and switchyard locations.

Table 3.6-4. Summary of Streams Present in the Proposed CC/Aero CT Plant and Switchyard Site

Type of Feature	Field ID	Number of Features	Total Extent
CC/Aero CT Plant			
Wet Weather Conveyances	BWA011, BWA012	2	1,333 LF
Switchyard			
None	--	--	--

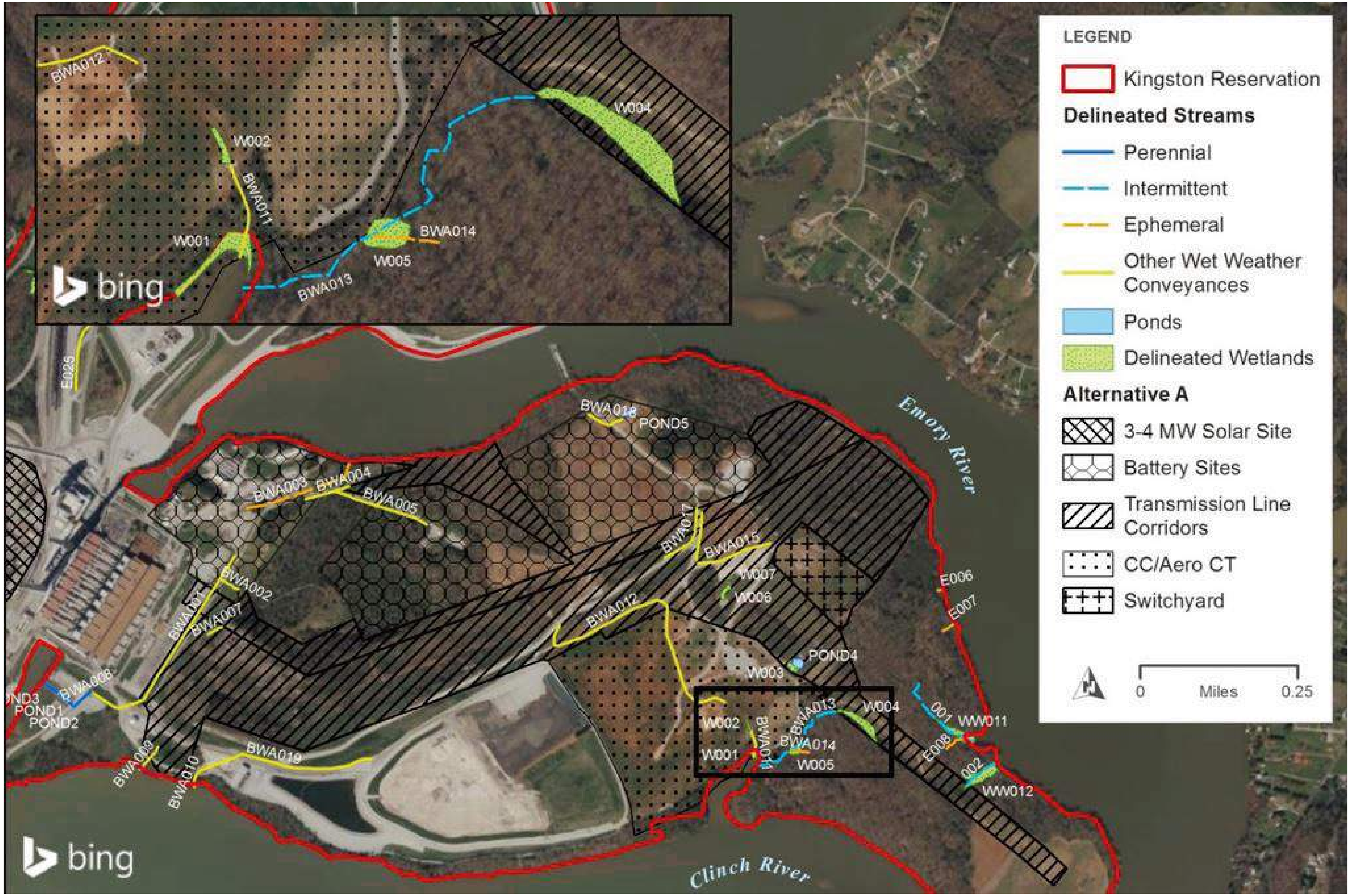

Figure 3.6-4. Alternative A Footprint on the Kingston Reservation

3.6.2.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

No surface waters occur within the bounds of the proposed 3- to 4-MW solar facility (Figure 3.6-4).

3.6.2.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Seven WWCs (totaling 2,536 LF) and one pond (0.12 acre) are present within the boundaries of Battery Sites 1, 2 and 3 (Figure 3.6-4, Table 3.6-5). Physical characteristics of the features are documented on TDEC hydrologic determination data forms provided in Appendix E. An AJD has been submitted but has not yet been received from the USACE for verification of waters classifications. The pond is a man-made detention pond located within the bounds of Battery Site 3. None of the surface waters within the proposed boundaries of Battery Sites 1, 2, or 3 are on the National Rivers Inventory for Wild and Scenic Rivers.

Table 3.6-5. Summary of Streams Present in the Proposed 100-MW BESS Sites

Type of Feature	Field ID	Number of Features	Total Extent
Battery Site 1			
Other Wet Weather Conveyances	BWA001-BWA004	4	1,682 LF
Battery Site 2			
Other Wet Weather Conveyances	BWA005, BWA006	2	534 LF
Battery Site 3			
Other Wet Weather Conveyances	BWA018	1	320 LF
Pond	POND5	1	0.12 acre

3.6.2.1.2.4 On-site Transmission Upgrades

Construction of the 100-MW BESS would include battery transmission line connections that tie in with the existing transmission lines on Kingston Reservation. Five WWCs totaling 607.3 LF are present within the extent of the battery transmission line connections boundary (Table 3.6-6). The WWCs are man-made drainages in the form of grassy swales or culverted ditches. One WWC has a bed and bank present, but the TDEC hydrologic determination form determined it is not a stream based on primary indicators. An AJD also has not been received from the USACE for waters verification. None of the surface waters within the proposed battery transmission line connection footprint are on the National Rivers Inventory for Wild and Scenic Rivers.

Table 3.6-6. Summary of Streams Crossed by the Proposed Battery Transmission Line Connections and On-site Transmission Corridor

Type of Feature	Field ID	Number of Features	Total Extent
Battery Transmission Corridor			
Other Wet Weather Conveyances	BWA001, BWA003, BWA004, BWA016, BWA017	5	607 LF
Existing On-site Transmission Corridor			
Intermittent	002	1	23 LF

Type of Feature	Field ID	Number of Features	Total Extent
Other WWCs	BWA001, BWA007, BWA009, BWA012, BWA015, BWA016, BWA017	7	3,659 LF

Under Alternative A, TVA would also make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant facilities and switchyard. Surface waters crossed by the new transmission line corridors include 1 intermittent stream (23 LF) and 7 WWCs totaling 3,659 LF. The intermittent stream is approximately 3 feet wide and 1-2 feet deep with clay substrate and a headwater seep. The WWCs are man-made drainages in the form of grassy swales or riprap ditches. One of the WWCs is includes a culvert to the Emory River.

3.6.2.1.2.5 Off-site Transmission Upgrades

3.6.2.1.2.5.1 Eastern Transmission Corridor

A field survey was completed in June 2022 to identify surface waters crossed by the Eastern Transmission Corridor (L 5108 and L5302) and Western Transmission Corridor (L5383) (HDR 2022b). TVA later determined the potential need for additional transmission upgrades within the Eastern Transmission Corridor for L5116, L5280, and L5381 for Alternative A. Additional field surveys for these areas have not yet been completed. However, the locations and types of watercourses identified will be included in the final EIS for this project.

As such, the analyses of surface waters presented in this draft EIS subdivides the evaluation of the Eastern Transmission Corridor based on the source of the data used:

- L5108 and L5302 — based on analysis of field survey results and other available publicly available data; and

- L5116, L5280, and L5381 — based on desktop analysis of publicly available data.

3.6.2.1.2.5.1.1 Lines 5108 and 5302 – Data from Field Surveys

The Eastern Transmission Corridor falls within Roane and Anderson counties (HDR 2022b; Appendix F). A total of 28 perennial streams (totaling 8,087 LF), 14 intermittent streams (totaling 2,765 LF), 13 ephemeral channels (3,307 LF), and 5 open water bodies (4 ponds and 1 excavated farm pond; 7.97 acres) were observed during field surveys (Table 3.6-5, Figure 3.6-5a through Figure 3.6-5d). The field survey report is provided as Appendix F. A total of 24 other WWCs (erosional gullies totaling 6,156 LF) were also identified during the survey. The erosional gullies were not observed to have an ordinary high-water mark, bed or bank, do not replace existing streams or wetland features, do not carry a relatively permanent flow of water, and do not have a direct hydrologic connection to any jurisdictional waters. Ephemeral channels, conversely, were observed to maintain some of these characteristics. Nine named creeks and rivers were identified crossing the eastern portion of the transmission corridor, including Clinch River, Bear Creek, Bearden Creek, Brushy Fork, Grassy Creek, East Fork Poplar Creek, Poplar Creek, Walker Branch, and Whiteoak Creek.

TDEC Designated Use Classifications for Surface Water Crossings are Listed in Table 3.6-8.

Table 3.6-7. Summary of Potential Surface Water Crossings for Upgrades to L5108 and L5302 within the Eastern Transmission Corridor under Alternative A

Feature	Number of Crossings	Total Extent
Streams		
Ephemeral	13	3,307 LF
Intermittent	14	2,765 LF
Perennial	28	8,087 LF
Total	*55*	*14,159 LF*
Open Waters		
Lake/Pond	5	7.97 acres
Other WWCs		
Erosional Gully	24	6,156 LF

Note: Information in this table is derived from field surveys completed in June 2022.

Table 3.6-8. Summary of Designated Uses for Surface Waters Crossed by the Eastern Transmission Corridor for Alternative A

Stream	Use Classification[1]							
	FAL	REC	LWW	IRR	TS	IWS	NRTS	DOM
Bear Creek[2]	X	X	X	X				
Bearden Creek[3,4]								
Brushy Fork[2]	X	X	X	X				
Clinch River[2]	X	X	X	X		X		X
East Fork Poplar Creek[2]	X	X	X	X				
Emory River[2,3]	X	X	X	X		X		X
Grassy Creek[3,4]								
Poplar Creek[2,3]	X	X	X	X		X		
Walker Branch[3]								
Whiteoak Creek[3,4]	X	X		X				
Unnamed Tributaries[2,3]	X	X	X	X				

Source: TDEC 2019

[1] Codes: FAL= Fish and Aquatic Life; REC = Recreation; LWW = Livestock Watering and Wildlife; IRR = Irrigation; TS = Trout Stream; IWS = Industrial Water Supply; NRTS = Naturally Reproducing Trout Stream; DOM = Domestic Water Supply

[2] Surface waters crossed by L5108 and L5302.

[3] Surface water crossed by L5116, L5280, and L5302.

[4] No designated use data available for this waterbody.

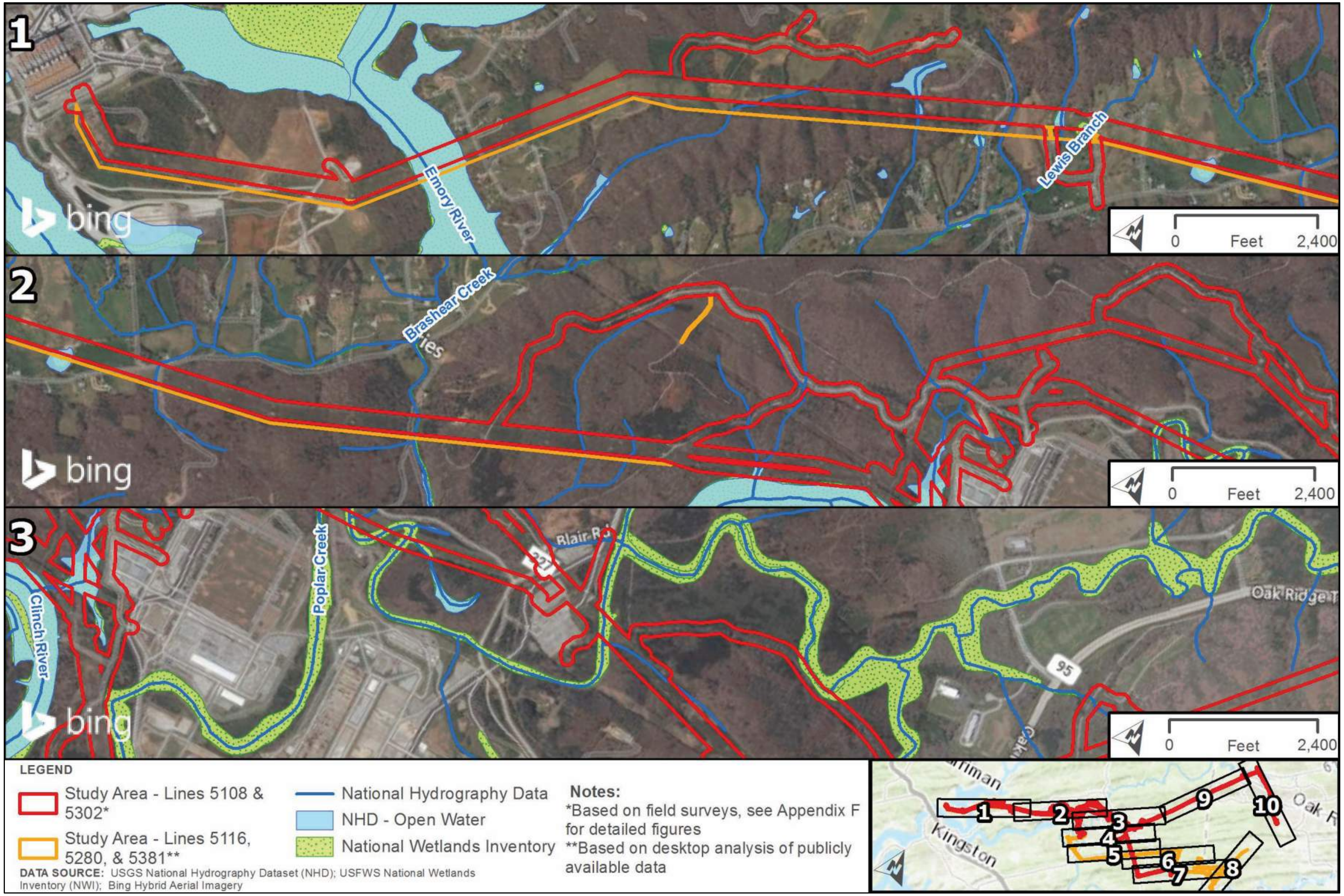

Figure 3.6-5a. Surface Waters Identified Within the Eastern Transmission Corridor Proposed for Off-site Transmission Upgrades Under Alternative A of the Kingston Retirement Project

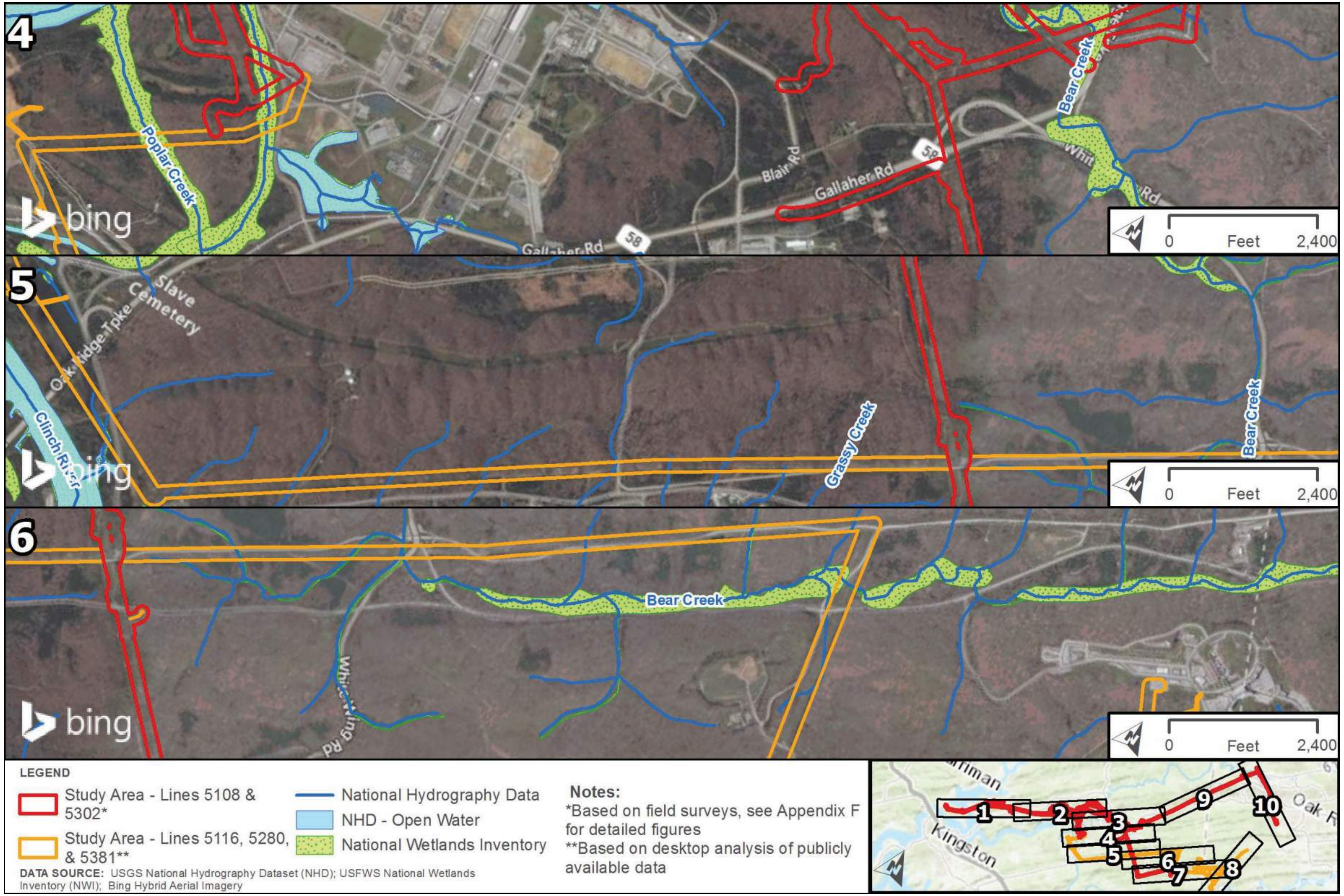

Figure 3.6-5b. Surface Waters Identified Within the Eastern Transmission Corridor Proposed for Off-site Transmission Upgrades Under Alternative A of the Kingston Retirement Project

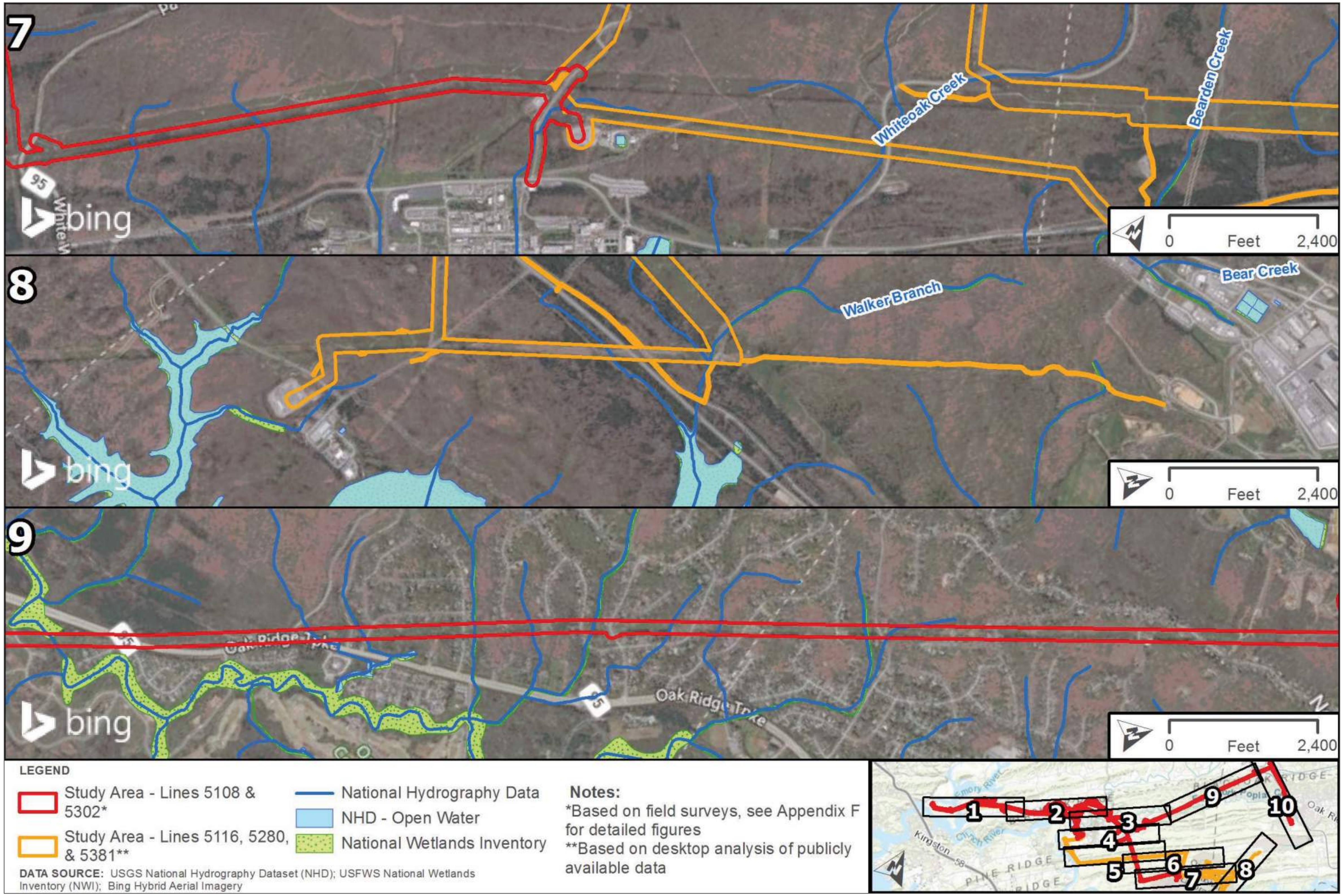

Figure 3.6-5c. Surface Waters Identified Within the Eastern Transmission Corridor Proposed for Off-site Transmission Upgrades Under Alternative A of the Kingston Retirement Project

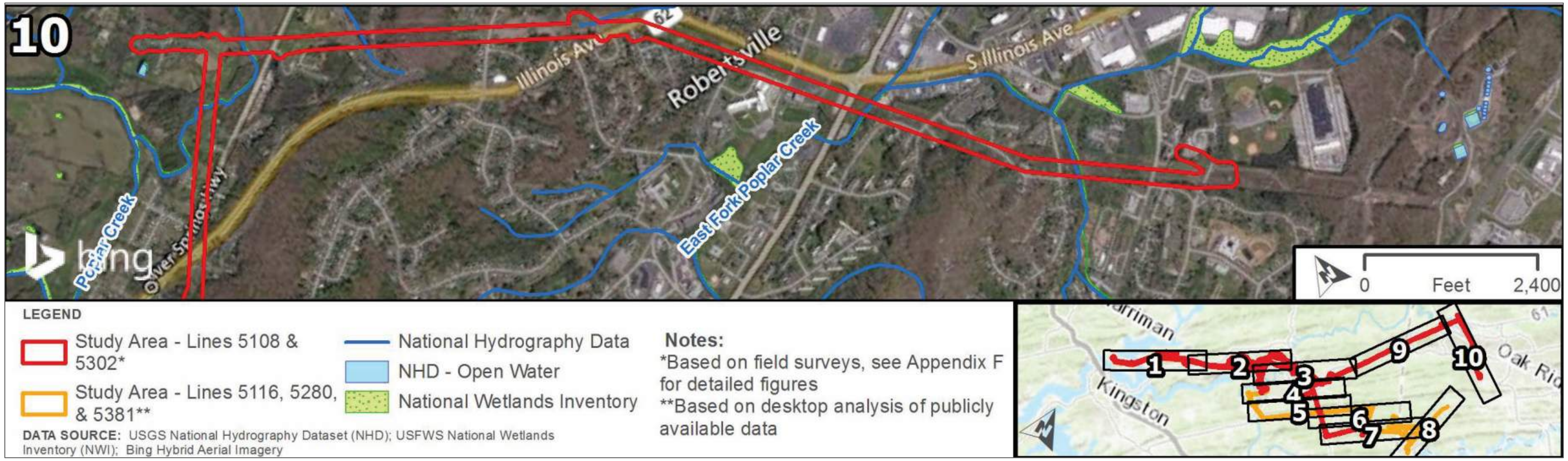

Figure 3.6-5d. Surface Waters Identified Within the Eastern Transmission Corridor Proposed for Off-site Transmission Upgrades Under Alternative A of the Kingston Retirement Project

Several waters crossed by L5108 and L5302 within the Eastern Transmission Corridor are listed as impaired on the 2022 303(d) list. Details including the cause for listing and potential sources are provided in Table 3.6-7.

Table 3.6-9. 2022 303(d) Listed Impaired Waters Identified Within the Footprint of the Proposed Off-Site Transmission Upgrades within the Eastern Transmission Corridor under Alternative A in Roane and Anderson Counties, Tennessee

Waterbody	Cause for Listing	Potential Source
Roane County		
Bear Creek	Cadmium	CERCLA National Priorities List (Superfund) Site
	Mercury	
	Nutrients	
	PCBs	
Clinch River Outlet	Cause Unknown	CERCLA National Priorities List (Superfund) Site
	Cesium	CERCLA National Priorities List (Superfund) Site
	Strontium	CERCLA National Priorities List (Superfund) Site
East Fork Poplar Creek	*E. coli*	Municipal (Urbanized High-Density Area)
		Sanitary Sewer Overflows
	Mercury	Contaminated Sediments
		Industrial Point Source Discharge
	Nutrients	Municipal (Urbanized High-Density Area)
		Municipal Point Source Discharges
	PCBs	Contaminated Sediments
	Other Anthropogenic Substrate Alterations	Municipal (Urbanized High-Density Area)
	Sedimentation/Siltation	Municipal (Urbanized High-Density Area)
Emory River	PCBs	Contaminated Sediments
	Mercury	Atmospheric Deposition – Toxics
Emory River Embayment of Watts Bar Reservoir	Chlordane	Contaminated Sediments
	Mercury	Atmospheric Deposition – Toxics
		Industrial Point Source Discharge
	PCBs	Contaminated Sediments
		Industrial Point Source Discharge
Grassy Creek	Alteration in Stream-Side or Littoral Vegetative Covers	Municipal (Urbanized High-Density Area)
	E. coli	
	Sedimentation/Siltation	

Waterbody	Cause for Listing	Potential Source
Poplar Creek	*E. coli*	Municipal (Urbanized High-Density Area)
		Sanitary Sewer Overflows
	Mercury	Industrial Point Source Discharge
		Contaminated Sediments
	Nutrients	Municipal Point Source Discharges
		Municipal (Urbanized High-Density Area)
	PCBs	Contaminated Sediments
	Sedimentation/Siltation	Municipal (Urbanized High-Density Area)
Whiteoak Creek	Cause Unknown	CERCLA National Priorities List (Superfund) Site
	Cesium	
	Strontium	
Anderson County		
East Fork Poplar Creek	*E. coli*	Municipal (Urbanized High-Density Area)
	Mercury	Contaminated Sediments
		Industrial Point Source Discharge
	Nutrients	Municipal (Urbanized High-Density Area)
	Other Anthropogenic Substrate Alterations	Municipal (Urbanized High-Density Area)
	PCBs	Contaminated Sediments
	Sedimentation/Siltation	Municipal (Urbanized High-Density Area)

Source: TDEC 2022g
Notes: CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act;
PCBs: Polychlorinated biphenyls

3.6.2.1.2.5.1.2 Lines 5116, 5280, and 5381 – Data from Desktop Sources

Field surveys of L5116, L5280, and L5381 to verify surface waters of the Eastern Transmission Corridor will be performed by TVA during summer 2023 (Figure 3.6-5a – Figure 3.6-5d). A desktop-based geospatial assessment of surface water resources along the ROWs of L5116, L5280, and L5381 was completed using USGS topographic maps, USGS NHD, and NWI data. Additionally, field surveys are currently underway along these lines to verify the existing known surface water information (Figure 3.6-5a-d). The desktop review using the aerial imagery identified a total of 32 perennial streams (totaling 5,986 LF), 27 intermittent streams (totaling 6,912 LF), 7 open water bodies (6 ponds and the Emory River, totaling 4.62 acres) were identified using publicly available resources (Table 3.6-10). Open waterbodies may overlap with some areas of streamlines from the USGS NHD. Six named creeks were identified crossing the eastern portion of the Eastern Transmission Corridor, including Bear Creek, Bearden Creek, Grassy Creek, Poplar Creek, Walker Branch, and Whiteoak Creek. TDEC Designated Use Classifications for these surface water features are summarized in Table 3.6-6, and descriptions of any impaired waters on the 2022 Section 303(d) list are provided in Table 3.6-6. None of the surface waters crossed by L5116, L5280, or L5381 of the Eastern Transmission Corridor are on the National Rivers Inventory for Wild and Scenic Rivers.

Table 3.6-10. Summary of Potential Surface Water Crossings by Lines L5116, L5280, and L5381 within the Eastern Transmission Corridor under Alternative A

Feature	Number of Crossings	Total Extent
Streams		
Intermittent	27	6,912 LF
Perennial	32	5,986 LF
Total	*59*	*12,897 LF*
Open Waters		
Lake/Pond	7	4.62 acres

Note: Information in this table is derived from publicly available online sources, such as USGS NHD, NWI, and USGS topographic maps.

3.6.2.1.2.5.2 Western Transmission Corridor

3.6.2.1.2.5.2.1 Line 5383 - Data from Field Surveys

A field survey was completed in June 2022 of the Western Transmission Corridor located in Cumberland County (HDR 2022b; Appendix F). A total of 7 perennial streams (totaling 2,300 LF), 7 intermittent streams (totaling 1,726 LF), 4 ephemeral channels (totaling 545 LF), and 3 open water ponds (1.54 acres) were identified within the ROW corridor (Table 3.6-11; Appendix F). No transmission upgrades are proposed within the western portion of the Western Transmission Corridor; as such, field surveys were limited to the portion of the corridor where transmission upgrades are currently proposed, as identified in Figure 3.6-6. Rocky Branch, one of two named perennial streams within the Western Transmission Corridor is crossed in three locations by the existing L5383 for a total crossing length of 1,428 LF. The other named perennial stream is the Obed River, which is crossed in a single location for a total crossing length of 260 LF. Proposed upgrades and reconductoring would occur on existing transmission lines within existing ROWs and no new structures would be placed within the Obed River or its tributaries.

Table 3.6-11. Summary of Surface Waters Crossings for Potential Upgrades within the Western Transmission Corridor under Alternative A

Feature	Number of Crossings	Total Extent
Streams		
Ephemeral*	4	545 LF
Intermittent	7	1,726 LF
Perennial	7	2,300 LF
Total	*18*	*4,571 LF*
Open Waters		
Pond	3	1.54 acres

Note: Information in this table is derived from field surveys completed in June 2022.
Source: HDR 2022b
*WWC and non-WWC.

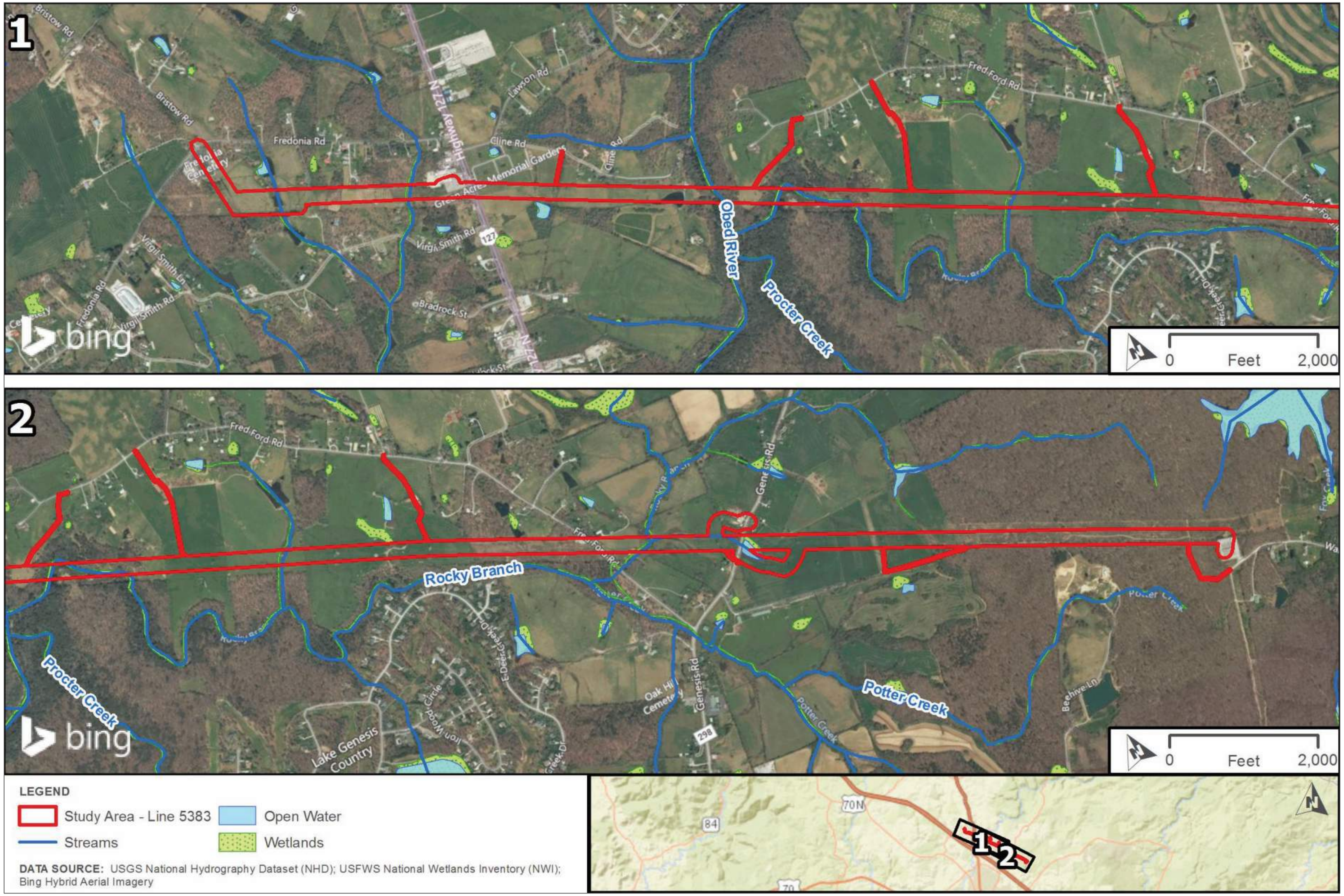

Figure 3.6-6. Surface Waters Identified Within the Western Transmission Corridor Proposed for Off-site Transmission Upgrades Under Alternative A of the Kingston Retirement Project

In accordance with TDEC Use Classifications for Surface Waters (TDEC 2019), any unnamed surface waters or all others not included in Rule 0400-40-04 are classified for fish and aquatic life, recreation, livestock watering and wildlife, and irrigation. Rocky Branch is not included in the classifications; therefore, the classification for this waterbody falls under the same uses as unnamed streams. Designated uses for the Obed River within the Western Transmission Corridor include supporting fish and aquatic life, recreation, livestock watering and wildlife, and irrigation uses. The Obed River, where it occurs within the Western Transmission Corridor, is included on the 2022 303(d) impaired waters list. The impairments and sources are summarized in Table 3.6-12.

Table 3.6-12. 2022 303(d) Listed Impairments for the Obed River Crossed by the Western Transmission Corridor under Alternative A Transmission Corridor in Cumberland County, Tennessee

Cause for Listing	Potential Source
Total Nitrogen	Discharges from biosolids (sludge) storage, application or disposal
	Municipal point source discharges
E. coli	Discharges from biosolids (sludge) storage, application or disposal
	Municipal (urbanized high-density area)
	Sanitary sewer overflows (collection system failures)
Total Phosphorus	Discharges from biosolids (sludge) storage, application or disposal
	Municipal (urbanized high-density area)
	Municipal point source discharges
Flow Regime Modification	Dam or Impoundment
Physical Substrate Habitat Alteration	Dam or Impoundment
	Municipal (urbanized high-density area)

Source: TDEC 2022g

3.6.2.1.2.6 Construction and Operation of a Natural Gas Pipeline

Surface waters along the ETNG Construction ROW were summarized by ETNG in Resource Report 2 (ETNG 2022c). The corridor is located within the Old Hickory Lake, Cordell Hull, Obey River, Emory River, and Lower Clinch River watersheds of the Tennessee River Basin. Surface water is a prominent source for drinking water in the state of Tennessee. In 2010, surface water intakes in the counties crossed by the ETNG Construction ROW supplied drinking water from less than one MGD for Trousdale and Jackson counties to between 5 and 15 MGD for Putnam and Roane counties (Robinson 2018).

Surface waters crossed by the ETNG Construction ROW were initially identified through a review of USGS topographic maps, USGS NHD, NWI data, and Tennessee Water Wells, Waterbodies, and Water Resources Permits datasets. Approximately 94 percent of the study area was field surveyed by qualified wetland scientists and completed in 2021 and 2022; approximately 6 percent of the corridor was unable to be surveyed due to access restrictions by private landowners (ETNG is in the process of obtaining access to the remaining area). For areas not surveyed in the field, environmental information using the publicly available resources mentioned above are provided and will be field verified when access is obtained. The proposed pipeline will cross a total of 567 waterbodies, including 192 perennial streams, 150 intermittent streams, 195 ephemeral channels, and 30 ponds or impoundments. These field surveys enabled ETNG to identify the presence of waterbodies along the proposed ETNG Construction

ROW should ETNG's Project be selected to transport natural gas supplies via expansion of ETNG's 3100 pipeline system.

TVA has independently reviewed and concurs with the water-related findings in ETNG's Resource Report 2 (ETNG 2022c). Waterbodies identified from these resources are summarized in Table 3.6-9 and depicted on figures in Appendix D-4.

Table 3.6-13. Summary of Streams Crossed by the Alternative A Natural Gas Pipeline

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Rocky Creek	Intermittent	FAL, REC, LWW, IRR	--
Rocky Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Rocky Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Rocky Creek	Ephemeral	N/A	--
UT to Second Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Second Creek	Ephemeral	N/A	--
UT to Second Creek	Ephemeral	N/A	--
UT to Second Creek	Ephemeral	N/A	--
UT to Second Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Second Creek	Ephemeral	N/A	--
UT to Second Creek	Intermittent	FAL, REC, LWW, IRR	--
Second Creek	Waterbody	FAL, REC, LWW, IRR	--
UT to Second Creek	Waterbody	FAL, REC, LWW, IRR	--
UT to Second Creek	Ephemeral	N/A	--
UT to Second Creek	Ephemeral	N/A	--
UT to Second Creek	Ephemeral	N/A	--
UT to Cumberland River	Ephemeral	N/A	--
UT to Cumberland River	Intermittent	FAL, REC, LWW, IRR	--
UT to Cumberland River	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Goose Creek	Ephemeral	N/A	--
UT to Little Goose Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Goose Creek	Ephemeral	N/A	--
UT to Little Goose Creek	Intermittent	FAL, REC, LWW, IRR	--
Little Goose Creek[2]	Perennial	FAL, REC, LWW, IRR	Total P, E. coli, Veg Cover Alteration
Goose Creek[2]	Perennial	FAL, REC, LWW, IRR	Total P, Nitrate/Nitrite
UT to Goose Creek	Ephemeral	N/A	--
UT to Goose Creek	Ephemeral	N/A	--
UT to Goose Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Goose Creek	Ephemeral	N/A	--
UT to Goose Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Goose Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Corley Branch	Ephemeral	N/A	--
UT to Cumberland River	Intermittent	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Cumberland River	Ephemeral	N/A	--
UT to Cumberland River	Intermittent	FAL, REC, LWW, IRR	--
UT to Cumberland River	Intermittent	FAL, REC, LWW, IRR	--
UT to Cumberland River	Perennial	FAL, REC, LWW, IRR	--
UT to Cumberland River	Perennial	FAL, REC, LWW, IRR	--
UT to Dixon Creek	Ephemeral	N/A	--
Glasgow Branch	Perennial	FAL, REC, LWW, IRR	--
Farm Pond	Pond	FAL, REC, LWW, IRR	--
UT to Second Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Second Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Second Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Second Creek	Ephemeral	N/A	--
UT to Second Creek	Ephemeral	N/A	--
UT to Welch Branch	Intermittent	FAL, REC, LWW, IRR	--
Lick Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Dixon Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Dixon Creek	Ephemeral	N/A	--
UT to Dixon Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dixon Creek	Intermittent	FAL, REC, LWW, IRR	--
Dixon Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Young Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Young Branch	Ephemeral	N/A	--
UT to Young Branch	Ephemeral	N/A	--
UT to Young Branch	Ephemeral	N/A	--
UT to Young Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Young Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Young Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Young Branch	Ephemeral	N/A	--
Young Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Toetown Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Toetown Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Toetown Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Toetown Branch	Ephemeral	N/A	--
UT to Toetown Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Toetown Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Toetown Branch	Ephemeral	N/A	--
UT to Toetown Branch	Intermittent	FAL, REC, LWW, IRR	--
Toetown Branch	Perennial	FAL, REC, LWW, IRR	--
Dickinson Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Dickinson Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Dickinson Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Dickinson Branch	Ephemeral	N/A	--
UT to Dickinson Branch	Ephemeral	N/A	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Dickinson Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Dickinson Branch	Ephemeral	N/A	--
Peyton Creek	Perennial	FAL, REC, LWW, IRR	--
Dillehay Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Dillehay Branch	Intermittent	FAL, REC, LWW, IRR	--
Dillehay Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Dillehay Branch	Ephemeral	N/A	--
UT to Defeated Creek	Perennial	FAL, REC, LWW, IRR	--
Defeated Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Kempville Branch	Ephemeral	N/A	--
UT to Kempville Branch	Ephemeral	N/A	--
UT to Kempville Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Kempville Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Kempville Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Kempville Branch	Ephemeral	N/A	--
UT to Kempville Branch	Ephemeral	N/A	--
UT to Kempville Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Kempville Branch	Perennial	FAL, REC, LWW, IRR	--
Kempville Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Ephemeral	N/A	--
UT to Little Salt Lick Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Ephemeral	N/A	--
UT to Little Salt Lick Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Ephemeral	N/A	--
UT to Little Salt Lick Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Salt Lick Creek	Ephemeral	N/A	--
UT to Little Salt Lick Creek	Ephemeral	N/A	--
UT to Salt Lick Creek	Intermittent	FAL, REC, LWW, IRR	--
Salt Lick Creek (Cordell Hull Reservoir)	Waterbody	FAL, REC, LWW, IRR	--
Salt Lick Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Salt Lick Creek (Cordell Hull Reservoir)	Waterbody	FAL, REC, LWW, IRR	--
UT to Salt Lick Creek (Cordell Hull Reservoir)	Waterbody	FAL, REC, LWW, IRR	--
UT to Salt Lick Creek	Ephemeral	N/A	--
UT to Cumberland River	Ephemeral	N/A	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Cumberland River	Intermittent	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
Cumberland River (Cordell Hull Reservoir)	Waterbody	DOM, IWS, FAL, REC, LWW, IRR, NAV	--
Cumberland River (Cordell Hull Reservoir)	Waterbody	DOM, IWS, FAL, REC, LWW, IRR, NAV	--
UT to Big Branch	Ephemeral	N/A	--
UT to Flynn Creek	Ephemeral	FAL, REC, LWW, IRR	--
UT to Flynn Creek	Intermittent	N/A	--
UT to Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
Flynn Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Flynn Creek	Ephemeral	N/A	--
UT to Flynn Creek	Ephemeral	N/A	--
UT to Flynn Creek	Ephemeral	N/A	--
Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
Rush Fork	Perennial	FAL, REC, LWW, IRR	--
Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Flynn Creek	Ephemeral	N/A	--
UT to Flynn Creek	Ephemeral	N/A	--
UT to Flynn Creek	Ephemeral	N/A	--
UT to Flynn Creek	Ephemeral	N/A	--
Flynn Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Flynn Creek	Ephemeral	N/A	--
UT to Flynn Creek	Ephemeral	N/A	--
UT to Bowman Branch	Ephemeral	N/A	--
UT to Bowman Branch	Ephemeral	N/A	--
UT to Bowman Branch	Ephemeral	N/A	--
UT to Bowman Branch	Intermittent	FAL, REC, LWW, IRR	--
Bowman Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Bowman Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Bowman Branch	Ephemeral	N/A	--
UT to Bowman Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Blackburn Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Blackburn Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Blackburn Fork	Ephemeral	N/A	--
UT to Blackburn Fork	Perennial	FAL, REC, LWW, IRR	--
Blackburn Fork[2]	Perennial	FAL, REC, LWW, IRR	E. coli
Cattle Pond	Pond	FAL, REC, LWW, IRR	--
UT to Blackburn Fork	Ephemeral	N/A	--
UT to Blackburn Fork	Ephemeral	N/A	--
UT to Blackburn Fork	Ephemeral	N/A	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	FAL, REC, LWW, IRR	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
Cattle Pond	Pond	FAL, REC, LWW, IRR	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to East Blackburn Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to East Blackburn Fork	Perennial	FAL, REC, LWW, IRR	--
UT to East Blackburn Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to East Blackburn Fork	Ephemeral	N/A	--
UT to Bear Creek	Ephemeral	N/A	--
UT to Bear Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bear Creek	Ephemeral	N/A	--
Bear Creek[2]	Perennial	FAL, REC, LWW, IRR	Sediment/Siltation
UT to Turkey Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Turkey Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Turkey Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Turkey Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Turkey Creek	Intermittent	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Turkey Creek	Perennial	FAL, REC, LWW, IRR	--
Turkey Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Turkey Creek	Ephemeral	N/A	--
UT to Turkey Creek	Ephemeral	N/A	--
UT to Turkey Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Turkey Creek	Intermittent	FAL, REC, LWW, IRR	--
Spring Creek[2]	Perennial	FAL, REC, LWW, IRR	E. coli
Spring Creek[2]	Perennial	FAL, REC, LWW, IRR	E. coli
Spring Creek[2]	Perennial	FAL, REC, LWW, IRR	E. coli
UT to Spring Creek	Perennial	FAL, REC, LWW, IRR	--
Spring Creek[2]	Perennial	FAL, REC, LWW, IRR	E. coli
Pond	Pond	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
Pond	Pond	FAL, REC, LWW, IRR	--
Spring Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Spring Creek	Intermittent	FAL, REC, LWW, IRR	--
Spring Creek[2]	Perennial	FAL, REC, LWW, IRR	E. coli
Spring Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Spring Creek	Ephemeral	FAL, REC, LWW, IRR	--
Spring Creek	Intermittent	FAL, REC, LWW, IRR	--
Spring Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Spring Creek	Ephemeral	N/A	--
UT to Spring Creek	Ephemeral	N/A	--
UT to Spring Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Spring Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Dry Hollow Creek	Ephemeral	N/A	--
UT to Garrison Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Garrison Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Garrison Branch	Perennial	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Garrison Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Garrison Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Garrison Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Garrison Branch	Ephemeral	N/A	--
UT to Garrison Branch	Ephemeral	N/A	--
UT to Garrison Branch	Ephemeral	N/A	--
UT to Garrison Branch	Ephemeral	N/A	--
UT to Garrison Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Garrison Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Garrison Branch	Ephemeral	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Ephemeral	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Ephemeral	N/A	--
UT to Yellow Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Ephemeral	N/A	--
UT to Yellow Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Yellow Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Mineral Springs Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Mineral Springs Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Mineral Springs Branch	Ephemeral	N/A	--
UT to Mineral Springs Branch	Ephemeral	N/A	--
UT to Mineral Springs Branch	Ephemeral	N/A	--
UT to West Fork Obey River	Ephemeral	N/A	--
UT to East Fork Obey River	Ephemeral	FAL, REC, LWW, IRR	--
UT to East Fork Obey River	Intermittent	FAL, REC, LWW, IRR	--
UT to East Fork Obey River	Perennial	FAL, REC, LWW, IRR	--
UT to East Fork Obey River	Perennial	FAL, REC, LWW, IRR	--
UT to East Fork Obey River	Perennial	FAL, REC, LWW, IRR	--
UT to East Fork Obey River	Perennial	FAL, REC, LWW, IRR	--
UT to East Fork Obey River	Perennial	FAL, REC, LWW, IRR	--
East Fork Obey River[2]	Perennial	DOM, FAL, REC, LWW, IRR	Fe, Mn, pH, Sediment/Siltation
UT to East Fork Obey River	Intermittent	FAL, REC, LWW, IRR	--
UT to East Fork Obey River	Intermittent	FAL, REC, LWW, IRR	--
UT to Looper Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Looper Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Fond Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Fond Branch	Perennial	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Fond Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Fond Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Fond Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Fond Branch	Ephemeral	N/A	--
UT to Fond Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Fond Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Fond Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Fond Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Fond Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Little Hurricane Creek	Ephemeral	N/A	--
UT to Little Hurricane Creek	Ephemeral	N/A	--
UT to Little Hurricane Creek	Ephemeral	N/A	--
UT to Little Hurricane Creek	Ephemeral	N/A	--
UT to Little Hurricane Creek	Ephemeral	N/A	--
UT to Little Hurricane Creek	Intermittent	FAL, REC, LWW, IRR	--
Little Hurricane Creek	Perennial	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Little Hurricane Creek	Ephemeral	N/A	--
UT to Hurricane Creek	Ephemeral	FAL, REC, LWW, IRR	--
UT to Hurricane Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Hurricane Creek	Ephemeral	N/A	--
UT to Hurricane Creek	Intermittent	FAL, REC, LWW, IRR	--
Hurricane Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Hurricane Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Hurricane Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Hurricane Creek	Ephemeral	N/A	--
UT to Hurricane Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Hurricane Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Hurricane Creek	Ephemeral	N/A	--
UT to Hurricane Creek	Ephemeral	N/A	--
UT to Hurricane Creek	Ephemeral	N/A	--
UT to Hurricane Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Cooper Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Cooper Branch	Intermittent	FAL, REC, LWW, IRR	--
Cooper Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Cooper Branch	Ephemeral	N/A	--
UT to Cooper Branch	Perennial	FAL, REC, LWW, IRR	--
TBD	Intermittent	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
TBD	Perennial	FAL, REC, LWW, IRR	--
UT to Clear Creek	Ephemeral	N/A	--
UT to Clear Creek	Ephemeral	N/A	--
UT to Clear Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Clear Creek	Perennial	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Clear Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Clear Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Clear Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Clear Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Big Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Big Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Big Branch	Ephemeral	N/A	--
Pond	Pond	FAL, REC, LWW, IRR	--
Big Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Peter Branch	Ephemeral	N/A	--
UT to Peter Branch	Intermittent	FAL, REC, LWW, IRR	--
Peter Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Peter Branch	Perennial	FAL, REC, LWW, IRR	--
Peter Branch	Perennial	FAL, REC, LWW, IRR	--
Peter Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Peter Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Glade Branch	Perennial	FAL, REC, LWW, IRR	--
Glade Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Perennial	FAL, REC, LWW, IRR	--
Shepherd Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Ephemeral	N/A	--
UT to Shepherd Branch	Ephemeral	N/A	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Ephemeral	N/A	--
UT to Shepherd Branch	Ephemeral	N/A	--
UT to Shepherd Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Shepherd Branch	Intermittent	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
Big Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Big Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Big Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Big Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Bice Creek	Intermittent	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Bice Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bice Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bice Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bice Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bice Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bice Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bice Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bice Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bice Creek	Ephemeral	N/A	--
Bice Creek	Perennial	FAL, REC, LWW, IRR	--
Bice Creek	Perennial	FAL, REC, LWW, IRR	--
TBD	Intermittent	FAL, REC, LWW, IRR	--
Bice Creek	Perennial	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Shell Creek	Ephemeral	N/A	--
UT to Muddy Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Muddy Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Muddy Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Muddy Branch	Ephemeral	N/A	--
UT to Four Mile Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Four Mile Creek	Perennial	FAL, REC, LWW, IRR	--
Four Mile Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Four Mile Creek	Perennial	FAL, REC, LWW, IRR	--
Little Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Little Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Little Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Creek	Intermittent	FAL, REC, LWW, IRR	--
Little Creek	Perennial	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to White Creek	Perennial	FAL, REC, LWW, IRR	--
UT to White Creek	Ephemeral	N/A	--
UT to White Creek	Ephemeral	N/A	--
UT to White Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to White Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to White Creek	Intermittent	FAL, REC, LWW, IRR	--
White Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Green Branch	Ephemeral	N/A	--
UT to Green Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Green Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Green Branch	Intermittent	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Mill Creek Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Mill Creek Branch	Ephemeral	N/A	--
UT to Mill Creek Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Clear Creek	Ephemeral	N/A	--
UT to Clear Creek	Ephemeral	N/A	--
UT to Clear Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Gordon Branch	Ephemeral	N/A	--
UT to Gordon Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Gordon Branch	Ephemeral	N/A	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Buck Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Buck Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Buck Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Little Clear Creek	Ephemeral	N/A	--
UT to Little Clear Creek	Ephemeral	N/A	--
UT to Little Clear Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Clear Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Gut Branch	Ephemeral	N/A	--
UT to Gut Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Gut Branch	Perennial	FAL, REC, LWW, IRR	--
Gut Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Gut Branch	Ephemeral	N/A	--
UT to Gut Branch	Ephemeral	N/A	--
UT to Gut Branch	Perennial	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Susan Branch	Ephemeral	N/A	--
UT to Susan Branch	Perennial	FAL, REC, LWW, IRR	--
Susan Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Price Branch	Ephemeral	N/A	--
UT to Price Branch	Perennial	FAL, REC, LWW, IRR	--
UT to Price Branch	Ephemeral	N/A	--
UT to Price Branch	Ephemeral	N/A	--
UT to Price Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Price Branch	Perennial	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Price Branch	Ephemeral	N/A	--
UT to Price Branch	Waterbody	FAL, REC, LWW, IRR	--
UT to Price Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Campground Creek	Perennial	FAL, REC, LWW, IRR	--
Campground Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Campground Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Emory River	Ephemeral	N/A	--
UT to Emory River	Perennial	FAL, REC, LWW, IRR	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Emory River	Intermittent	FAL, REC, LWW, IRR	--
UT to Emory River	Ephemeral	FAL, REC, LWW, IRR	--
UT to Emory River	Ephemeral	N/A	--
Emory River	Perennial	DOM, IWS, FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Emory River	Perennial	FAL, REC, LWW, IRR	--
UT to Emory River	Intermittent	FAL, REC, LWW, IRR	--
UT to Emory River	Intermittent	FAL, REC, LWW, IRR	--
UT to Emory River	Intermittent	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Bonafacius Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Bonafacius Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Bonafacius Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
Crooked Fork[2]	Perennial	DOM, FAL, REC, LWW, IRR	Sediment/Siltation, Substrate/Habitat
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Intermittent	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Ephemeral	N/A	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Crooked Fork	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Intermittent	N/A	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
Pond	Pond	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Forked Creek	Ephemeral	N/A	--
UT to Forked Creek	Perennial	FAL, REC, LWW, IRR	--
Forked Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Ephemeral	N/A	--
Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Intermittent	N/A	--
Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Intermittent	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Bitter Creek	Ephemeral	N/A	--
UT to Bitter Creek	Ephemeral	N/A	--
Little Emory River	Perennial	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Emory River	Perennial	FAL, REC, LWW, IRR	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Ephemeral	N/A	--

Waterbody or Tributary Name	Flow Regime	State Water Quality Classification[1]	Pollutant(s)
UT to Little Emory River	Perennial	FAL, REC, LWW, IRR	--
UT to Little Emory River	Perennial	FAL, REC, LWW, IRR	--
UT to Little Emory River	Perennial	FAL, REC, LWW, IRR	--
UT to Little Emory River	Perennial	FAL, REC, LWW, IRR	--
UT to Little Emory River	Ephemeral	N/A	--
Emory River[2]	Perennial	FAL, REC, LWW, IRR	Chlordane, Hg, PCBs
UT to Elverton Branch	Ephemeral	N/A	--
UT to Little Emory River	Ephemeral	FAL, REC, LWW, IRR	--
UT to Elverton Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Elverton Branch	Intermittent	FAL, REC, LWW, IRR	--
UT to Little Emory River	Perennial	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Ephemeral	FAL, REC, LWW, IRR	--
UT to Little Emory River	Perennial	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Intermittent	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Perennial	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Intermittent	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Perennial	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Intermittent	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Ephemeral	N/A	--
UT to Little Emory River	Perennial	DOM, IWS, FAL, REC, LWW, IRR	--
UT to Little Emory River	Ephemeral	N/A	--
Kings Creek	Perennial	FAL, REC, LWW, IRR	--
UT to Kings Creek	Ephemeral	N/A	--
UT to Lewis Branch	Ephemeral	N/A	--
Emory River	Perennial	FAL, REC, LWW, IRR	--
UT to Clinch River	Ephemeral	N/A	--

[1] Tennessee Designated Use Classification: DOM – Domestic Water Supply; IWS – Industrial Water Supply; FAL – Fish and Aquatic Life; REC – Recreation; LWW – Livestock Watering and Wildlife; IRR – Irrigation; NAV – Navigation; N/A – WWCs do not have state water quality classifications; UT – unnamed tributary (T 2019).
[2.] Stream on the 303(d) impaired waters list.

Within the ETNG Construction ROW, 12 crossings of 8 named streams (Spring Creek is crossed in 5 locations) identified as impaired (see Table 3.6-13). None of the waterbodies listed along the proposed pipeline route are included in the National Wild and Scenic Rivers System inventory (NWSRS 2022); however, portions of the Obed Wild & Scenic River complex are within 2 miles of the pipeline, including Clear Creek (0.5 mile away), Emory River (1 mile away), and Obed River (2 miles away).

Additionally, the ETNG Construction ROW crosses several tributaries of the Obed Wild & Scenic River (but does not cross any lands within the Obed Wild and Scenic boundary), as well as waterbodies on the National Rivers Inventory List. Tributaries to the Obed Wild & Scenic River within the Study Area include Campground Creek, Susan Branch, Gut Branch, Little Clear Creek, Gordon Branch, Green Branch, Douglas Branch, White Creek, Little Creek, Four Mile Creek, and Bice Creek. Though Milligan Branch, a tributary of the Obed Wild & Scenic River, is not crossed by the Study Area, it is located approximately 0.25 mile from the Study area. Waterbodies on the National Rivers Inventory List within the Study Area include Crooked Fork Creek, Emory River (portion not currently listed as part of the Obed Wild & Scenic River), White Creek, Spring Creek, Blackburn Fork of the Roaring River, Flynn Creek, and Goose Creek. TVA and its partners would continue to coordinate with the NPS in accordance with Sections 7(a) and 10(a) of the WSRA, particularly with respect to Alternative A which proposes to install natural gas pipeline crossings at several tributaries to the Obed Wild and Scenic River as part of East Tennessee Natural Gas, LLC's Ridgeline Expansion Project. Obed Wild and Scenic River is managed by the NPS.

Accordingly, measures may be necessary to preserve and protect the outstandingly remarkable values, free flow character, and water quality of Obed Wild and Scenic River to ensure compliance with Sections 7(a) and 10(a) of the WSRA. If necessary, such measures would be developed in coordination with the NPS, a coordinating agency for this Project, for all tributary stream crossings by the Ridgeline Expansion Project when sufficient, detailed information becomes available for the stream crossing locations and methodologies, which is likely to be during the evaluation of the project by the Federal Energy Regulatory Commission.

The NPS has sole authority for determining compliance of the proposed project with the WSRA, and such a determination must be made prior to the commencement of construction activities related to the Obed Wild and Scenic River tributary stream crossings.

ETNG is currently coordinating with TDEC to determine if its pipeline Project would impact Exceptional Tennessee Waters or Outstanding Resource Waters.

3.6.2.1.3 Alternative B

3.6.2.1.3.1 East Tennessee TVA Power Service Area

River basins in the eastern TVA region include the Cumberland, Upper Tennessee, and Middle Tennessee-Hiawassee/Lower Tennessee basins (TDEC 2022f; State of Tennessee, n.d.). The Cumberland River Basin in the eastern TVA region includes the South Fork Cumberland and Clear Fork watersheds. The Middle Tennessee-Hiawassee/Lower Tennessee River Basin in East Tennessee includes Guntersville Lake, Lower Tennessee, and Hiwassee River watersheds. The Upper Tennessee River Basin encompasses the largest portion of the East Tennessee Region, including major watersheds such as the Sequatchie, Emory, Lower Tennessee, Hiwassee, Little Tennessee, Watts Bar Lake, Lower Clinch, Upper Clinch, Powell, Lower French Broad, Upper French Broad, Fort Loudoun Lake, Pigeon, Nolichucky, Holston, North Fork Holston, South Fork Holston, and Watauga. Fresh water is abundant in much of this area and generally supports most beneficial uses, including fish and aquatic life, public and industrial water supply, waste assimilation, agriculture, and water-contact recreation, such as swimming.

A number of water quality management plans exist for watersheds within these basins (Table 3.6-14) (TDEC 2022f). The state of Tennessee conducts a watershed approach to the management of the states' waters; this approach involves evaluating all of the activities on-going within a watershed to form a decision-making process that reflects a common strategy for a specific watershed. It is an organizational framework that works on a five-year cycle with key activities that include: (1) planning and data review; (2) water quality monitoring; (3) water quality assessment; (4) TMDL/Alternative Restoration Plans; and (5) permit issuance. Watersheds across the state are grouped into five groups. On a rotating basis, TDEC conducts monitoring in one group; performs assessment, priority setting, and follow-up monitoring in a second group; conducts modeling and TMDL studies in a third group; develops management plans in a fourth group; and implements management plans in the fifth group.

There are approximately 60,392 miles of streams and rivers in the state of Tennessee, and TDEC has assessed approximately 28,003 miles (46 percent) for categories and designated uses (TDEC 2022g). Information is not available for the East Tennessee region specifically; therefore, data presented here are for the state of Tennessee as a whole. Categories and designated uses are provided in Table 3.6-15.

Table 3.6-14. List of Water Quality Management Plans Available for Watersheds in the East Tennessee Region

River Basin	Watershed Water Quality Management Plans		
Cumberland	Upper Cumberland River		
Upper Tennessee	Emory River	South Fork Holston River	Powell River
	Holston River	Fort Loudoun Lake	Upper Clinch River
	Lower Clinch River	Little Tennessee River	Upper French Broad River
	Nolichucky River	Lower French Broad River	Watauga River
	Pigeon River	North Fork Holston River	Watts Bar Lake
Middle Tennessee-Hiawassee / Lower Tennessee	Middle Tennessee-Hiwassee		
	Guntersville Lake		

Source: TDEC 2022f

Table 3.6-15. Stream Categorizations and Designated Uses in the State of Tennessee

Stream Categories		
Category	**Description**	**Stream/River Miles**
1	Fully supporting all uses	4,771
2	Fully supporting, but not all uses supported	7,713
3	Insufficient data/not assessed	32,398
4a	Impaired/has a TMDL	3,364
4b	Impaired/does not require TMDL	9
4c	Impaired/impact by alteration, not pollutant	193
5	Impaired/needs a TMDL	11,951
5a	Approved alternative plan	4.5

Designated Uses		
Designated Uses	**Miles of Stream Classified (Assessed)**	**Miles of Stream Meeting Designated Use**
Fish and Aquatic Life Protection (FAL)	60,389 (26,640)	14,807
Recreation (REC)	60,389 (16,141)	7,136
Irrigation (IRR)	60,389 (27,840)	27,839
Livestock Watering and Wildlife (LWW)	60,389 (27,763)	27,762
Domestic Water Supply (DOM)	3,996 (3,490)	3,424
Industrial Water Supply (IWS)	3,403 (2,997)	2,994

Source: TDEC 2022g

3.6.2.2 Environmental Consequences

3.6.2.2.1 The No Action Alternative

Under the No Action Alternative, KIF would continue operating and TVA would not construct the proposed new facilities. The existing wastewater discharges would continue as authorized under NPDES Permit TN0005452. Discharges would continue to comply with all applicable permit limits, and therefore, surface water quality adjacent to KIF should remain approximately the same. TVA would implement all the planned actions related to the current and future management and storage of CCRs and requirements under the USEPA's Steam Electric ELGs at the sites, which have either been reviewed or would be reviewed in subsequent NEPA analyses. Continued operations at KIF under the No Action Alternative would not be expected to cause any additional direct or indirect effects to local surface water resources, and therefore, would not change existing conditions.

3.6.2.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Under Alternatives A and B, KIF would be retired. TVA would implement the planned actions related to the current and future management and storage of CCRs at KIF, which have either been reviewed or would be reviewed in subsequent NEPA analyses. Indirect effects may be associated with stormwater runoff due to demolition and temporary construction activities. Erosion and sediment control BMPs would be implemented to minimize potential effects.

Current operations would cease, and surface water withdrawals would be eliminated with the retirement of KIF. Wastewater discharges would be significantly reduced. The existing wastewater streams would continue to be authorized under NPDES Permit TN0005452. The CCR at the facility would follow requirements detailed in the USEPA Disposal of Coal Combustion Residuals from Electric Utilities final rule (80 FR 21301). The remaining discharge flows would come from fire protection water, main station sumps, stormwater flow, and from ponds until closed. Surface water discharges would be expected to have direct and indirect beneficial effects due to the decrease in loading of metals as a result of ceasing coal operations. The termination of withdrawals and discharges of cooling water would eliminate impingement and entrainment effects and have other beneficial effects from reduced water consumption and thermal discharges. Minor beneficial impacts to water quality would occur due to reduced loading of metals in the'coal plant's discharge.

Demolition of the existing fossil plant, associated buildings, and appurtenant features (including intake bays, the coal unloading area, transfer stations, conveyers, oil-water separators, and reverse osmosis system) would have the potential to temporarily affect surface water via fugitive emissions, debris, and stormwater runoff. The intake condenser circulating water tunnels, discharge condenser circulating water tunnels, and water treatment building and reverse osmosis trailers are also under consideration for deconstruction/demolition; however, the intake pump station would remain in place. The demolition boundary encompasses 8 WWCs (totaling 4,029 LF), 1 perennial stream (434 LF), and 1 ephemeral channel (864 LF) (Table 3.6-3).

TVA would comply with appropriate state and federal permit requirements for demolition activities. TVA would obtain a Construction Storm Water Permit prior to beginning demolition. Surface water effects resulting from disturbance during selective demolition would be mitigated using stormwater pollution prevention BMPs to minimize the extent of disturbance and erosion. Stormwater would discharge via either NPDES permitted discharge points or the designated construction stormwater outfalls. Silt fences, sediment basins, and/or other sediment and erosion control measures, as described in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities, Revision 3* (TVA 2020b), would be installed, inspected, and maintained for the duration of demolition as needed to avoid contamination of surface waters adjacent to the Kingston Reservation. Therefore, minor effects to surface water would be expected due to surface water runoff from the construction site. Proposed project activities would be conducted in a manner to ensure that waste materials are contained, and the introduction of pollution materials to the receiving waters would be minimized.

Currently active industrial stormwater outfalls are monitored, every six months or annually, depending on the NPDES requirements. This monitoring would continue throughout the demolition process, with modifications as directed by the construction BMP plan. Following demolition, permits may be modified or reduced based on the change in operation at the facility. Permit modification requests would be negotiated with TDEC, as necessary.

Stack demolition has the potential to release fugitive dust, fill, and residual ash to adjacent surface water during demolition due to the uncontrolled nature of dropping the stack in a single, brief action. This action would result in the generation of fugitive dust and debris, which would then be subject to potential erosion and transport to adjacent surface waters. Following shut-down of the units, stacks would be washed to remove as much ash and dust as possible to reduce potential effects to surface waters during demolition. These demolition activities would be designed in a way to minimize any effects to adjacent waters; however, mitigation measures, such as turbidity curtains in adjacent waters, would be considered to help mitigate any incidental discharge of ash, soil, or sediment to receiving streams. With mitigation measures and BMPs in place, incidental discharges to the Clinch and Emory rivers due to these activities would be minimized.

Deconstruction of intake/discharge structure facilities (turbine bays and potentially the intake and discharge condenser circulating water tunnels) and the demolition of the barge unloading area has the potential for effects to surface waters through conveyance of sediment as part of the removal process. BMPs would be implemented to reduce these potential effects. To conduct this work, USACE and TDEC permits would be required. Anticipated effects to waters of the State or United States associated with the proposed actions would be mitigated with the use of BMPs and implementation of a maintenance program. Mitigation would be identified through the USACE Section 404 and TDEC Section 401 permitting process, providing for compensation for the loss of wetlands or stream reaches. Potential surface water effects during demolition would be mitigated; the effects would be minor with the implementation of BMPs as well as compliance with the requirements of the USACE and TDEC permitting process. Logistical measures for demolition activities would be taken, including portable toilets for the construction workforce with appropriate maintenance measures to avoid contamination of nearby waters and equipment washing and dust control, which would be handled in accordance with BMPs and the KIF NPDES permit.

With the implementation of appropriate BMPs, effects to surrounding surface waters from demolition activities are expected to be minor. Cumulative effects to surface water may occur with due to the proximity of CCR management activities as RFFAs on Kingston Reservation. With the use of proper BMPs and compliance with all federal, state, and local regulations and guidelines, cumulative surface water effects are expected to be temporary and minor. Overall, the retirement of the fossil plant would likely result in a net-benefit of effects to on-site and downstream surface waters due to the elimination of waste generation and effluent.

3.6.2.2.2.1 Environmental Justice Considerations

Negative effects to surface water and water quality that would occur as a result of the Kingston coal facility retirement and D4 activities would be temporary, minimized, or mitigated, and generally limited to the TVA-owned reservation, where no EJ populations are present. Off-site effects to surface water and water quality have the potential to result in amplified effects towards EJ-qualifying populations. Over time, there would be beneficial effects to nearby waters or waters on the Kingston Reservation as a result of ceasing coal operations.

3.6.2.2.3 Alternative A

3.6.2.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Construction activities have the potential to temporarily affect surface water via stormwater runoff. TVA would comply with all appropriate state and federal permit requirements. Appropriate BMPs would be followed, and all proposed Project activities would be conducted in a manner to ensure that waste materials are contained, and the introduction of pollutants to the receiving waters is minimized. The use of BMPs to reduce runoff into the Clinch and Emory rivers and Watts Bar Reservoir would minimize adverse impacts, and the proposed action is not anticipated to measurably affect water quality in these water bodies.

There are two WWCs totaling 1,333 LF within the proposed CC/Aero CT Plant site (Figure 3.6-4) that would be permanently impacted due to placement of fill. No other water features would be impacted by the construction of the proposed CC/Aero CT Plant.

At full CC/Aero CT Plant buildout, facility deliveries may be made by barge; minor modifications to the current barge unloading facilities would consist of grading and creation of dirt/rock ramping to the nose of the barge, which would result in temporary effects such as turbidity in the localized area of the Clinch River. For activities for which the turbidity is expected to have an adverse effect on water quality, mitigation measures such as use of turbidity curtains may be used while those activities are conducted. Should in-water work be necessary for completion of the upgrades to the barge unloading facilities, TVA would pursue permit authorizations, as needed. Most delivered items would be placed in project laydown areas to await installation.

The proposed CC/Aero CT Plant would contain an air-cooled condenser system and would not require cooling water withdrawals from the Emory or Clinch rivers or other surface waters. To prevent concentration of minerals in the steam cycle, the HRSG would require a demineralized water feed and boiler blowdown to remove accumulating minerals. See Section 2.1.3.2.2.1 for further information regarding the water requirements of the proposed CC/Aero CT Plant. Service water would be obtained from potable water sources and not from surface waters on-site. Treatment pond(s) for holding and treating process and stormwater flow would also be constructed; discharges from the operation of the proposed CC/Aero CT Plant would require compliance with a site-specific NPDES permit and compliance with all applicable regulations and conditions.

TVA proposes to use air-cooling instead of water-cooling for the new CC/Aero CT Plant, which would eliminate the need for water withdrawal from the Clinch River. To prevent concentration of minerals in the steam cycle, the HRSG would require a demineralized water feed and boiler blowdown to remove accumulating minerals. See Section 2.1.3.2.2.1 for further information regarding the water requirements of the proposed CC/Aero CT Plant.

Applicable USACE Section 404 and Section 10 permits and TDEC ARAP (401 Water Quality Certification) would be obtained for upgrades to the barge facilities and for necessary stream alterations, and the terms and conditions of these permits would require mitigation for the proposed activities. Erosion and sediment control BMPs would be implemented as a condition of a NDPES General Construction Storm Water permit. With the use of BMPs and adherence to all permit conditions, effects to surface waters and surface water quality would be minor.

3.6.2.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

No surface waters are present within the boundary of the proposed 3- to 4-MW Solar Facility; therefore, no impacts to surface waters from this component would occur (Figure 3.6-4).

3.6.2.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The placement of fill materials for the 100-MW BESS would result in permanent impacts to up to three WWCs and one ephemeral channel, depending on which battery site is chosen (Figure 3.6-4). Under Battery Option 1, one ephemeral channel (996 LF) and three WWCs (totaling 686 LF) would be permanently impacted due to placement of fill. Under Battery Option 2, two WWCs totaling 534 LF would be permanently impacted. Under Battery Option 3, one WWC consisting of 320 LF would be permanently impacted due to fill. Additionally, a non-jurisdictional detention pond approximately 0.12 acre in extent would be permanently filled under Battery Option 3.

See Section 2.3 for information on avoidance and minimization of effects to surface waters. All appropriate 404 and 401 permits would be acquired for this component of Alternative A. Erosion and sediment control BMPs would be implemented as a condition of a NDPES General Construction Storm Water permit. The ephemeral channels and WWCs do not provide habitat that can support aquatic life therefore there is no risk to aquatic organisms. With the use of BMPs and adherence to all permit conditions, effects to surface waters and surface water quality would be minor.

3.6.2.2.3.4 On-site Transmission Upgrades

Four WWCs totaling 607 LF are present within the transmission line connections for the 100-MW BESS. All drainages would be spanned by the transmission lines and not directly impacted by this action. Additionally, TVA would comply with all appropriate state and federal permit requirements including appropriate BMPs. No impacts to the WWCs within the battery connection corridor would be impacted.

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant facilities and switchyard. Impacts to streams or open water areas within the on-site transmission line corridors associated with the proposed CC/Aero CT Plant footprint are discussed in Section 3.6.2.2.3.1. Outside of the CC/Aero CT Plant footprint, 7 WWCs totaling

3,659 LF and 1 intermittent stream (23 LF) are crossed by the on-site transmission lines (Figure 3.6-6). Appropriate BMPs would be installed as needed to prevent stormwater impacts related to any ground disturbance, if necessary, for transmission line upgrades. No drainages or the intermittent stream would be directly impacted by this action. TVA would comply with all appropriate state and federal permit requirements and appropriate BMPs would be followed to avoid and minimize effects to surface waters to the maximum extent practicable.

Overall, with BMPs in place, to WWCs or surface waters for the battery connects or upgrades to the existing on-site transmission line corridor are expected.

3.6.2.2.3.5 Off-site Transmission Line Upgrades

3.6.2.2.3.5.1 Eastern Transmission Corridor

3.6.2.2.3.5.1.1 Lines 5108 and 5302 – Data from Field Surveys

A total of 55 streams, 5 open waterbodies, and 24 other WWCs would be crossed by L5108 and L5302 within the Eastern Transmission Corridor and/or access roads proposed for upgrades as part of Alternative A. Construction activities would be localized to areas requiring replacement, maintenance, or modifications to existing structures (typically within 100 feet surrounding the work structure), and/or development of new temporary or permanent access roads. Construction vehicles such as bulldozers and bucket trucks would use existing access roads to the maximum extent practicable. The new OPGW installation would occur via helicopter with designated pull points along the transmission corridor, which are located typically along the most accessible path on the ROW (adjacent to road crossings or existing access roads). No direct long term impacts to surface waters are anticipated Temporary impacts would be minimized by using BMPs such as silt fencing, straw wattles, etc. Temporary structures, such as matting, will be used to reduce permanent impacts. No new structures would be placed in surface waters for any length of time that would result in permanent impacts.

3.6.2.2.3.5.1.2 Lines 5116, 5280, and 5381 – Data from Desktop Sources

A desktop review identified 48 streams and 7 open waterbodies crossed by L5116, L5208, and L5381 in the Eastern Transmission Corridor and/or access roads proposed for upgrades as part of Alternative A. Construction activities for surface water crossings would be the same as with L5108 and L5302 within the Eastern Transmission Corridor. As such, no impacts to surface waters would be anticipated; temporary effects would be minimized by using BMPs and, if necessary, matting for vehicle crossings as the corridors are existing and no new structures would be installed.

3.6.2.2.3.5.2 Western Transmission Corridor

3.6.2.2.3.5.2.1 Line 5383 - Data from Field Surveys

A total of 18 streams and 3 open waterbodies are crossed by L5383 within the Western Transmission Corridor and/or access roads proposed for upgrades as part of Alternative A. Construction activities for surface water crossings would be same as with the Eastern Transmission Corridor. As such, no direct impacts to surface waters are anticipated (including to the Obed River); temporary impacts would be minimized by using BMPs and, if necessary, matting for vehicle crossings. No new structures would be placed in surface waters. Overall effects to waters within the Western Transmission Corridor would be temporary and minor.

3.6.2.2.3.6 Construction and Operation of a Natural Gas Pipeline

Construction of the natural gas pipeline would temporarily impact a total of 567 ephemeral channels, streams, ponds, and major waterbodies (defined in the FERC Plan and Procedures as waterbodies greater than 100 feet wide at the water's edge at the time of crossing). Temporary impacts include effects to waterbody banks and water quality due to clearing, trenching, temporary bridge supports, and installation of the pipeline facilities across waterbodies. In addition, heavy equipment operating on stream banks could result in erosion and waterbody sedimentation. No impacts to surface waters from the construction of compressor stations would be expected.

Spills or leaks of hazardous materials could adversely affect water quality. No permanent impacts are expected to the 18 major waterbodies,10 of which are proposed to be crossed via HDD, and 8 are proposed to be crossed via dry. The total number and total combined stream crossing widths by water feature and crossing type are presented in Table 3.6-16 for the natural gas pipeline.

Table 3.6-16. Total Number and Total Combined Width of Stream Crossings by Water Feature and Crossing Type by the Proposed Natural Gas Pipeline under Alternative A

Feature Type	Number of Stream Crossings	Total Stream Width Crossing the ETNG Construction ROW (feet)
Workspace		
Ephemeral	94	2
Intermittent	54	2
Perennial	43	0
Pond	18	0
Waterbody	1	0
Dry Open Cut[1]		
Ephemeral	99	304
Intermittent	86	808
Perennial	136	2,264
Pond	4	798
Waterbody	1	109
HDD[2]		
Ephemeral	2	4
Intermittent	1	2
Perennial	9	2,052
Waterbody	6	4,710
Crossing Method TBD[3]		
Intermittent	9	0
Perennial	4	0

[1]Seven crossings by dry open cut method would be located on waters designated as sensitive, consisting of Flynn Creek and Blackburn Fork.
[2]Ten crossings by HDD would be located on waters designated as sensitive, consisting of Goose Creek, Flynn Creek, Cumberland River, and Spring Creek.
[3]The East Fork Obey River is considered a sensitive waterbody.

The construction area outside of the 50-foot permanent ROW and ATWS would be revegetated in accordance with the E&SCP to prevent migration of sediment off-site during operation. ETNG would install erosion and sediment control devices in accordance with its E&SCP and FERC’s Plan and Procedures (FERC 2013a, 2013b) to protect waterbodies within construction workspaces from impacts from sediment-laden runoff during construction.

A release of fuel or hazardous material into a waterbody can directly cause mortality to aquatic organisms and wildlife that use the waterbody. To prevent the introduction of fuels and/or hazardous materials into waterbodies, ETNG would follow Kingston's SPCC Plan to prevent, contain, and clean up spills and address necessary precautions during material storage. As part of the SPCC Plan, fuel storage and refueling of equipment would be maintained at an approved distance from waterbody boundaries.

To the extent possible, sensitive waterbody[16] crossings would be completed using the HDD method to avoid disturbance of the waterbody substrate and avoid ground disturbance immediately adjacent to the waterbody (ETNG 2022c). The use of the HDD method can avoid and/or minimize the potential for surface water impacts resulting from erosion, sedimentation, and/or excess turbidity. Vegetation between the HDD entry and exit pits would not be cleared except for travel lanes used for the HDD tracer wire. Activity within the travel lanes would be limited to foot traffic. Minor vegetation removal may be required along with travel lanes but would be limited to clearing with hand-tools. ATWS would be located on either side of the waterbody feature to accommodate the entry and exit locations of the HDDs. There are eight proposed locations where the HDD method would occur (ETNG 2022c).

The execution of the HDD method requires the use of drilling mud under pressure, and the potential exists for an inadvertent return of drilling mud. ETNG would prepare an HDD Plan that outlines specific procedures and methods for addressing an inadvertent return of drilling mud. This plan would include procedures for monitoring, detecting, isolating, stopping, and cleaning up inadvertent drilling returns, as well as making necessary agency notifications. ETNG would stage BMPs, including boats, silt curtains, coffer dams, straw bales, silt fence, shovels, and rakes, near each HDD waterbody crossing. BMPs would be deployed in the event an inadvertent return occurs in a waterbody. In addition, stormwater BMPs would be in place prior to the start of each HDD activity to limit sediment run-off from graded construction workspaces into nearby waterbodies. The stormwater BMPs would be frequently inspected and maintained throughout construction and restoration to ensure proper function.

Intermittent and ephemeral waterbodies would be crossed during dry field conditions, where practicable (ETNG 2022c). A dry crossing method will be used to install the pipeline facilities at waterbody crossing locations if there is flowing water at the time of construction. Dry crossing methods involve installation of a flume pipe(s) and/or dam and pump prior to trenching to divert the stream flow over the construction area and allow trenching of the stream crossing in drier conditions isolated from the stream flow. A wet open cut crossing method would be performed at waterbody crossing locations if there is no flowing water at the time of construction (therefore, no flume would be installed/used). A minimum cover depth of three feet will be maintained over the pipeline for all designated waterbodies crossed with the dry or wet open cut methods. ETNG would complete construction activities within 24 to 48 hours for each crossing, limiting the amount of time of disturbance before the channel is returned to its original grade and banks recontoured. ETNG would follow FERC's Plan and Procedures, along with the Project E&SCP, to minimize potential impact from all crossing methods.

If trench dewatering is necessary, the removed trench water would be discharged into an energy dissipation/sediment filtration device in uplands located away from the water's edge to

[16] Sensitive waterbodies are those that 1) do not meet state water quality standards or have been designated for intensive water quality management; 2) contain threatened or endangered species or critical habitat; 3) are crossed less than 3 miles upstream of a potable water intake; 4) are afforded national or state status for exceptional quality; and 5) are listed on the National Rivers Inventory. Other factors that can provide a basis for sensitivity are location of a waterbody within a protected watershed, steep banks and other characteristics that might contribute to high risk of erosion impacts, and important riparian areas (ETNG 2022c).

prevent silt-laden water from flowing into the waterbody in accordance with the E&SCP, FERC Procedures, and applicable permits. Dewatering would be monitored to ensure that all flow from the structure is infiltrating into the underlying soil.

The use of blasting for rock excavation may be used for rock excavation in areas around waterbodies where the construction of pipeline becomes impeded (ETNG 2022c). ETNG would utilize an approved blasting plan and operations would be performed by a state licensed expert. This safety measure would ensure an appropriate level of protection to waterbodies.

ETNG would construct its facilities in accordance with the regulations and requirements of applicable permits such as USACE and TDEC authorizations under CWA Sections 401 and 404. Restoration of stream crossings are described by ETNG as follows in Resource Report 2 (ETNG 2022c), which TVA has independently reviewed:

> Completed stream crossings will be stabilized in accordance with the FERC Procedures. Original stream bed and bank contours will be re-established, and mulch, jute thatching, or bonded fiber blankets will be installed on the stream banks to prevent erosion and encourage reestablishment of vegetation cover. Where poor soil conditions are present, rip-rap may be used for bank stabilization. Seeding of [additional temporary workspaces (ATWS)] and disturbed ROW approaches to stream crossings will be completed immediately after final grading, in accordance with the Project E&SCP, weather and soil conditions permitting. Where necessary, slope breakers (i.e., interceptor dikes) will be installed adjacent to stream banks to minimize the potential for erosion.
>
> Temporary sediment barriers, such as silt fence or other BMPs, will be maintained across the ROW until a permanent vegetation cover is established. For certain waterbodies, site-specific restoration and habitat enhancement measures will be implemented. Within the permanent ROW, a 25-foot-wide riparian strip adjacent to waterbodies will be allowed to revegetate with native plant species. A 10-foot-wide area centered on the pipeline may be maintained to facilitate periodic pipeline corrosion/leak surveys. Any trees greater than 15 feet in height and within 15 feet of the pipeline that have roots that could compromise the integrity of the pipeline coating may be cut and removed from the permanent ROW during maintenance activities.

In ETNG's Resource Report 1, they state,

> [ETNG] will operate and maintain the newly constructed Project facilities in the same manner as it currently operates and maintains its existing system, including compliance with the DOT regulations of 49 CFR Part 192. The pipeline will be patrolled on a routine basis, and personnel well-qualified to perform both emergency and routine maintenance on interstate pipeline facilities will handle emergencies and maintenance. […]
>
> Pipeline inspection will be accomplished by ground and aerial surveys, and in accordance with applicable laws and regulations. During periodic pipeline and ROW patrols, all permanent erosion control devices installed during construction will be inspected to ensure that they are functioning properly. In addition, attention will be given to:

- erosion and washouts along the ROW;
- performance of water control devices such as diversions;
- fallen timber or other threats to the pipeline;
- general health of shrubs and other vegetation planted during construction; and
- any other conditions that could endanger the pipeline or cause erosion.

The local operations supervisor will be notified of any conditions that need attention. Prompt corrective measures will be performed as needed in accordance with the FERC Plan and FERC Procedures.

Hydrostatic Testing and Water Use

ETNG would utilize surface water for hydrostatic testing of the facilities. Hydrostatic test water would be discharged to well-vegetated and stabilized upland areas where practicable and in accordance with applicable permit conditions. Environmental impacts associated with the discharge of hydrostatic test water would be minimized by implementing the following measures:

- locating hydrostatic test manifolds outside of riparian areas (and wetlands), to the extent practicable;
- complying with all appropriate permit requirements;
- discharging test water to a well-vegetated and stabilized area; and
- regulating the discharge rate, using energy dissipation device(s), and installing sediment barriers, as necessary, to prevent erosion and sedimentation.

ETNG does not anticipate that it would use chemicals for testing or for drying the pipeline following hydrostatic testing. Sampling and discharge of hydrostatic test water would be conducted in accordance with permit requirements, and therefore, would not impact surface water quality.

In addition, ETNG may require water for dust control. Estimates of water use and proposed sources for hydrostatic testing and dust suppression water (e.g., annual registration reports for groundwater or surface water) would be available in the Environmental Report to be submitted to FERC by ETNG.

TVA has independently reviewed and concurs with the water-related findings in ETNG’s Resource Report 2 (ETNG 2022c). Overall, the installation of the natural gas pipeline would result in temporary, minor impacts to surface waters as all surface waters would be returned to original grade and streambanks restored following pipeline construction.

3.6.2.2.3.7 Summary of Alternative A

Permanent and temporary impacts are proposed under Alternative A (Table 3.6-17). Overall, impacts from Alternative A would have minor, permanent impacts, and minor temporary impacts to surface waters.

Table 3.6-17. Summary of Estimated Surface Water Impacts for Alternative A

Alternative A Component	Impact Type	Stream Feature (LF) Perennial	Intermittent	Ephemeral[1]	*Total*	Ponds and Impoundments (No.)
D4 Process	Temporary	434	--	4,893	*5,327*	3 waterbodies
CC/Aero CT Plant	Permanent	--	--	1,133	*1,133*	--
	Temporary	--	--	--	--	--
3-4-MW Solar Facility	Permanent	--	--	--	--	--
	Temporary	--	--	--	--	--
100-MW BESS	Permanent	--	--	320-1,682[2]	*320 - 1,682*	0-1 waterbody
	Temporary	--	--	--	--	--
On-site Transmission Lines	Permanent	--	--	--	--	
	Temporary	--	23	4,266	*4,289*	--
Off-site Transmission Lines[3]	Permanent	--	--	--	--	--
	Temporary	16,373	11,403	10,008	*37,784*	15 waterbodies
Total	**Permanent**	**0**	**0**	**1,453-2,815**	***1,453 - 2,815***	**0-1 waterbody**
	Temporary	**16,373**	**11,426**	**14,274**	***42,073***	**15 waterbodies**
	TBD	**434**	**--**	**4,893**	***5,327***	**3 waterbodies**
Natural Gas Pipeline[4]	Permanent	--	--	--	--	--
	Temporary	4,316	812	310	*5,438*	8 waterbodies

[1]Includes WWCs
[2]Impacts depend on Battery Option chosen.
[3] Includes both field and desktop information for the off-site transmission corridors
[4]Includes impacts associated with waterbody crossings, access roads, and workspaces. Waterbodies crossed via HDD are excluded. Linear footage provided represents the total water width that would be crossed by the natural gas pipeline.

TVA Actions

Permanent impacts would primarily occur due to fill of WWCs and/or ephemeral channels within the boundaries of the CC/Aero CT Plant and battery site option footprints; no permanent impacts are proposed to intermittent or perennial streams or waterbodies. Ephemeral channels and WWCs do not support aquatic life due to the impermanence of water flow, as these features convey water only during significant rain events. Most, if not all, of these features are also man-made and provide poor (if any) habitat. Drainage of rainfall would be disrupted if these channels become filled; however, appropriate stormwater drainage features or facilities would be constructed as part of the Alternative A planning and design. Furthermore, proposed impacts to these features would not be subject to TDEC permitting, per Tennessee Code Annotated section 69-3-108(q), which would be confirmed through the agency permitting and consultation process. Temporary impacts to streams would be the result of disturbance from nearby construction activities or diversion during natural gas pipeline installation on the Kingston Reservation.

Surface water withdrawals would not be required under the proposed construction of the CC/Aero CT Plant. Additionally, all wastewaters would be stored on-site in newly constructed storage tanks. Therefore, there would be a beneficial impact to nearby surface waters, as a result of reducing surface water withdrawal needs from the existing cooling water intake structure. Temporary effects as summarized in Table 3.6-13 would not result in long-term impacts. Similarly, temporary effects by transmission corridor upgrades would not result in long-term impacts, as transmission towers would be constructed in upland areas to the extent practicable.

ETNG Actions - Natural Gas Pipeline and Associated Structures
Temporary impacts during construction of the natural gas pipeline would result from clearing activities, HDD, dry and wet open cut crossing installation methods, temporary access road crossings, temporary workspaces, and hydrostatic test discharges. Minor, temporary impacts from potential spills or leaks of hazardous liquids from refueling procedures, and potential blasting activities are not planned but could occur and would be minimized through the use of standard BMPs. Turbidity would increase temporarily in streams that are trenched; however, trenched streams would be returned to their natural, original grade following completion of the pipeline installation and associated activities. No impacts to surface waters from the construction of compressor stations are anticipated.

Cumulative Effects
Cumulative effects to surface waters may occur given the proximity of past/present and RFFAs near the natural gas pipeline and transmission line corridors. Cumulative effects would include decreased water quality and aquatic habitat due to accidental hazardous spills or in-stream sedimentation caused by erosion of disturbed soils. Effects to surface waters would be minimized and mitigated through proper siting of these facilities, the use of BMPs, and adherence to mitigation requirements in applicable CWA Section 404 and 401 permits.

3.6.2.2.3.8 Environmental Justice Considerations

TVA Actions
Effects to surface water and water quality, as summarized above, that would occur as a result of the proposed CC/Aero CT Plant activities would be minor and minimized, or mitigated through CWA 404, 401, and 402 (NPDES) permitting with some effects (i.e., localized effects) occurring on the TVA-owned Kingston reservation, where no populations are settled. As such, no effects on EJ populations are anticipated.

ETNG Actions - Natural Gas Pipeline and Associated Structures
Effects occurring as a result of ETNG's proposed pipeline activities, while minor, would occur outside of the TVA-owned reservation. In instances where EJ populations were identified along the ETNG Construction ROW, it is TVA's current assessment that amplified effects may occur given that these populations tend to be more vulnerable or sensitive to the effects from temporary 404/401 permitting impacts/activities. ETNG is currently completing its own assessments, and TVA may update its conclusions based on ETNG's findings. Effects to surface waters and water quality that may adversely affect aquatic life that are utilized by EJ populations are addressed in Section 3.8.3.

3.6.2.2.4 Alternative B

3.6.2.2.4.1 Construction and Operations of Solar and Storage Facilities

Alternative B would result in construction activities that have the potential to permanently affect streams and/or temporarily affect surface water via stormwater runoff. Based on TVA's evaluation of typical effects associated with the development of solar facilities (Table 3.2-1), new solar facilities result in an average of approximately 8.7 LF of stream effects per MW, with a range from 0 to 41 LF. Based on the addition of 1,500 MW of solar facilities in Alternative B, an average of 13,050 LF of stream would be impacted, with up to 61,500 LF of total stream effects possible. For 2,200 MW of BESS facilities, impacts would range between approximately 19,140 LF and 90,200 LF based on values from Table 3.2-1.TVA and solar developers would minimize effects to surface waters by siting facilities on lands with few surface water resources, configuring the solar arrays, access roads, and other infrastructure to avoid surface waters, and establishing and maintaining buffers around surface waters. Applicable CWA Section 404 and 401 permits would be obtained from USACE and TDEC and necessary mitigation credits purchased if surface water effects cannot be avoided. Should mitigation credits not be available within the primary or applicable secondary watersheds, TVA would pursue mitigation through in-lieu fee credit purchases or through permittee-responsible mitigation.

Soil erosion and sedimentation can clog small streams and threaten aquatic life. As noted in the 2019 TVA IRP EIS (TVA 2019b), the conversion of a site to a solar facility with a permanent grass and herbaceous vegetative cover can reduce the runoff of silt and agricultural chemicals that often occurs from cropland/agricultural land. Appropriate BMPs would be installed, and all proposed project activities would be conducted in a manner to ensure that waste materials are contained and that the introduction of pollution materials to the receiving waters is minimized. A general construction stormwater permit would be needed for the proposed solar and BESS facilities since more than one acre would be disturbed. This permit requires the development and implementation of a SWPPP, which would identify specific BMPs to address construction-related activities that would be adopted to minimize stormwater effects. With the use of BMPs and adherence to all permit conditions, effects to surface waters and surface water quality would be minor.

Although not part of this NEPA analysis, TVA plans to expand future solar facilities by 10,000 MW by 2035 in order to meet customer and system demand per the 2019 IRP. Cumulative effects to surface water may occur under Alternative B with the addition of the planned 10,000 MW of solar throughout the TVA PSA. Based on the average of 8.7 LF of effect per MW, this would result in 87,000 LF of additional stream effects within the TVA PSA. Cumulative effects to surface waters would be minimized and mitigated through proper siting of solar facilities, the use of BMPs, and adherence to mitigation requirements in applicable CWA Section 404 and 401 permits.

3.6.2.2.4.2 Transmission and Other Components

As noted in Table 3.3-1, transmission lines typically result in an average of 2.9 stream crossings per mile of new line; with an estimated 1.71 average length of new transmission line for solar facility interconnections, a total of 74 stream crossings for solar facilities and 84 stream crossings for BESS facilities are estimated for installing new transmission lines. TVA and solar developers would avoid placing structures within surface waters, and effects would be minimized by crossing surface waters at a perpendicular angle where practicable. Erosion and sediment control BMPs would be deployed and USACE and TDEC permits would be obtained. Associated substations and/or switchyards would be sited to avoid surface waters to the maximum extent practicable. With the use of BMPs and adherence to all permit conditions, effects to surface waters and surface water quality would be minor.

Cumulative effects to surface water may occur under Alternative B from the combined transmission effects of the 1,500 MW of proposed solar under Alternative B and the additional 10,000 MW of solar installations planned throughout the TVA PSA (to be evaluated under separate NEPA analyses). Transmission lines associated with this expansion would result in stream crossings and effects. Cumulative effects to surface waters would be minimized and mitigated through proper siting of transmission lines, the use of BMPs, and adherence to mitigation requirements in applicable CWA Section 404 and 401 permits.

3.6.2.2.4.3 Environmental Justice Considerations

Effects to surface water and water quality that would occur because of the proposed solar facilities and transmission line activities would be avoided or minimized to the extent practicable through the implementation of standard BMPs and are not anticipated to have amplified adverse human health or environmental effects on EJ populations. Individual solar sites and transmission-related impacts to EJ populations would be further evaluated under future NEPA evaluations for each individual solar project/BESS facility.

3.6.3 Wetlands

The USACE regulates the discharge of fill material into waters of the United States, including wetlands, pursuant to Section 404 of the CWA (33 USC 1344). Additionally, EO 11990 (Protection of Wetlands) requires federal agencies to avoid, to the extent possible, adverse impacts to wetlands and to preserve and enhance their natural and beneficial values. Wetlands are also protected by state regulations (e.g., Tennessee's Aquatic Resources Alteration Permit [ARPA] program). As defined in regulations implementing Section 404 of the CWA (45 FR 85346), wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands and wetland fringe areas can also be found along the edges of many watercourses and impounded waters (both natural and man-made). Wetland habitat provides valuable public benefits, including flood storage, erosion control, water quality improvement, wildlife habitat, and recreation opportunities.

3.6.3.1 Affected Environment

3.6.3.1.1 Kingston Reservation (No Action and D4 Activities)

Field surveys for wetlands were completed during the summer of 2019 (TVA 2020c; Appendix E and J). A portion of the site was re-evaluated in the spring of 2022 due to permitted disturbances in the area since 2019 (Figure 3.6-4). In accordance with the authorized USACE Section 404 permit (Permit No. LRN-2006-00597) issued by the Nashville District Corps of Engineers to TVA on June 10, 2020, up to 0.69 acre of wetlands were permitted for permanent discharge of fill material associated with the construction of the Phase 2 coal combustion residual landfill at the Kingston Reservation.

An additional survey was completed in January 2023 by Qualified Hydrologic Professionals in areas that may be impacted by demolition or actions under Alternative A on the Kingston Reservation. Wetland determinations were performed according to USACE standards, which require documentation of wetland (hydrophytic) vegetation, hydric soil, and wetland hydrology (USACE 1987; Reed 1997). Broader definitions of wetlands, such as that used by the USFWS Service (Cowardin et al. 1979), the Tennessee definition (Tennessee Code 11-14-401), and the TVA Environmental Review Procedures definition (TVA 1983), were also considered in this review (TVA 2020c). In addition, the Tennessee Rapid Assessment Method (TRAM; TDEC 2015) was used to assess wetland condition and identify wetlands with special ecological significance (Mack 2001) (Appendix E, Appendix G).

Nineteen wetlands totaling 4.60 acres were delineated during the field surveys. Five wetlands (W008-W012 totaling 0.15 acre) identified within the 2023 delineation area on the western portion of Kingston Reservation (see Figure 3.6-4) exist within a stormwater/wastewater conveyance for treatment; therefore, TDEC considers these wetlands exempt from regulation, however verification of these features is pending an AJD from the USACE.

Most wetlands on Kingston Reservation are persistent emergent wetlands with herbaceous vegetation communities (totaling 3.23 acres), followed by forested, broad-leaved wetlands (totaling 1.4 acres), and one small scrub-shrub wetland (0.01 acre). Wetlands are depicted on Figure 3.6-4 and summarized in Table 3.6-18.

Table 3.6-18. Summary of Wetlands Present on Kingston Reservation

Cowardin Classification[1]	Cowardin et al (1979) Description and Field Notes	Field ID	Number of Wetlands	Acres
PEM1E	Persistent emergent wetlands, seasonally flooded/saturated. Depression wetlands or wetland swales.	W002 W004 W006 W007	4	0.59
PEM1E/PSS	Persistent emergent wetland/scrub-shrub wetlands with broad-leaved deciduous vegetation, seasonally flooded/saturated. Associated with streams.	WW013 WW015	2	2.39
PEM1Hr	Persistent emergent wetland, permanently flooded, artificial. Emergent wetland fringe in manmade pond; disturbed.	W003	1	0.10
PEM1Jd	Persistent emergent wetland, intermittently flooded, partly drained/ditched. Linear wetlands in wastewater/stormwater conveyance for treatment.	W008 W009 W010 W011 W012	5	0.15
PFO/PSS/ PEM1E/PSS1C	Mixed wetland area with forested, scrub-shrub, and emergent wetland types with broad-leaved deciduous and persistent emergent vegetation types, seasonally flooded. Associated with a low-lying wet-weather conveyances along shoreline.	WW011 WW012	2	0.93
PFO1A	Forested wetlands with broad-leaved deciduous vegetation, temporarily flooded. Located in low-lying areas.	WW002 WW006	2	0.16
PFO1E	Forested wetlands with broad-leaved deciduous vegetation, seasonally flooded/saturated. One wetland located in a depression surrounding conveyances; one wetland located as a fringe to the Clinch River.	W001 W005	2	0.27
PSS1A	Scrub-shrub wetland with broad-leaved deciduous vegetation, temporarily flooded. Associated with a drainage feature.	WW001	1	0.01
		Total	**19**	**4.60**

[1] PEM: palustrine emergent wetland; PFO: palustrine forested wetland; PSS: palustrine scrub-shrub.

3.6.3.1.2 Alternative A

3.6.3.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Three wetlands totaling approximately 0.15 acre were identified within the CT/Aero CC Plant footprint during the field reconnaissance in March 2022 (TVA 2022b). The wetlands were classified as emergent and forested wetlands adjacent to the Clinch River. No wetlands are present within the switchyard area. Wetlands within the proposed CT/Aero CC Plant boundary are depicted on Figure 3.6-4 and summarized in Table 3.6-19. Representative photographs, USACE wetland determination data forms, and TRAM forms are provided for wetlands W001, W002, and W005 in Appendix E. Based on TRAM form ratings, all three wetlands hold low resource value.

Table 3.6-19. Summary of Wetlands Present within the CC/Aero CT Plant Boundary

Cowardin Classification[1]	Cowardin et al. (1979) Description and Field Notes	Field ID	Number of Wetlands	Acres
PEM1E	Persistent emergent wetland, seasonally flooded or saturated. Wetland swale draining to reservoir, within prior disturbed area, maintained.	W002	1	0.03
PFO1E	Forested wetlands with broad-leaved deciduous vegetation, seasonally flooded/saturated. One wetland located in a depression surrounding conveyances; one wetland located as a fringe to the Clinch River.	W001 W005	2	0.13
		Total[2]	**3**	**0.15**

[1]PEM: palustrine emergent wetland; PFO: palustrine forested wetland
[2]Total varies due to rounding.

3.6.3.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

No wetlands are present on the proposed 3- to 4-MW solar facility site (Figure 3.6-4).

3.6.3.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

No wetlands are present on any of the three battery storage site options (Figure 3.6-4).

3.6.3.1.2.4 On-site Transmission Upgrades

Construction of the 100-MW BESS would include battery transmission line connections that tie in with the existing transmission lines on Kingston Reservation. No wetlands occur within the bounds of the proposed battery transmission line connection corridor (Figure 3.6-4).

Under Alternative A, TVA would also make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant and switchyard. Five wetlands totaling 0.68 acre were identified within the extent of the on-site transmission line corridor (Table 3.6-20). The majority of the wetlands (0.66 acre) were classified as emergent wetlands, with the remaining 0.02 acre classified as mixed forested, scrub-shrub, and emergent wetlands. Representative photographs, USACE wetland determination data forms, and TRAM forms are provided for wetlands W003, W004, W006, and W007 in Appendix E. Based on TRAM form ratings, all five wetlands hold low resource value.

Table 3.6-20 Wetlands Crossed by the Alternative A Existing On-site Transmission Line Corridor

Cowardin Classification[1]	Cowardin et al. (1979) Description and Field Notes	Field ID	Number of Wetlands	Area (acres)
PFO/PSS/PEM1E/PSS1C	Emergent/scrub-shrub/forested wetland associated with low-lying WWC along shoreline; seasonally flooded/saturated.	WW012	1	0.02
PEM1Hr	Persistent emergent wetland, permanently flooded and artificial. Wetland fringe to manmade pond, disturbed.	W003	1	0.10
PEM1E	Persistent emergent wetland, seasonally flooded/saturated. Two wetlands are depressions, and one wetland appears as a swale within the existing transmission line ROW.	W004 W006 W007	3	0.56
		Total	**5**	**0.68**

[1]PEM: palustrine emergent; PFO: palustrine forested; PSS: palustrine scrub-shrub

3.6.3.1.2.5 Off-site Transmission Line Upgrades

Corridors associated with transmission upgrades (including access roads) are described below with respect to Eastern and Western transmission corridors.

3.6.3.1.2.5.1 Eastern Transmission Corridor

A wetlands field survey was completed in June 2022 of the Eastern Transmission Corridor (L5108 and L5302) and Western Transmission Corridor (L 5383) (HDR 2022b). TVA later determined the potential need for additional transmission upgrades within the Eastern Transmission Corridor for L5116, L5280, and L5381 for Alternative A. Since additional field surveys for these areas have not yet been completed, the analysis for impacts to wetlands for these areas is based on desktop analysis of publicly available data.

As such, the analyses of wetlands presented in this draft EIS subdivides the evaluation of the Eastern Transmission Corridor based on the source of the data used:

- L5108 and L5302 — based on analysis of field survey results and other available publicly available data; and
- L5116, L5280, and L5381 — based on desktop analysis of publicly available data.

3.6.3.1.2.5.1.1 Lines 5108 and 5302 – Data from Field Surveys

A total of 28 potentially jurisdictional wetlands encompassing 11.84 acres and five isolated wetlands totaling 0.49 acre were delineated. (Table 3.6-21). Forested wetlands listed in Table 3.6-21 were typically early successional forested areas with small trees, located along ROW margins (wetlands 18, 41, and 42) or unmaintained access roads (wetlands 36 and 38) (see data forms and representative photographs in Appendix F). Twenty-two of the 28 wetlands observed hold low resource value according to TRAM metrics, however five were rated as moderate and one rated as an Exceptional TN Water (Wetland 28). Higher ratings were primarily driven by elevated scores for “hydrology”, “habitat”, “buffer”, and for the Exceptional TN Water, special wetland community”. All isolated wetlands were determined to have low resource value. Additional information on wetland quality, figures, photolog, TRAM and USACE wetland determination data forms are provided in Appendix F.

Table 3.6-21. Summary of Wetlands within the Eastern Transmission Corridor Proposed for Upgrades (L5108 and L5302) under Alternative A

Cowardin Classification[1]	Description	Field ID	Number of Wetlands	Acres
Wetlands Present				
PEM1	Emergent wetland with persistent emergent vegetation.	Wetlands 13, 17, 20-22, 24-25, 31, 33, 35, 40, 43, 45, 46	16	7.23
PEM1/PFO1	Dominant emergent wetland with persistent emergent vegetation, subdominant forested wetland with broad-leaved deciduous trees.	Wetlands 32, 39	2	3.47
PSS1	Scrub-shrub wetland with broad-leaved deciduous shrubs.	Wetlands 18, 47-49	4	0.21
PSS1/PFO1	Dominant scrub-shrub wetland with broad-leaved deciduous shrubs, subdominant forested wetland with broad-leaved deciduous trees.	Wetland 26	1	0.39
PFO1/PFO1A	Forested wetland with broad-leaved deciduous trees.	Wetlands 36-38, 41-42	5	0.54
		Total	**28**	**11.84**
Isolated Wetlands				
PEM1	Emergent wetland with persistent emergent vegetation.	Wetlands 19, 23, 29, 30, 34	5	0.49

Note: Information in this table is derived from field surveys completed in June 2022.
[1]PEM: palustrine emergent; PFO: palustrine forested; PSS: palustrine scrub-shrub

3.6.3.1.2.5.1.2 Lines 5116, 5280, and 5381 – Data from Desktop Sources

Field surveys of L5116, L5280, and L5381 of the Eastern Transmission Corridor to verify jurisdictional wetlands will be performed by TVA during summer 2023 (Figure 3.6-5a – Figure 3.6-5d). A desktop-based geospatial assessment of surface water resources along the ROWs of L5116, L5280, and L5381 on the Eastern Transmission Corridor was completed using USGS topographic maps, USGS NHD, soil survey geographic database (SSURGO 2018), NWI and NLCD data, and aerial imagery. Additionally, field surveys are currently underway along these lines to verify jurisdictional wetlands (Figure 3.6-5a-d). The desktop review using the aerial imagery identified a total of 14 potentially jurisdictional wetlands encompassing 2.36 acres were identified in the aerial imagery. All fourteen wetlands were categorized as forested, however, as existing transmission line corridors, it is likely that these wetlands are scrub-shrub or emergent wetlands as they undergo regular maintenance and woody vegetation control. Wetlands are depicted on Figure 3.6-5a-d and summarized in Table 3.6-22.

Table 3.6-22. Summary of Wetlands within the Eastern Transmission Corridor (L5116, L5280 and L5381) under Alternative A

Cowardin Classification[1]	Description	Number of Wetlands	Acres
Wetlands			
PFO1A	Forested wetlands with broad-leaved deciduous vegetation, temporarily flooded. Located in a low-lying area.	14	2.36
	Total	**14**	**2.36**

Note: Information in this table is derived from publicly available online sources, such as USGS NHD, NWI, and USGS topographic maps.
PFO: palustrine forested

3.6.3.1.2.5.1.3 Western Transmission Corridor–Line 5383 - Data from Field Surveys

Field surveys were completed in June 2022 of the Western Transmission Corridor (see figures in Appendix F). No transmission upgrades are proposed within the western portion of the Western Transmission Corridor; as such, field surveys were limited to the portion of the corridor where transmission upgrades are currently proposed, as identified in Figure 3.6-6. Wetland determinations were performed according to USACE standards, which require documentation of wetland (hydrophytic) vegetation, hydric soil, and wetland hydrology (USACE 1987, 2012; Reed 1997). Additionally, TRAMs were used to assess wetland condition and identify wetlands with special ecological significance (TDEC 2015).

A total of 11 wetlands encompassing approximately 8.26 acres and five isolated wetlands totaling 0.58 acre were delineated (Table 3.6-23). The majority of wetlands within the Western Transmission Corridor were categorized as emergent, followed by an emergent/forested combination, scrub-shrub, and forested. Most wetlands (eight) were determined to have low resource value according to TRAM forms, and three with moderate rating, primarily driven by elevated scores for hydrology, habitat, and buffer. All isolated wetlands were observed to have low resource value. Wetland figures, photolog, TRAM and USACE wetland determination data forms are provided in Appendix F.

Table 3.6-23. Summary of Wetlands Crossed by L5383 within the Western Transmission Corridor under Alternative A

Cowardin Classification[1]	Description	Field ID	Number of Wetlands	Acres
Wetlands				
PEM1	Emergent wetland with persistent emergent vegetation.	Wetlands 2, 6, 8, 9, 12, 13-15	8	4.18
PEM1/PFO1	Dominant emergent wetland with persistent emergent vegetation, subdominant forested wetland with broad-leaved deciduous trees.	Wetland 11	1	3.88
PSS1	Scrub-shrub wetland with broad-leaved deciduous shrubs.	Wetland 7	1	0.12
PFO1	Forested wetland with broad-leaved deciduous vegetation.	Wetland 5	1	0.08
		Total	**11**	**8.26**

Cowardin Classification[1]	Description	Field ID	Number of Wetlands	Acres
		Isolated Wetlands		
PEM1	Emergent wetland with persistent emergent vegetation.	Wetland 1, 3, 4, 10, 16	5	0.58

[1]PEM: palustrine emergent; PSS: Palustrine scrub-shrub, PFO: palustrine forested wetland

3.6.3.1.2.6 Construction and Operation of a Natural Gas Pipeline

ETNG conducted field surveys along the ETNG Construction ROW in 2021 and 2022 with qualified wetland scientists using the Routine On-Site Determination Method defined in the USACE Wetland Delineation Manual (USACE 1987), and Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region (USACE 2012). As with field surveys for surface waters discussed above, these surveys would allow ETNG to identify the actual presence of wetlands should ETNG's Project be selected to transport natural gas supplies via expansion of ETNG's 3100 pipeline system. Field surveys would continue through 2023 where additional survey permission is granted. Table 3.6-24 provides a summary of wetlands delineated within the ETNG Construction ROW, including Cowardin et al. (1979) classification, description, total number of wetlands, and acreage of wetlands crossed. Based on ETNG's draft Resource Reports, there are approximately 26.2 acres of wetlands within the proposed ETNG Construction ROW (including aboveground facilities), consisting of approximately 21.9 acres of palustrine emergent wetlands (PEM) and 0.2 of PEM for aboveground facilities, 1.4 acres of palustrine scrub-shrub (PSS) wetlands, and 2.7 acres of palustrine forested wetlands (PFO) (ETNG 2022c); however, an AJD has not been received from the USACE for waters verification. Anticipated wetlands crossed by the ETNG Construction ROW are summarized in and shown on figures in Appendix D-4.

Table 3.6-24. Summary of Wetlands Crossed by the ETNG Construction ROW

Wetlands Crossed by Project and Aboveground Facilities			
Cowardin Classification[1]	**Description**	**Number of Wetlands**	**Acres**
PEM	Emergent wetland with persistent emergent vegetation.	221+	30.1
PSS	Palustrine scrub-shrub vegetation	13	1.4
PFO	Forested wetland with broad-leaved deciduous vegetation.	57	2.7
	Total	**291**	**26.2**

[1]PEM: palustrine emergent; PSS: Palustrine scrub-shrub, PFO: palustrine forested wetland

3.6.3.1.3 Alternative B

3.6.3.1.3.1 Eastern Tennessee TVA Power Service Area

Wetlands occur across the TVA region and are most extensive in the south and west where they comprise 5 percent or more of the landscape (USGS 2016). Wetlands in the TVA Power Service Area consist of two main systems: (1) palustrine wetlands such as marshes, swamps and bottomland forests dominated by trees, shrubs, and persistent emergent vegetation, and (2) lacustrine wetlands associated with lakes, such as aquatic bed wetlands (Cowardin et al. 1979).

Riverine wetlands associated with moving water within a stream channel are also present but uncommon. Almost 200,000 acres of wetlands are associated with the TVA reservoir system, where they are more prevalent on mainstem reservoirs and tailwaters than tributary reservoirs and tailwaters (TVA 2004). Almost half of this 200,000-acre area is forested wetlands; other types include aquatic beds and flats, ponds, scrub-shrub wetlands, and emergent wetlands.

3.6.3.2 Environmental Consequences

3.6.3.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue current plant operations until the scheduled retirement, and no work would be conducted that would result in a change to existing conditions. Therefore, there would be no direct or indirect effects to wetlands because there would be no physical changes to the current conditions.

3.6.3.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Under the following action alternatives, KIF would be retired and deconstructed. Two wetlands totaling less than 0.01 acre were identified within the demolition boundary area. These wetlands are two of the five that were identified within stormwater/wastewater conveyances and are unlikely to be jurisdictional; however, results of an AJD and consultation with the USACE are pending. Total impacts to wetlands within the demolition boundary from D4 activities would be minor.

3.6.3.2.2.1 Environmental Justice Considerations

No effects to wetlands are expected to occur as a result of the Kingston coal facility retirement and D4 activities since no wetlands are currently present within the existing plant footprint or within the proposed demolition boundary. Therefore, amplified effects are not anticipated to occur to EJ populations with this alternative.

3.6.3.2.3 Alternative A

3.6.3.2.3.1 Construction and Operation of a CC/Aero CT Plant, Switchyard, and Transmission Facilities on the Kingston Reservation

Under Alternative A, the proposed CC/Aero CT Plant would be constructed and KIF would be retired. TVA would implement the planned actions related to the current and future management and storage of CCRs on the Kingston Reservation, which have either been reviewed or would be in subsequent NEPA analyses. Three wetlands would be permanently impacted due to fill within the footprint of the proposed CC/Aero CT Plant, totaling 0.13 acre of forested wetlands and 0.03 of emergent wetlands. Applicable CWA Section 404 and 401 permits would be obtained from USACE and TDEC and erosion and sediment control BMPs would be used to minimize indirect effects to wetlands (TVA 2018a). Impacts to wetlands within the CC/Aero CT Plant footprint would be minor and would potentially be avoided in their entirety during the design phase, if feasible.

3.6.3.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

No wetlands are present within the boundary of the 3- to 4-MW solar facility; therefore, no impacts to wetlands from this component of Alternative A would occur.

3.6.3.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

No wetlands are present within boundaries of Battery Sites 1, 2, or 3; therefore, no impacts to wetlands from this component of Alternative A would occur.

3.6.3.2.3.4 On-site Transmission Upgrades

No wetlands are present within the boundary of the corridor identified for proposed Battery Transmission Line Connections corridor associated with the proposed 100-MW BESS; therefore, no impacts to wetlands from this component would occur (Figure 3.6-6).

Under Alternative A, TVA would also make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant facilities and switchyard. Approximately 0.02 acre of mixed forested wetlands would be permanently converted to scrub-shrub or emergent wetlands to assure the safe and reliable operation of the transmission facilities. This wetland (WW012) is located on the boundary of the existing transmission line and likely has undergone previous maintenance to maintain the wetland as herbaceous or scrub-shrub within the corridor; a remaining portion of the wetland extending from the transmission line corridor to the Emory River is, and would remain, forested. Stumps, root wads, and root systems of trees in wetland areas cleared for the transmission line would be left in place. The remaining 0.66 acre of emergent wetlands could be directly or indirectly impacted from construction during the upgrade of the existing transmission lines. Erosion and sediment control BMPs would be used to the extent practical to minimize indirect effects to wetlands. With the use of BMPs and adherence to all permit conditions, effects wetlands would be minor.

3.6.3.2.3.5 Off-site Transmission Line Upgrades

3.6.3.2.3.5.1 Eastern Transmission Corridor

3.6.3.2.3.5.1.1 Lines 5108 and 5302 – Data from Field Surveys

Approximately 11.84 acres of wetlands were identified during field surveys as being within the Eastern Transmission Corridor ROW; however, an application for an AJD has not yet been submitted to the USACE for verification of waters classifications. Should new structures be needed TVA would avoid placement within wetlands, when possible. The transmission line would require clearing of 0.62 acres of forested wetlands, which would convert forested systems to emergent wetlands due to the necessary routine ROW vegetation maintenance cycles. Initial maintenance clearing would likely result in removal of early successional and small sapling forested wetland habitat. Subsequent maintenance (every three years) would result in the clearing scrub-shrub wetland habitat given that it's unlikely that wetland areas would meet the forested qualification in this amount of time. Access across wetlands located in the ROW would be conducted in accordance with wetland BMPs to minimize soil compaction and ensure only temporary effects result (TVA 2022a). This includes use of low ground pressure equipment, wetland mats, and dry season work scheduling. Erosion and sediment control BMPs would be implemented and USACE and TDEC permits would be obtained, and any necessary mitigation credits would be purchased. Therefore, minor impacts due to the clearing of forested wetlands are anticipated for the life of the transmission line ROW. Discussion of construction activities and avoidance and minimization measures are described in Section 3.6.2.2.3.1.

3.6.3.2.3.5.1.2 Lines 5116, 5280, and 5381 – Data from Desktop Sources

A desktop review identified approximately 2.36 acres of wetlands within the Eastern Transmission Corridor ROW. Field surveys are currently being performed and once completed, an application for an AJD will be submitted to the USACE for verification of waters classifications. However, the potential for project impacts are anticipated to be comparable to those anticipated for proposed upgrades and reconductoring for L5108 and L5302, as described above.

TVA would avoid direct impacts to wetlands when possible; otherwise, unavoidable impacts would be minimized using low ground pressure equipment, wetland mats, and dry season work scheduling. Erosion and sediment control BMPs would be deployed and USACE and TDEC permits would be obtained, and necessary mitigation credits purchased. Therefore, minor permanent impacts due to the clearing of forested wetlands are anticipated. Discussion of construction activities and avoidance and minimization measures are described in Section 3.6.2.2.3.1.

3.6.3.2.3.5.1.3 Western Transmission Corridor–Line 5383 - Data from Field Surveys

Approximately 8.26 acres of wetlands were identified in the field as being within the Western Transmission Corridor; however, an application for an AJD has not yet been submitted to the USACE for verification of waters classifications. A summary of construction activities and avoidance and minimization measures is described in Section 3.6.2.2.3.1. No permanent impacts are anticipated to wetlands identified within the Western Transmission Corridor. Should wetland crossings within the transmission corridor be required to complete the proposed upgrades, they would be done in accordance with BMPs for minimizing impacts to wetlands, including steps to minimize soil compaction (TVA 2022a). Additional steps may include the use of low ground-pressure equipment, temporary placement of mats, and schedule work during the dry season. Standard BMPs from TVA's E&SC Plan developed for this Action would be deployed, necessary permits would be obtained from the USACE and TDEC, and any required mitigation credits would be purchased. With the use of BMPs and adherence to all permit conditions, effects to wetlands within the Western Transmission Corridor, if any, would be minor and temporary.

3.6.3.2.3.6 Construction and Operation of a Natural Gas Pipeline

ETNG anticipates that it would be able to avoid and minimize impacts to wetlands during construction of the Project, and most impacts would be temporary in nature. No permanent filling impacts are proposed. ETNG would install the pipeline across wetlands in accordance with FERC's Procedures and the conditions and limitations of the applicable USACE permit. Temporary impacts to wetlands within construction workspaces would include the removal of vegetation and disturbance of soils. Following construction, wetlands within ATWS would be allowed to revegetate to their original condition following restoration, thereby restoring wetland function. The herbaceous vegetation would regenerate quickly (typically within 1 to 2 years), while scrub-shrub and forest vegetation would require a longer period to regenerate. Where PSS and PFO wetlands are within the permanent easement, permanent operational impacts would be limited to areas maintained as herbaceous and scrub-shrub cover to facilitate corrosion and leak inspections.

Measures to minimize impacts to wetlands would include:

- limiting the construction ROW to 85 feet in wetlands, where practicable;
- installation and regular maintenance of erosion and sediment controls, to include equipment matting, silt fence, staked BMPs;
- expediting construction in and around wetlands to reduce the amount of time wetland soils are exposed to drier conditions;
- maintaining a 10-foot strip as herbaceous vegetation community, centered over the pipeline in accordance with FERC procedures;
- returning of wetland bottoms and drainage patterns to their original configurations and contours to the extent practicable;

- permanently stabilizing upland areas near wetlands as soon as practicable after trench backfilling to reduce sediment run-off;
- segregating up to the top 12 inches of topsoil in unsaturated wetlands to preserve the native seed source (which would facilitate re-growth of herbaceous vegetation once pipeline installation is complete);
- using seed mixes as recommended by the appropriate agencies unless otherwise requested by the landowner; and
- post-construction wetland monitoring to evaluate the progress of wetland revegetation and minimize the threat of invasive species establishment.

Compaction of wetland soils and rutting within wetlands due to equipment operation can affect wetland hydrology and revegetation. Compaction would be minimized by limiting equipment operation in wetlands and installing temporary equipment mats, as necessary. Soil characteristics can also be changed during construction because of inadvertent mixing of topsoil and subsoil during grubbing and trenching. To prevent such mixing in unsaturated wetlands, topsoil would be removed from the area directly over the trench and stockpiled for restoration as close as feasible to its original horizon. No topsoil segregation would be attempted in saturated wetlands.

Permanent changes in surface and subsurface hydrology through a wetland can have a long-term impact on the habitat type and quality. Trench plugs would be installed at the entrance and exit of the pipeline trench through the wetland to ensure that the wetland is not drained along the pipeline. Any confining layers that are breached during construction would be restored during backfilling. Restoration of each wetland would involve returning contours to pre-construction levels and removing temporary erosion control measures. Permanent erosion control devices may be installed during restoration and can include slope breakers, interceptor diversion devices, and/or vegetation cover in adjacent upland areas to minimize long-term sedimentation into the wetlands. Energy dissipation devices may be installed at the down-slope end of surface water diversion devices to help prevent erosion off the ROW into wetlands.

Wetland crossings completed using the HDD method would avoid and minimize the potential for wetland impacts resulting from erosion, sedimentation, and/or excess turbidity by avoiding surface disturbance in and immediately adjacent to the wetlands. However, as described above, the potential for an inadvertent return of drilling mud exists. Impacts from an inadvertent return would be minimized by implementation of ETNG's HDD Plan, which would include procedures for monitoring, detecting, isolating, stopping, and cleaning up inadvertent returns, as well as making necessary agency notifications.

ETNG's would adhere to ETNG's SPCC Plan including restrictions and mitigation measures to limit potential impacts associated with the release of fuels, lubricants, or other potentially toxic materials used during routine construction. Fuel storage and refueling of equipment would be maintained at an approved distance from wetland boundaries.

During operations, tree-clearing within wetlands would be limited to selectively clearing trees within 15 feet of the pipeline with roots that could compromise the integrity of the pipeline coating. Trees and shrubs that become reestablished beyond 15 feet on either side of the pipeline would not be disturbed. No herbicides would be used in wetlands. As stated in ETNG's Resource Report 2 (ETNG 2022c), wetland mitigation efforts would include the following:

- In compliance with federal and state regulatory permitting framework relative to wetland protection, [ETNG] will develop a Project-specific wetland mitigation plan that will include the purchase of mitigation credits from established wetland banks prior to construction. The mitigation plan will provide measures to avoid, minimize, and compensate for temporary and permanent impacts. [ETNG] will consult with the applicable federal and state regulatory agencies for guidance during development of the proposed mitigation measures and plans. As additional mitigation measures are developed and submitted as part of the federal and state permit applications, supplemental information will be provided to the Commission with the Project Application.

Other specifications for ETNG's regular operation and maintenance expectations are provided in Section 3.6.2.2.3.6. TVA has independently reviewed and concurs with the wetlands-related findings in ETNG's Resource Report 2 (ETNG 2022c).

3.6.6.2.3.3 Summary of Alterative A

TVA Actions

Permanent and temporary effects to wetlands would be proposed for Alternative A (Table 3.6-25). Permanent impacts to wetlands would potentially occur as a result of the construction of the proposed CC/Aero CT Plant; however, the impacts would be minor and would potentially be avoided in their entirety during the design phase. Permanent impacts related to the transmission line corridors would result from the conversion of forested wetland habitat to emergent or scrub-shrub habitat. While this would not eliminate wetland habitat, some wetland functions would be altered due to the change in the vegetation community.

Impacts anticipated for the construction of the proposed CC Plant would be minor and may be avoided in their entirety once design plans are finalized. Overall, wetland impacts would consist primarily of temporary wetland impacts and permanent conversion of forested wetland habitat to emergent wetlands. Where any permanent impacts would be unavoidable, TVA would comply with the mitigation requirements in the applicable CWA 404 and 401 permits. Thus, TVA actions would result in minor effects to wetlands.

Cumulative effects to wetlands may occur with the proximity of CCR management activities as RFFAs in the Kingston Reservation. Cumulative effects to wetlands may also occur given proximity of past/present and RFFAs near the transmission line corridors. Cumulative effects to wetlands would be minimized and mitigated through proper siting of facilities (i.e., avoidance wherever possible), the use of BMPs, and adherence to mitigation requirements in applicable CWA Section 404 and 401 permits.

Additionally, based on the TRAM, all the wetlands within the Alternative A disturbance area (W001 through W007) were determined to have low resource values (Appendix E). Therefore, wetland effects for Alternative A would be minor based on the existing quality of wetlands present and minimization efforts, and temporary as impacted wetlands would likely be given the opportunity to return to their existing habitats.

ET–G Actions - Natural Gas Pipeline and Associated Structures

The permanent effect for the natural gas pipeline would be related to a new permanent easement for the operation of the pipeline. Within the ROW, these effects include approximately 0.4 acre of forested wetland and 0.7 acre of shrub-scrub that would be converted to emergent wetland habitat. Temporary effects from construction of the natural gas pipeline would also occur due to temporary workspaces and access roads needed for construction and open cut installation of the pipeline through wetlands. With the use of BMPs and adherence to all permit conditions, effects to wetlands would be minor. Although TVA has assessed these impacts to be minor and temporary, and potentially amplified to identified EJ populations, ETNG is still evaluating effects of their proposed project and resulting changes will be incorporated into TVA's final EIS.

Table 3.6-25. Estimated Wetland[1] Impacts (Acres) for Alternative A

Alternative A Component	CC/Aero CT Plant		3-4-MW Solar Facility		100-MW BESS		On-Site Transmission Line Upgrades		Off-Site Transmission Line Upgrades		Natural Gas Pipeline	
Feature Type[2]	**Perm***	**Temp***	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**	**Perm**	**Temp**
Emergent (PEM)	--	--	--	--	--	--	--	0.64	--	18.76	--	22.1
Scrub-Shrub (PSS)	--	--	--	--	--	--	--	--	--	0.72	0.7	1.4
Forested (PFO)	0.15	--	--	--	--	--	--	--	2.98	--	0.4	2.7
Mixed (PEM/PSS/ PFO)	--	--	--	--	--	--	0.02	--	--	--	--	--
Total	**0.15**	**--**	**--**	**--**	**--**	**--**	**0.02**	**0.64**	**2.98**	**19.48**	**1.1**	**26.2**

[1]Two wetlands totaling less than 0.01 acre that are present stormwater/wastewater conveyances and are unlikely to be jurisdictional, however consultation is pending. Isolated wetlands are not included.
[2]Designations for each type of wetland follow the classifications developed by the USFWS after Cowardin et al. (1979). PEM = Palustrine Emergent Wetland, PSS= Palustrine Scrub-Shrub Wetland; PFO = Palustrine Forested Wetland.
*Perm: permanent impacts; Temp: temporary impacts

3.6.3.2.4 Alternative B

3.6.6.2.3.4 Construction and Operations of Solar and Storage Facilities

TVA Actions

Alternative B would result in construction activities that have the potential to impact wetlands temporarily, indirectly during construction activities or permanently from wetland type conversion (i.e., from forested to scrub-shrub) for transmission facilities. As noted in Table 3.2-1, TVA has evaluated typical effects associated with the development of solar facilities. Solar facilities average approximately 0.003 acre of wetland effects per MW, with a range of 0 to 0.1 acre. Solar facilities average approximately 0.01 acre of forested wetland clearing per MW, with a range of 0 to 0.1 acres. Construction of 15 solar facilities totaling 1,500 MW would average 4.5 acres and up to 150 acres of wetland effects, in addition to an average of 15 acres and up to 150 acres of forested wetland clearing. For BESS facilities, wetland area affected averages 5.1 acres (maximum 170 acres) and 17 acres (maximum 170 acres) for forested wetlands. TVA and solar developers would minimize effects to wetlands by siting facilities on land with few wetland resources, configuring the solar arrays, access roads, and other infrastructure to avoid wetlands, and establishing and maintaining buffers around wetlands. Appropriate BMPs would be installed, and all proposed project activities would be conducted in a manner to ensure that waste materials are contained, and the introduction of pollutants to wetlands would be minor.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Cumulative effects to wetlands may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA. Based on the average of 0.003 acres of effect per MW, this would result in 30 acres of additional wetland effects within the TVA PSA. Cumulative effects to wetlands would be minimized and mitigated through proper siting of solar facilities, the use of BMPs, and adherence to mitigation requirements in applicable CWA Section 404 and 401 permits.

3.6.6.2.3.5 Transmission and Other Components

As noted in Table 3.3-1, transmission lines typically result in an average of 0.9 acres of wetland effects per mile of new line. Based on TVA’s evaluation, approximately 1.7 miles of new transmission line are needed for each solar facility, which indicates that approximately 1.5 acres of wetlands may be impacted for each facility. For 15 solar facilities, this totals to 23 acres of wetlands affected by news lines, or 26 acres for 17 BESS facilities. TVA would avoid placing structures within wetlands where practicable. The transmission line may require clearing of forested wetlands, which would result in permanent conversion of forested systems to emergent, maintained wetlands. Access across wetlands located in the ROW would be conducted in accordance with wetland BMPs to minimize soil compaction and ensure only temporary effects result (TVA 2022a). This includes use of low ground pressure equipment, wetland mats, and dry season work scheduling. Erosion and sediment control BMPs would be deployed and USACE and TDEC permits would be obtained, and necessary mitigation credits purchased. With the use of BMPs and adherence to all permit conditions, effects to wetlands would be minor.

Cumulative effects to wetlands may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA. Transmission lines associated with this expansion would likely result in wetland crossings and conversion of forested wetlands to maintained wetlands. Cumulative effects to wetlands would be minimized and mitigated through proper siting of transmission lines, the use of BMPs, and adherence to mitigation requirements in applicable CWA Section 404 and 401 permits.

3.7 Air Quality and Greenhouse Gases

[Preparer's Note: Just prior to submitting the DEIS for public review, new manufacturer's data became available regarding the Alternative A CC/CT emissions performance. In addition, this new data allows a conservative emission calculation for the CC duct burners to be revised. The results of these changes will lower criteria pollutant emissions so that all criteria pollutants will not be subject to Prevention of Significant Deterioration (PSD) permitting for Alternative A. However, this new information was not provided in time to incorporate into this draft EIS but it will be incorporated into the FEIS.]

Air pollution is defined as the presence in the outdoor atmosphere of one or more air contaminants in sufficient quantities and of such characteristics and duration as to be injurious to human, plant, or animal life, or to property, or which unreasonably interfere with the enjoyment of life and property [Rules of TDEC, Division of Air Pollution Control, Chapter 1200-03-02-.01(d)]. Air quality, as a resource, incorporates several components that describe the levels of overall air pollution within a region, sources of air emissions, and regulations governing air emissions. The National Ambient Air Quality Standards (NAAQS), state level ambient air quality standards, local ambient air quality, and the air quality requirements for stationary sources in the areas affected by the alternative actions are discussed further below.

The global climate system changes in time under the influence of its own internal dynamics and because of external forcings, such as volcanic eruptions, solar variations, orbital forcing, and human-generated (*i.e.*, anthropogenic) forcings, including the changing composition of the atmosphere and land-use change. Greenhouse gases (GHG) in the atmosphere[17], primarily CO_2, N_2O, methane (CH_4), and other fluorine-containing compounds, absorb heat that is radiated from the Earth's surface. Anthropogenic increases in atmospheric concentrations of GHGs are considered the main driver for warming of the Earth's atmosphere since the beginning of the industrial era by trapping more heat, resulting in what is referred to as global warming, which is one aspect of climate change. The majority of anthropogenic GHG emissions, primarily in the form of CO_2, result from the combustion of fossil fuels in both stationary sources (e.g., power plants, industrial facilities, boilers) and mobile sources (e.g., on-road and off-road motor vehicles and construction equipment, rail, and marine transportation). Additional anthropogenic sources of GHG emissions that contribute to climate change include methane and nitrous oxide from agricultural sources, hydrofluorocarbons used in refrigerant equipment, and sulfur hexafluoride used as a gaseous dielectric medium for high-voltage circuit breakers, switchgears, and other electrical equipment. There is the potential for minor leaks of hydrofluorocarbons and sulfur hexafluoride from equipment seal leaks, particularly from older equipment, as well as during manufacturing, installation, servicing, and disposal.

General TVA-wide information regarding GHG emissions and the climate conditions in the TVA region are described further below in the Affected Environment section. In addition, alternative specific GHG emissions are also described further below.

3.7.1 Affected Environment

3.7.1.1 Air Quality and Associated Laws/Regulations

The CAA of 1970, as amended in 1977 and 1990, is the comprehensive law that regulates emissions of air pollutants from stationary sources (such as power plants and industrial plants)

[17] *See* 42 U.S.C. §7545(o)(1)(G) (defining GHG to include carbon dioxide, hydrofluorocarbons, methane, nitrous oxide, perfluorocarbons, sulfur hexafluoride).

and mobile sources (such as motor vehicles, locomotives, and marine vessels). It requires USEPA to establish and update NAAQS for ubiquitous air pollutants and directs states to develop State Implementation Plans to achieve these standards. This is accomplished through air quality construction and operating permitting programs that establish emissions limits, installation of emissions control technologies, and work practice requirements applicable to various sources. The CAA also requires USEPA to set standards for emissions of specific hazardous air pollutants (HAPs).

While power plant air emissions disperse across county and state lines and contribute to effects in areas downwind, these long-distance effects from any one facility or set of facilities, such as those assessed in this document, are expected to be minimal because the largest impact of individual facility emissions typically occurs in the near field, i.e., at or just beyond a fence line, and lessens with increasing distance from the facility. This is especially the case for natural gas combustion plants vs. coal and oil-fired power plants as coal and oil generates much more particulate emissions. Under the mandates of the CAA, USEPA programs to reduce large-scale effects have included nationwide programs, including major source permitting requirements, New Source Performance Standards (NSPS), Acid Rain rules, Interstate Air Pollution Transport rules, several programs to reduce fleetwide emissions of on-road and nonroad engines, and other rules. Thus, for the proposed action and alternatives, the air quality study areas, including for cumulative impacts, are set at the county scale. The potential impact area for GHG emissions is effectively the global atmosphere. However, this EIS focuses its GHG emissions study area on the direct impacts from the locations where construction/demolition will occur under each alternative and the indirect impacts that include the entire TVA power generation system.

3.7.1.1.1 Ambient Air Quality Standards

Air quality is measured primarily by the concentrations of six criteria pollutants within a region. Those six criteria air pollutants are subject to NAAQS that were developed by the USEPA Office of Air Quality Planning and Standards and were chosen because they are the predominant air pollutants of concern for the environment and public health. The criteria pollutants are ozone (O_3), carbon monoxide (CO), nitrogen dioxide (NO_2), lead (Pb), sulfur dioxide (SO_2), and PM, which includes two subcategories: particles less than 10 microns in diameter (PM_{10}) and particles less than 2.5 microns in diameter ($PM_{2.5}$).[18] The NAAQS are summarized in Table 3.7-1. States and U.S. territories with delegated authority for regulating air quality have the option to impose stricter ambient air quality standards than the NAAQS. The Tennessee Ambient Air Quality Standards (TN AAQS) are included in Table 3.7-1 where they differ from the NAAQS.

USEPA designates compliance status for the NAAQS through a formal rulemaking process involving publication of proposed and final rules in the *Federal Register*. For each pollutant for which there is a NAAQS, USEPA designates an area as attainment, nonattainment, or maintenance. An attainment area meets the NAAQS. A nonattainment area does not meet the NAAQS but has a state implementation plan that establishes requirements to restrict emissions to achieve attainment status. A maintenance area (or maintenance/attainment area) is one that was designated as nonattainment within the prior 20 years and has come into attainment with the NAAQS. Part of the redesignation process requires that the state or local agency with responsibility for managing air quality in the area must submit for USEPA approval, a plan to

[18] Ozone is not directly emitted from the emissions sources in this Proposed Action, but it is formed in the lower atmosphere through photochemical reactions between direct emissions of nitrogen oxides (NO_X) and volatile organic compounds (VOCs) and sunlight.

maintain compliance with the NAAQS for which the area was in nonattainment status. After the 20-year maintenance period ends and compliance is still maintained, this area defaults to "normal" attainment area status. Strategies necessary to maintain compliance remain in place even after the 20-year period unless the delegated regulatory agency demonstrates to the USEPA that such measures are no longer needed.

Table 3.7-1. National and Tennessee Ambient Air Quality Standards

Pollutant	Averaging Times	Primary NAAQS and TN AAQS	Secondary NAAQS and TN AAQS
CO	8-hour [(a)]	9 ppm (10 mg/m^3)	None; TN – Same as Primary
	1-hour [(a)]	35 ppm (40 mg/m^3)[h]	None; TN – Same as Primary
Pb	Rolling 3-Month Average	0.15 µg/ m^3; TN - None	Same as Primary; TN - None
	Quarterly Average	1.5 µg/ m^3	Same as Primary
NO_2	Annual (Arithmetic Mean)	0.053 ppm (100 µg/m^3)	Same as Primary
	1-hour [(f)]	0.100 ppm (188 ug/m^3); TN - None	None
PM_{10}	24-hour [(b)]	150 µg/m^3	Same as Primary
	Annual (Arithmetic Mean)	None; TN – 50 µg/m^3	None; TN – Same as Primary
$PM_{2.5}$	Annual [(c)] (Arithmetic Mean)	12.0 µg/m^3; TN - None	15.0 µg/m^3; TN - None
	24-hour [(d)]	35 µg/m^3; TN - None	Same as Primary; TN - None
O_3	8-hour [(e)]	0.075 ppm (2008 std.)	Same as Primary
	8-hour [(e)]	0.070 ppm (2015 std.)	Same as Primary
	1-hour	None; TN – 0.12 ppm	None; TN – 0.12 ppm
SO_2	3-hour [(a)]	None	0.5 ppm (1300 µg/m^3)
	1-hour [(g)]	0.075 ppm (196 ug/m^3)	Same as Primary

Sources: 40 CFR part 50, USEPA 2021a; Chapter 1200-3-3-.03, https://publications.tnsosfiles.com/rules/1200/1200-03/1200-03.htm (TDEC 2021c).

[a] Not to be exceeded more than once per year.

[b] Not to be exceeded more than once per year on average over 3 years.

[c] To attain these standards, the 3-year average at any monitor must not exceed 12.0 micrograms per cubic meter (µg/m^3) for the primary standard and 15.0 µg/m^3 for the secondary standard.

[d] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m^3.

[e] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed the standard. While both the 2008 and 2015 standards are still in place, the 2015 standard is the controlling one, given its greater stringency.

[f] Standard is attained when the 3-year average of the annual eighth-highest daily maximum 1-hour average NO2 concentration does not exceed 0.100 parts per million (ppm) or 100 parts per billion.

[g] Standard is attained when the 3-year average of the fourth-highest daily maximum 1-hour average SO2 concentration does not exceed 0.075 ppm (196 parts per billion).

[h] mg/m3: milligrams per cubic meter

3.7.1.1.2 Hazardous Air Pollutants

Other air pollutants that have caused concern due to their harmful health and/or environmental effects and known or suspected potential for causing cancer include HAPs. The CAA identifies 187 pollutants as HAPs, some of which are emitted from power plants. The most notable HAPs regarding coal and oil-fired plants include heavy metals such as mercury, cadmium, lead, and arsenic, and hydrogen chloride, hydrogen fluoride, and various hydrocarbons. The emissions of most HAPs from coal-fired power plants are much greater than from natural gas-fired power plants, on a pound (lb) per million British Thermal Unit (lb/MMBtu) of fuel basis, due to higher concentrations of pollutant-forming compounds in coal.

The USEPA has singled-out mercury as a special pollutant of concern regarding oil and coal-fired power plants. In 2011, the USEPA promulgated the Mercury and Air Toxics Standards (MATS) [Title 40, CFR, Part 63, Subpart UUUUU] to reduce mercury and other toxic air pollutants from such plants. TVA mercury emissions have decreased 96 percent between 2000 and 2017 due to retirement of coal-fired units and replacement with natural-gas fired units and installation of emissions controls on most remaining units (e.g., flue gas desulfurization, selective catalytic reduction, and activated carbon injection systems).

The USEPA has also promulgated National Emissions Standard for Hazardous Air Pollutants (NESHAP) for Stationary Combustion Turbines under 40 CFR 63, Subpart YYYY, that are major sources of HAPs, defined as sources having the potential to emit 10 tons/year of any individual HAP or 25 tons/year or more of any combination of HAPs. These requirements include emissions limitations for formaldehyde and operational limitations including operating parameter limits; performance testing; operations and maintenance requirements; and recordkeeping and reporting requirements. Applicability of this rule will be determined during the air permitting process when more specific information on HAP emissions from the turbine manufacturer will be available.

Another NESHAP that applies to existing reciprocating internal combustion engines (RICE) at KIF and any proposed RICE under Alternative A is 40 CFR 63, Subpart ZZZZ. In general, this rule has operational requirements for maintaining RICE and tracking their operating run time. For new emergency RICE at a major HAP source or new emergency/non-emergency RICE at a non-major HAP source, additional requirements might include complying with the applicable RICE New Source Performance Standard described in the following section. For new non-emergency RICE at a major HAP source, additional requirements might include emissions controls to reduce formaldehyde or carbon monoxide emissions.

The TDEC has promulgated rules for hazardous air pollutant controls under rules of TDEC Chapter 1200-03-31. These rules, which generally mirror the federal rules for HAPs, require major sources of hazardous air pollutants to implement Maximum Achievable Control Technology and some sources may need to implement Generally Available Control Technology; each is implemented on a case-by-case determination that may include control equipment, work practice standards, emission standards, process modification, or raw materials substitution or reformulation, or both.

3.7.1.1.3 New Source Performance Standards (NSPS)

The USEPA has promulgated standards of performance for various emissions source categories with more significant emissions potential. These standards require new units to meet more stringent emissions limits and/or operational requirements than their older counterparts. The proposed CC/Aero CT Plant will be subject to 40 CFR 60, Subpart KKKK. This NSPS applies to stationary combustion turbines, both the combustion turbine engine and any associated heat recovery steam generator and duct burners, for units that commenced construction after February 18, 2005. The key pollutants USEPA regulates from these sources include NO_x and SO_2. The effects of this rule are discussed further in Section 3.7.2.

An NSPS for fossil fuel-fired electric utility steam generating units is outlined in 40 CFR Part 60, Subpart Da. Subpart Da covers fossil fuel-fired electric utility steam generating units that commenced construction after September 18, 1978,; and are boilers capable of combusting over 250 MMBtu/hr of fossil fuel. These include units that were also constructed for the purpose of supplying more than one-third of their potential electric output capacity and more than 25 MW electrical output to any utility power distribution system for sale. The key pollutants USEPA regulates from these sources include PM, NO_x, and SO_2. This rule does not apply to the proposed Aeroderivative CT units as they are not steam generating units. Subpart Da would not apply to the proposed CC units at KIF because Subpart Da states that an affected facility (unit) meeting the applicability criteria of 40 CFR 60, Subpart KKKK, must meet the emission standards under that rule instead. In addition, Subpart KKKK states that a heat recovery steam generator or duct burner subject to Subpart KKKK is exempt from Subpart Da.

While under the current federal Subpart Da, the CC units and any duct burners would be exempt from Subpart Da, the TDEC has a rule comparable to the old NSPS Subpart Da under TDEC Chapter 1200-03-16-.03 with emissions limits for these same three pollutants that would apply to the proposed CC plant. However, the newer federally applicable NSPS Subpart KKKK, or applicable Best Available Control Technology (BACT), will be as stringent or more stringent than the state limits under the older Subpart Da.

Another NSPS that applies to the proposed CC/Aero CT Plant is 40 CFR 60, Subpart TTTT. This 2015 final rule sets standards for GHG emissions from new (after January 8, 2014), modified, and reconstructed (after June 1, 2014) fossil fuel-fired power plants. For natural gas-fired CC plants (e.g., base load or intermediate load units), the rule has a CO_2 emissions limit of 1,000 lbs./MWh. For natural gas-fired Aeroderivative CTs (effectively peaking units), CO_2 emissions are limited to 120 pounds per Million British Thermal Units (lbs./MMBtu). To maintain compliance with the “lbs/MMBtu” limit, an Aeroderivative CT unit must adopt an annual generation restriction, which is based upon the unit’s thermal to electrical energy conversion efficiency. The effects of this rule are discussed further in Sections 3.7.2.3.1 and 3.7.2.4.1.

There are additional NSPS that apply to ancillary, less significant emission sources found at natural gas-fired CC and dual-fueled Aeroderivative CT power plants, such as those proposed at KIF. Ancillary sources may include auxiliary boilers and RICE (both the compression ignition type and spark ignition type). Auxiliary boilers with heat input ratings between 10-100 MMBtu/hr would be subject to the NSPS under 40 CFR 60, Subpart Dc. However, for units that are fired with only pipeline quality natural gas, no emissions standards would apply under Subpart Dc. Instead, such units would be subject to reporting and recordkeeping requirements.

The RICE at CC and Aeroderivative CT plants includes emergency generators, black start generators, or emergency fire pump engines. The compression ignition type is typically diesel fuel-fired and spark ignition type is natural gas- or gasoline fired-engines. The NSPS requirements that apply are dependent on various design characteristics of the engines, when construction of the engines commenced, and whether they are for emergency or non-emergency purposes. In general, these NSPS requirements require either purchasing a USEPA-certified engine that meets specific emissions standards or installing, configuring, operating, and maintaining the engine per the manufacturer’s instructions. The second option may require emissions performance testing.

3.7.1.1.4 Visibility Impairment and Regional Haze

Air pollution affects visibility which is of particular importance within national parks and wilderness areas when pollutants are converted into particulate matter or visible gases such as NO_2. The CAA designated national parks greater than 6,000 acres and wilderness areas greater than 5,000 acres as Class I protected areas to maintain their air quality. There are eight Class I areas in the counties that make-up the TVA service region: Great Smoky Mountains National Park, Mammoth Cave National Park and the Joyce Kilmer, Shining Rock, Linville Gorge, Cohutta, Sipsey, and Upper Buffalo Wilderness Areas. The Great Smoky Mountains National Park is the largest Class I area in the TVA region (TVA 2019b).

Visibility is affected by the ability of particles and gases to scatter and absorb light and is expressed in units of inverse mega-meters or deciviews. Visibility thresholds have been established under 40 CFR 51, Appendix Y that help determine whether modeled visibility effects from a source are large enough to require installation of BACT. These requirements, in addition to other regulatory programs, have resulted in significant progress towards attaining natural visibility conditions in the TVA region and nationwide.

The USEPA promulgated the Regional Haze Rule in 1999 to improve visibility in Class I protected areas with the goal to achieve natural background visibility by 2064. Significant visibility improvements have occurred from 1990 through 2016 within the Great Smoky Mountains, with between 44 and 47 percent improvement for best days and worst days, respectively (TVA 2019b).

Emissions of visibility impairing pollutants (e.g., ammonium sulfate from SO_2 emissions, ammonium nitrate from NOx emissions, and particulate emissions) are significantly greater from coal-fired power plants compared to natural gas-fired power plants. TVA's actions in retiring coal-fired power plants and in replacing them with options generating much lower emitting amounts of visibility impairing pollutants is contributing to visibility improvements in TVA's service territory.

3.7.1.1.5 Acid Deposition

Acid deposition is primarily caused by SO_2 and NO_x emissions, which are transformed into sulfate (SO_4) and nitrate (NO_3) aerosols, then deposited onto surface waters through precipitation (rain, snow, or fog). This precipitation can cause acidification of these surface waters, which can adversely affect aquatic life, especially within sensitive ecosystems.

In 1990, CAA Amendments established the Acid Rain Program with the goal to reduce SO_2 and NO_x emissions from the power sector and the resulting acid deposition. Since regulations were implemented in 1995, significant reductions in these and other pollutants have occurred along with significant reductions in sulfate and nitrate deposition in surface waters. TVA's SO_2 emissions in Tennessee have decreased by 97% since 1990 and its NO_x emissions in the state have decreased by 95% from a peak in 1997 (TVA 2019b). The retirement of TVA coal-fired power plants has contributed to reductions in acid deposition and is expected to continue to further reduce acid deposition in TVA's service territory. Emissions of SO_2 from natural gas-fired power plants are significantly less than from coal-fired power plants because natural gas has a much lower sulfur content. NO_x emissions from modern natural gas-fired combustion turbines have the ability to be controlled to lower levels than with coal combustion. Meeting the NSPS limitations and BACT, if applicable, for natural gas-fired combustion turbines and ancillary natural gas-fired emission units, will generally result in substantially lower plantwide NO_x emissions compared to a coal-fired facility of similar electric generating capacity.

3.7.1.1.6 General Conformity

The USEPA requires federal non-transportation projects to undergo an air quality conformity analysis to ensure federal actions conform to the state or federal Implementation Plans. These requirements were promulgated on November 30, 1993, under 40 CFR 51 and 93 and were updated effective March 24, 2010. These General Conformity requirements only apply to federal actions within nonattainment and maintenance areas.

Under Alternative A, actions at the Kingston Reservation are subject to General Conformity evaluation because the reservation is in an area designated in 2017 as a $PM_{2.5}$ maintenance area. The pollutant emissions subject to a General Conformity determination for the Kingston Reservation include not only directly emitted $PM_{2.5}$, but also the $PM_{2.5}$ precursor pollutants of SO_2, NO_x, VOC, and ammonia (NH_3). The applicable de minimis emissions threshold for direct $PM_{2.5}$ and precursor pollutants is 100 tons/year for each pollutant under 40 CFR 93, Subpart B. Any emissions increase over this threshold would require a General Conformity determination in consultation with state and federal air quality regulatory agencies. However, emission levels were below thresholds triggering a conformity analysis; refer to the Environmental Consequences section (3.7.2.3.1.2) for further General Conformity details.

Several of the proposed solar and battery storage installations under Alternative B could be in attainment areas; however, some of the counties in East Tennessee (e.g., Anderson, Blount, Cocke, Jefferson, Knox, Loudon, Roane, and Sevier) are $PM_{2.5}$ and/or Ozone maintenance areas and would be subject to the General Conformity rule.

3.7.1.1.7 Air Quality Permitting for Construction and Operation

TDEC implements programs for permitting the construction and operation of new or modified stationary sources of air emissions in Tennessee that emit regulated pollutants. The TDEC rules for construction and operating permits are contained within the TDEC Division of Air Pollution Control Rules, Chapter 1200-03-09. Depending on the type and size of the emissions units and levels of regulated pollutants emitted, TDEC determines the applicable emission standards and associated requirements for inclusion in the issued construction permit.

The air quality permitting process begins with the application for a construction permit. TDEC can issue four types of air quality construction permits for the construction and temporary operation of new or modified emissions sources that are potentially applicable to each proposed alternative (listed in order of highest complexity, stringency, and typical time to process):

- Prevention of Significant Deterioration (PSD) Permit (or PSD Permit Major Modification) in Attainment Area, Major Source permit.
- Owner Requested Limit (ORL) Permit (synthetic minor permit to voluntarily limit emissions below PSD permit triggers or operating permit triggers).
- Minor Source permit.
- Permit by Rule (applicability dependent on source type, size, and/or emissions from the source).

Issuance of the above construction permits by TDEC would establish federal and state air quality requirements applicable to each alternative. Meeting the construction permit requirements would ensure compliance with the State Implementation Plan and ambient air quality standards. It is likely that only the preferred alternative would require an air permit for construction of the source.

Title V of the CAA requires states to establish an air operating permit program for stationary sources that exceed major source thresholds, which are dependent on the attainment status of the area (e.g., 100 tons/year of any criteria pollutant in an attainment area). A Title V operating permit is also required for sources with potential to emit 10 tons/year of any individual HAP, or 25 tons/year of all HAPs combined. The requirements of Title V are outlined in the federal regulations in 40 CFR Part 70 and in the TDEC, Division of Air Pollution Control regulations within Section 1200-03-09-02. The permits required by these regulations are often referred to as Title V or Part 70 permits.

3.7.1.1.8 Greenhouse Gases and Climate

3.7.1.1.8.1 Greenhouse Gas Emissions

The Earth's temperature is dependent on the balance between the amount of energy incoming from the sun and the amount reflected and radiated into space by the Earth's surface, clouds, gases, and small particles in the atmosphere. The primary GHG of concern (i.e., CO_2) is naturally exchanged between the atmosphere, plants, and animals through photosynthesis, respiration, and decomposition, and between the atmosphere and oceans through gas exchange. Each year, billions of tons of CO_2 are absorbed by oceans and living biomass and emitted to the atmosphere through natural and human processes. GHGs in the atmosphere absorb heat that is radiated from the Earth's surface. An increase in the atmospheric concentration of GHGs results in the trapping of additional heat, causing the Earth to warm (TVA 2019b). Atmospheric levels of CO_2 have increased from below 300 ppm in 1900 to a global average of 412.5 ppm in 2020 (NOAA 2021), which is higher than scientists believe the Earth has experienced in over a million years. GHGs can remain in the atmosphere for differing periods of time, ranging from several years to thousands of years. Each GHG is assigned a global warming potential (GWP), which is an estimate of the relative amount of infrared radiation it absorbs in comparison to CO_2 on a pound-for-pound basis, projected over a 100-year-period. The main GHG pollutants that apply to TVA operations and their GWPs are CO_2 GWP = 1; CH_4 (methane) GWP = 25; N_2O (nitrous oxide) GWP = 298; and SF6 (sulfur hexafluoride) = 22,800 (40 CFR 98, Table A-1). For example, 1 pound of methane emissions is considered equivalent to 25 pounds of CO_2 emissions or CO_2-e.

Emissions of anthropogenic GHGs are estimated annually by the USEPA for the U.S. and each state for several sectors of the economy. In 2019, total CO_2 net emissions for the entire U.S. were approximately 5,769 million metric tons (MMT), with electricity production accounting for approximately 25% of this total (29% transportation, 23% industrial, and 23% commercial, residential, and agriculture) or approximately 1,442 MMT. In that same year, U.S. net emissions decreased 1.7% compared to 2018 (5,870 MMT in 2018) and decreased 13%% from 2005 (6,635 MMT in 2005) (USEPA 2021b). Emissions of CO_2 from TVA power plants decreased by 55% between 2005 and 2019, from 95.8 MMT to 43.1 MMT. This trend is mainly due to retirement of coal-fired plants and replacement with natural gas-fired plants, which have lower CO_2 emissions, and due to TVA's nuclear power generation fleet, which has no CO_2 emissions (TVA 2022d).

3.7.1.1.8.2 Climate Status and Projections

The climate in the TVA region is affected by a transition area between a humid continental climate to the north and a humid subtropical climate to the south. This results in temperatures that are generally mild with plenty of rainfall for agricultural and water uses. There is some vegetation-killing freezing from mid-autumn through early spring, occasional severe thunderstorms, infrequent snow, and infrequent effects from tropical storms. The seasonal climate changes cause a peak power demand in both the summer for cooling and winter for heating. Rainfall varies throughout the year but peaks in late winter/early spring and again in summer. Winds are strongest during winter and early spring and lightest between late summer and early autumn (TVA 2019b).

The TVA region, i.e., Tennessee area, average monthly temperature trends over a 30-year period from 1981 to 2010 show an overall warming trend of 0.4 to 0.5 degrees Fahrenheit per decade. The annual average trend for a 100(+)-year period from 1895 to 2015, based on least squares regression analysis, indicates a slight increase of 0.24 degrees Fahrenheit per 100 years with the annual average winter temperature increasing 0.67 degrees Fahrenheit per 100 years and the annual average summer temperature decreasing 0.09 degrees Fahrenheit per 100 years (TVA 2019b).

The TVA region precipitation trend over a 30-year period from 1981 to 2010 is not discernable as there is significant year-to-year variability. Annual average precipitation in the region was 49.92 inches, with monthly averages ranging between 2.6 inches in October to 4.73 inches in December, for this 30-year period. The annual average snowfall in most of the region is between 5 and 25 inches, with up to 100 inches in the higher elevations of the southern Appalachians in North Carolina and Tennessee. The average annual precipitation trend for the 100(+)-year period between 1895 and 2017 was an increase of 8% per 100 years, based on a linear regression analysis. The majority of this increase occurred prior to 1970 with no significant trend since that time (TVA 2019b).

Under a low GHG emissions increase scenario, i.e., large reductions in fossil fuel use and large increases in renewable energy use, forecasted climate trends from the Fourth National Climate Assessment published in 2018 by the U.S. Global Change Research Program (USGCRP) predict higher average annual temperatures in the southeastern U.S. by 3.4 degrees Fahrenheit in 2050 and 4.4 degrees Fahrenheit higher by late century. However, the report notes that the temperatures in the southeast over the last century have not increased as much as the climate model projections anticipated from increases in atmospheric GHG concentrations that have already occurred. Projections for changes in seasonal precipitation in the southeastern U.S. are generally within the range of natural variability, except for slightly greater winter precipitation predicted for much of the TVA region (TVA 2019b).

Potential climate change effects in general include more frequent and intense heat waves; increased damages from floods and major storm events; changes in precipitation patterns; damage from thawing permafrost and sea ice; reduced availability of freshwater during dry seasons; and harm to water resources, agriculture, wildlife, and ecosystems. TVA conducts routine probabilistic analyses to ensure resource adequacy for serving electricity demand in the Tennessee Valley service territory. It considers the uncertainty of unit availability, transmission capability, weather-dependent unit capabilities (e.g., hydro, wind and solar), economic growth, and weather variations to compute expected reliability impacts and costs. This informs reserve margin targets for summer and winter that target an industry best practice standard of one loss of load event (LOLE) in 10 years. These targets are used in planning and operation decisions. Climate shifts could influence operational decisions to generate more or less power in the cold and warm seasons, but such changes would not appreciably affect how efficiently the TVA-wide power system operates or result in system failures, over all alternatives (USGCRP 2018).

3.7.1.1.8.3 GHG and Climate Assessment Methodology

For purposes of climate assessment, the study area for this EIS is the counties where the proposed alternatives are located with respect to local climate conditions, and with respect to GHG emissions, the impact area is the global environment. The assessment of GHG emissions more specifically focuses on life cycle GHG emissions for each independent alternative (action and no action alternatives) and the entire TVA power plant system under each proposed alternative.

The GHG emissions were analyzed for this EIS using a geographic emissions comparison analysis, supplemented with two separate types of Life Cycle Analysis (LCA); individual and systemwide. TVA used the geographic emissions comparison analysis to assess the net change in predicted estimates of GHG emissions for each alternative as a percent of State of Tennessee, U.S., and global GHG emissions. These emission estimates are then contextualized by explaining how the proposed action alternatives would help advance climate goals of reducing GHG emissions by 70 percent by 2030 as set out in TVA's Strategic Intent and Guiding Principles document. The two LCAs were performed for facilities that are directly part of each alternative, including their potential upstream and downstream GHG sources.[19]

An LCA was done on both an individual replacement resource by alternative (henceforth "individual") and a TVA system-wide portfolio basis with simulated generation dispatch (henceforth "system-wide"). For the supplemental analyses, the system-wide LCA is important because implementation of each alternative has different impacts on the power generation mix throughout the TVA system. For example, Alternative A is estimated to indirectly reduce GHG emissions from other TVA coal plants as their load factors will likely decrease due to increased efficiency of the new Kingston CC/Aero CT Plant compared to the existing KIF coal plant.

The two LCAs also include the future estimated social costs of GHGs. The TVA system-wide LCA is focused on the estimated future GHG emissions and social costs for each proposed action in comparison to the No Action Alternative. The individual LCA provides the same comparison but focuses on estimated future total GHG emissions and social costs for the life cycle of each alternative without consideration of their effects on operation and dispatch of other TVA fleet facilities or resources. Lastly, future direct GHG operational emissions are also estimated and presented in terms of a comparison of existing GHG operational emissions to proposed direct GHG operational emissions at the specific sites under each alternative. The relative difference between estimated future direct GHG operational emissions for each alternative is compared to the No Action Alternative.[20]

The GHG geographic comparison analysis is provided in Section 3.7.2 and the TVA system-wide GHG LCA and the individual LCA for each alternative are summarized in Section 3.7.2 with more details provided in Appendix H and Appendix I. A description of the estimated future social costs of GHG (SC-GHG), uncertainty regarding their values and the range of values presented in this EIS, and a discussion of potential methane leak emissions is provided below.

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[19] Upstream GHG sources include resource extraction/production, processing/conversion, material manufacturing, component manufacturing, delivery to site, construction for plant components, and the fuel cycle including fuel extraction/processing/distribution/transport and coal bed methane. Downstream GHG sources include dismantling, decommissioning, disposal, and recycling of the power generation facility. GHG emissions for the Alternative A pipeline construction and pipeline operational methane leak emissions are not separately presented but they are accounted for in the emissions calculations for the upstream and ongoing non-combustion life cycle segments; refer to Appendix I for details on this LCA. Emissions associated with the proposed natural gas pipeline are discussed qualitatively in detail in Section 3.7.2.3.4 below.

[20] GHG and other pollutant emissions from construction activities would be temporary. Since the types, quantities, and activity levels of construction equipment are not known at this early stage, construction emissions are discussed in a qualitative manner. However, using general emission factors, they are quantitatively included in the LCA for each alternative.

The SC-GHG in this EIS collectively refers to the estimated future social cost of three main greenhouse gases: CO_2, CH_4, and N_2O. Each of these GHGs has a unique social cost rate in units of dollars per metric ton of emissions. The SC-GHG attempts to monetize the net cost to society associated with adding an estimated amount of these three GHG to the atmosphere in a given year. In principle, it includes the value of all climate change impacts (both negative and positive), including (but not limited to) changes in net agricultural productivity; human health effects; property damage from increased flood risk and natural disasters; disruption of energy systems; risk of conflict; environmental migration; and the value of ecosystem services. In practice, estimates of the SC-GHG are unable to include all of the important physical, ecological, and economic impacts of climate change due to data and climate modeling limitations, and at best provide a range of values based on educated assumptions and predictions.

While governmental and non-governmental stakeholders have an interest in the future costs and effects of carbon emissions resulting from decisions, there is uncertainty and disagreement surrounding the use of specific SC-GHG prices and associated escalation. Among the points of disagreement are the selected economic discount rate and whether it is based on domestic effects or, more broadly, global effects given that the effects of GHG emissions are not restricted to the area of their origin. Another factor related to their use in NEPA analyses is that SC-GHG does not measure the actual incremental environmental effects of a project-level proposed action, since the social costs were for broader regulatory cost-benefit analysis. Nonetheless, the SC-GHG analysis has been included to supplement the geographic comparison analysis since the SC-GHG analysis provides a rough means of comparing alternative actions by monetizing the potential environmental impacts of their estimated future GHG emissions.

Due to legal and other uncertainties regarding the propriety of social cost of SC-GHG rates, the SC-GHG supplemental analysis presented in this EIS provides an SC-GHG range based on federal government published SC-GHG documents (e.g., Interagency Working Group [IWG] figures or other federal government agency policy or Executive Orders). For example, there is a prior Administration 2020 social cost of CO_2 (SCC) rate of $7 per metric ton at a 3 percent discount rate that only addresses domestic effects, and a current Administration 2020 SCC rate of $51 per metric ton at a 3 percent discount rate that addresses global effects.[21] Presenting estimated future social costs as a range of values from successive Administrations provides decision-makers and the public with better information in an area fraught with uncertainty.[22] The social costs of methane (SCM) and nitrous oxide (SCN) are also provided in the LCAs based on their cost rates within the Biden Administration's Interagency Working Group interim guidance issued in February 2021 (IWG 2021). Under the prior Administration, social cost rates were also presented for SCM and SCN in a 2020 U.S. Government Accountability Office report: Social Cost of Carbon: Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO 2020).

The SC-GHG results for TVA system-wide effects essentially show that both action alternatives are relatively close regarding their overall potential GHG effects; therefore, due to the purpose

[21] The Biden Interagency Working Group (IWG) hasn't issued final SC-GHG rates since publishing the interim rates in 2021. In November 2022, the USEPA published proposed new SC-GHG rates that are significantly higher than the IWG 2021 interim rates.
[22] The 3 percent discount rate SC-GHG values under the prior Administration were used under the LCA for each alternative because no SCM or SCN values were available at the 7 percent discount rate.

and need of this EIS, the SC-GHG outcome was not determinative for the Preferred Alternative decision.

One of the GHGs mentioned above, methane, has been receiving more government and public attention due to the recent increase in the production and consumption of natural gas, the primary source of methane, and its high global warming potential. Methane emissions from leaks in the natural gas production and transport sectors are being addressed in the natural gas industry. The company that would be constructing the natural gas pipeline for Alternative A, Enbridge (owner of ETNG), has joined the USEPA Methane Challenge Program as a ONE Future Coalition commitment partner. Members in this program commit to methane reduction goals and providing transparency by reporting annual methane emissions reductions to the USEPA. Enbridge has voluntarily committed to voluntarily reduce methane emissions across each individual segment of the U.S. natural gas value chain to 1% or less of total produced natural gas by 2025. In addition, the overall ONE Future leak rate for all members in 2020 was less than 0.5 percent of total natural gas flow for its entire life cycle (USEPA 2022a; ONE Future 2021). Enbridge is also a member of the USEPA's Natural Gas STAR Program and the Environmental Partnership. The STAR Program provides a framework for partner companies to implement methane emissions reducing technologies and practices across operations and document voluntary emission reduction activities. The Environmental Partnership works to continuously improve the oil and natural gas industry's environmental performance through technically feasible and commercially proven solutions that will result in significant emissions reductions (INGAA 2021).

Based on analysis of USEPA data, the American Gas Association indicates that methane fugitive emissions across the entire natural gas supply chain (wellhead-transportation-storage-combustion) are typically around 1.0%, and leakage rates previously estimated by USEPA are around 1.4 percent (American Gas Association 2021). There are numerous ongoing industry and government efforts to further reduce methane leakage throughout the natural gas supply chain, resulting in a 16% reduction in total methane emissions from natural gas systems between 1990 and 2019, a period when gross natural gas withdrawals almost doubled (American Gas Association 2021).

3.7.1.1.8.4 Executive Orders Addressing GHG Emissions Reductions

President Biden issued EO 14008 on January 27, 2021, which sets forth a government-wide approach to address climate change.

President Biden issued EO 14057 on December 8, 2021, which establishes policies to reduce carbon emissions in the federal government sector as follows:

1. Use 100 percent carbon pollution-free electricity by 2030, at least half of which will be locally supplied clean energy to meet 24/7 demand.
2. 65 percent reduction in Scope 1 (emissions from agency-owned or controlled emission sources) and Scope 2 (emissions from agency purchase of electricity, steam, heat, and cooling) GHG emissions as defined by the Federal Greenhouse Gas Accounting and Reporting Guidance, from federal operations by 2030 (2008 baseline).
3. Net-zero emissions from federal procurement no later than 2050, including a Buy Clean policy to promote use of construction materials with lower embodied emissions, i.e., upstream emissions from production of a product.

4. A net-zero emissions building portfolio by 2045, including a 50 percent emissions reduction by 2032 (2008 baseline).
5. Most significantly, net-zero emissions from overall federal operations by 2050.

President Biden issued EO 14082 on September 12, 2022, to implement provisions from the Inflation Reduction Act. It reiterates the goal of reducing GHG emissions 50 to 52 percent by 2030 (2005 baseline), achieving a carbon pollution-free electricity sector by 2035, and achieving net-zero emissions by 2050. The EO further states that it shall be implemented consistent with applicable law and subject to the availability of appropriations.

All action alternatives significantly reduce system carbon intensity, compared to the No Action Alternative. The highly efficient advanced-class CC in Alternative A reduces system carbon emissions by offsetting coal generation and by improving the combined fuel efficiency of the entire TVA gas fleet. Solar facilities in Alternative B reduces system carbon emissions by offsetting coal and gas generation, and while existing fossil units increase generation for battery charging or when solar is not available, this Alternative has the lowest system carbon rate (see Appendix C, Appendix H, and Appendix I for details on the carbon rate analysis). Although Alternatives A and B would help achieve the Administration's goal of reducing emissions from overall federal operations, Alternative B likely would go further in achieving the goals outlined in EO 14057 and 14082, the targets agreed to in the Paris Agreement, and National net zero policy. The Alternatives Evaluation includes a carbon rate comparison and the LCA goes into more detail.

TVA remains committed to achieving the goals under these Executive Orders to the extent these goals can be achieved consistent with other statutory mandates applicable to TVA under the TVA Act and the Energy Policy Act of 1992, such as the requirements to provide power at rates as low as feasible and least-cost planning. GHG mitigation measures and their impacts are further discussed in the Environmental Consequences section of this EIS.

As described in the TVA Strategic Intent and Guiding Principles document (TVA 2021h), TVA has a plan for 70 percent TVA system-wide carbon reductions by 2030 (referenced to 2005 baseline), a path to approximately 80 percent carbon reductions by 2035, and aspires to net-zero carbon emissions by 2050. The entire TVA system has achieved 63 percent mass carbon emission reductions from 2005 to 2020.

3.7.1.2 Kingston Reservation

The Kingston Reservation is in Roane County, which is in an attainment area for all criteria pollutants (USEPA 2021c); however, a portion of the county that includes the Kingston Reservation is a maintenance area for PM2.5. Table 3.7-2 summarizes monitoring data for ozone and PM2.5 (USEPA 2021d), the only two criteria pollutants for which monitoring data are available for recent years within approximately 20 miles of Kingston. The monitoring site for ozone is located at the Freel's Bend Study Area, Melton Lake, Oak Ridge National Lab Reservation, approximately 16 miles northeast of Kingston. The monitoring site for PM2.5 is located at Harriman High School in Harriman, approximately three miles northwest of Kingston. The ambient monitoring data indicate compliance with the NAAQS based on three-year averages, which is the basis for USEPA attainment/nonattainment designations.

Table 3.7-2. Monitored Air Quality in Region of Kingston

Pollutant	Averaging Period	Monitored Design Concentrations [a]				
		Units	2016-2018	2017-2019	2018-2020	NAAQS
Ozone [b]	8-hour	ppm	0.064	0.064	0.061	**0.070**
PM2.5 [c]	24-hour	µg/m3	16	15	15	**35**
PM2.5 [c]	Annual	µg/m3	7.6	7.2	6.9	**12**

[a] The design concentration is the monitored (ranked or percentile basis) concentration that would be used to assess compliance with the NAAQS.
[b] Monitoring station in Anderson County, TN Ozone Maintenance Area (neighboring county), 2015 8-hour Ozone standard.
[c] Monitoring station in Knoxville-Sevierville-La Follette, TN PM-2.5 Maintenance Area (Roane County), 2006 24-hr standard.

Based on its potential to emit (PTE), the KIF currently operates under the conditions stipulated by Tennessee Air Pollution Control Board, (Title V) Operating Permit No. 572149. TVA submitted a Title V renewal application on July 2022; according to TDEC records at the time of this EIS the renewal is pending review. This permit includes applicable federal and state air quality requirements and addresses the following emission sources: nine coal-fired boilers; emergency diesel generator and black start diesel engine; limestone handling process; coal handling facility; dry fly ash handling process; gypsum dewatering and handling process; bottom ash dewatering plant; and a coal screening operation. In addition, air quality in Tennessee is protected by the suite of TDEC, Division of Air Pollution Control regulations within Chapter 1200-03.

3.7.1.3 Alternative A

3.7.1.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The proposed CC/Aero CT Plant, switchyard, and associated equipment would be located on the Kingston Reservation. The affected environment and existing conditions for air quality described above for the Kingston Reservation in Section 3.7.1.2 apply to this plant and switchyard on the Kingston Reservation.

3.7.1.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions for air quality described above for the Kingston Reservation in Section 3.7.1.2 apply to the proposed 3- to 4-MW solar facility location on the Kingston Reservation.

3.7.1.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions for air quality described above for the Kingston Reservation in Section 3.7.1.2 apply to the proposed 100-MW BESS on the Kingston Reservation.

3.7.1.3.4 On-site Transmission

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/ Aero

CT Plant and switchyard. The affected environment for on-site transmission upgrades to air quality is described in Section 3.7.1.2.

3.7.1.3.5 Off-site Transmission Upgrades

3.7.1.3.5.1 Eastern Transmission Corridors

As part of Alternative A, TVA would perform upgrades to existing off-site transmission lines, including replacement/reconducting of conductors or rebuilding of transmission lines and OPGW installation. Some of the L5108 and L5302 reconductoring or rebuilding efforts would also be performed on portions of the transmission lines that are located on the Kingston Reservation. All upgrade efforts for L5108 and 5302 would occur within Roane and Anderson counties. Both of these counties are in attainment with criteria pollutant ambient air quality standards. Air monitoring data in Roane and Anderson counties is discussed above under Section 3.7.1.2.

3.7.1.3.5.2 Western Transmission Corridor

As part of Alternative A, TVA would perform upgrades to off-site L5383, including reconductoring or rebuilding of transmission lines and OPGW installation. These upgrades would occur within Cumberland County. Cumberland County is in attainment with criteria pollutant ambient air quality standards. There are no USEPA or TDEC air monitoring network stations in Cumberland County.

3.7.1.3.6 Construction and Operation of a Natural Gas Pipeline

The proposed 122-mile ETNG Construction ROW would pass through Roane, Morgan, Fentress, Overton, Jackson, and Smith counties. The new pipeline would largely run within or adjacent to an existing natural gas pipeline ROW. Except for Roane County, all counties that would be transected are currently in attainment for all criteria pollutants, and only the Kingston Reservation portion of Roane County is in maintenance status for $PM_{2.5}$. There are no available air monitoring data for these other counties in the USEPA air monitoring database or the TDEC air monitoring network. Air monitoring data for Roane County is discussed above in Section 3.7.1.2.

3.7.1.4 Alternative B

3.7.1.4.1 East Tennessee TVA Power Service Area

Although locations of the proposed solar and storage facilities are not currently known, they would be within portions of East Tennessee. The East Tennessee counties are in attainment with the ambient air quality standards, except for a portion of Sullivan County, which is nonattainment for SO_2. However, it is assumed that solar facilities will not be installed in this nonattainment area. Should facilities be in Middle Tennessee counties, the facilities would be located in attainment areas. As stated previously, some counties in East Tennessee are maintenance areas for $PM_{2.5}$ and/or ozone; therefore, compliance with the General Conformity rule would be necessary for Alternative B facilities located in those counties.

3.7.2 Environmental Consequences

3.7.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate the KIF coal-fired power plant. USEPA regulated criteria pollutant emissions and HAP emissions from the continued operation of the plant would include emissions from the plant's boiler stacks, as well as associated emissions such as those from coal mining; handling and transportation activities; additive handling and transportation; and ash handling and disposal. Emissions rates from KIF would be expected to remain similar to current levels. For example, a recent 3-year average (2018-2020) for SO_2, NO_x, and PM_{10} emissions were 1,374+ tons/year, 1,038+ tons/year, and 328+

tons/year, respectively (see Table 3.7-3 or Appendix H for the KIF annual emissions). Pollutants such as sulfuric acid, hydrogen fluoride, and hydrogen chloride would continue to be emitted at recent levels (e.g., in 2015, sulfuric acid = 250 tons; hydrogen fluoride = 4.3 tons; and hydrochloric acid = 48.5 tons emissions) as compared to no or negligible emissions of these pollutants under the other alternatives. For the existing coal-fired units to remain operational, additional repairs and maintenance would be necessary to maintain reliability. The GHG emissions from the No Action Alternative would remain at levels comparable to current emissions, which are higher quantities than anticipated under Alternative A or B; 2018-2020 annual average of approximately 3.4 million tons of CO_2-e emissions. Additionally, estimated LCA GHG emissions for KIF under the No Action Alternative would be 105.2 million tons of CO_2-e emissions; see Appendix I for details on the LCA.

3.7.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Most buildings and structures at the KIF facility, approximately 1.6 million square feet in size, would be decontaminated (where needed) and demolished down to grade or just below grade level. The area would then be backfilled and provided with proper drainage. Temporary, direct air pollutant and GHG emissions would occur due to the generation of fugitive dust and use of vehicles and off-road equipment in the decontamination and demolition process; transportation of demolition debris and wastes to off-site recycling and disposal facilities; and movement and transportation of fill materials and landscaping materials to restore portions of disturbed land that will not be redeveloped. These activities and effects are expected to occur over a three-year period under all action alternatives.

Fugitive particulate matter emissions from demolition activities typically produce particles that are mainly deposited on the property where the demolition occurs. The potential drift distance of particles is governed by the initial injection height of the particle, the terminal settling velocity of the particle, and the degree of atmospheric turbulence. Theoretical drift distance, as a function of particle diameter and mean wind speed, has been computed by the USEPA for fugitive dust emissions. For a typical mean wind speed of 16 kilometers per hour (10 miles per hour), particles larger than about 100 micrometers (µm) are likely to settle out within 6 to 9 meters (20 to 30 feet) from the point of emission. Particles that are 30 to 100 µm in diameter are likely to settle within a few hundred feet from the point of emission. Smaller particles, particularly PM_{10} and $PM_{2.5}$, have slower gravitational settling velocities and are more likely to have their settling rate retarded by atmospheric turbulence and thus be transported off-site without dust control measures (USEPA 1995)[23]. Site preparation and vehicular traffic over paved and unpaved roads at the site would also result in the emission of fugitive dust particulates during active deconstruction or demolition debris removal. The largest fraction (greater than 95 percent by weight) of fugitive dust emissions would be deposited within the demolition site boundaries. The remaining fraction of the dust would be subject to transport beyond the property boundary without dust control measures.

Most of the immediate neighboring property around the KIF plant structures is either undeveloped, limited light industrial use, or part of the Clinch and Emory Rivers. The closest residence to the decontamination and deconstruction project area is located approximately 0.4 miles to the south. Considering the distance from the plant and control measures expected to be implemented, this location and more distant receptors would be subject to a minor impact from fugitive dust emissions generated during typical building demolition activities. This is because

[23] Although this USEPA reference does not provide an injection height for this case, it is estimated a typical or average injection height would be approximately 2 to 10 feet above grade.

these emissions would be temporary and of a minor magnitude. There would also be the potential for an intense, temporary release of fugitive dust associated with the removal of the stacks or other larger structures by dropping with explosives. Fugitive dust would be released in an uncontrolled manner and would likely be released within several minutes, after which these emissions would cease. Dropping the stacks or structures via explosives would likely produce the most particulate matter of any site activity, with the highest potential to travel off the demolition site. The distance the particulate matter could travel would be dependent on the height of the dust column generated from demolition, wind and weather conditions during demolition, and dust control measures implemented such as wetting the area before and during the demolition, among other measures.

To minimize potential fugitive dust mobilization associated with explosive demolition, the demolition contractor would be required, to the extent practical, to remove ash from the facilities proposed for deconstruction and demolition prior to removal of that facility and implement dust control measures during demolition to prevent the spread of dust, dirt, and debris. These methods may include wetting equipment and demolition areas, using misting cannons during the demolition, covering waste or debris piles, using covered containers to haul waste and debris, and wetting unpaved vehicle access routes during hauling. Wet suppression can reduce fugitive dust emissions from roadways and unpaved areas. TVA also requires on-site contractors to maintain engines and equipment in good working order (TVA 2021f).

Site preparation and vehicular traffic over paved and unpaved roads at the site would result in the emission of fugitive dust during active deconstruction, demolition debris removal, and restoration activities. The largest fraction of fugitive dust emissions would be deposited on-site within the demolition site boundaries. TVA and its contractors would comply with TDEC Air Pollution Control Rule 1200-3-8, which requires reasonable precautions to prevent particulates from becoming airborne. If necessary, emissions from open demolition areas and paved/unpaved roads could be mitigated by spraying water on the work areas and roadways to reduce fugitive dust emissions (TVA 2021f).

Combustion of gasoline and diesel fuels by internal combustion engines (vehicles, generators, demolition equipment, etc.) would generate local emissions of particulate matter, CO, NO_x, SO_2, volatile organic compounds (VOCs), and CO_2 during the site preparation, demolition, and restoration periods. However, new emission control technologies and fuel mixtures have significantly reduced vehicle and equipment emissions. These vehicles and equipment would comply with the USEPA mobile source regulations in 40 CFR Part 85 for on-road engines and 40 CFR Part 1039 for non-road engines. These regulations include requiring a maximum sulfur content in diesel fuel of 15 ppm. Additionally, it is expected that all vehicles would be properly maintained, which would also minimize emissions (TVA 2021f).

Demolition debris and any scrap metal would be transported to an off-site vendor, landfill, or recycling facility by truck. Transport of these materials would occur along existing roadways in the vicinity of KIF and would result in increased emissions for the duration of the deconstruction process. Mitigation measures, including implementing BMPs for controlling fugitive dust and proper maintenance of vehicles for controlling emissions, would help to minimize effects (TVA 2021f).

The use of vehicles and demolition equipment in the activities associated with this alternative, including off-site vehicle operations (such as debris disposal and workforce transportation), would result in a minor temporary increase in CO_2 emissions. There would also be a small risk of a release of pollutants and/or GHGs with hydrofluorocarbons or hydrochlorofluorocarbons associated with handling and removal of refrigeration and electrical equipment during decontamination and deconstruction activities. Routine capture and recycling procedures are followed for these gaseous materials, minimizing any release of these pollutants to the atmosphere. Additionally, such emission levels are expected to be de minimis in comparison to the total GHG emissions from each alternative and the regional and world-wide volumes of GHG emissions. As such, these decontamination and deconstruction activities are expected to have temporary, localized, and minor effects on air quality due to temporary minor increases in emissions and minor direct or indirect effect on regional climate change due to temporary increases in GHG emissions.

The effects from elimination of the KIF coal plant operational emissions are discussed below under Alternatives A and B.

Under both Action Alternatives, emissions of greenhouse gasses and fugitive dust would occur as a result of the deconstruction and construction activities. Similar emissions could be anticipated from the other projects in the area as a result of construction activities. The combined projects could cause cumulative minor, temporary effects to air quality in the area, which is discussed further in Section 3.4.2. Such effects would be mitigated through the use of BMPs, such as water suppression for dust control and regular inspections and maintenance of construction vehicles.

3.7.2.2.1 Environmental Justice Considerations

Effects to air quality that would occur because of the Kingston coal facility retirement and D4 activities are not anticipated to have environmental and human health effects on EJ populations because no residential populations are present on the Kingston Reservation. Moreover, the immediate Kingston Reservation vicinity, where fugitive dust emissions have some likelihood of becoming airborne, does not contain EJ populations. EJ and other populations utilizing areas near or on the Kingston Reservation may benefit from the permanent changes to local air quality from the proposed retirement of the existing KIF coal facilities.

3.7.2.3 Alternative A

3.7.2.3.1 Construction and Operation of CC/Aero CT Plant and Switchyard on the Kingston Reservation

Alternative A includes construction and operation of a 673 MW capacity natural gas CC plant, 80-MMBtu/hr natural gas auxiliary boiler, 1,064 MMBtu/hr duct burner, and an 848-MW capacity dual-fuel Aeroderivative CT plant on the Kingston Reservation. The main plant components include a CC combustion turbine with a duct burner and one HRSG, an auxiliary boiler, an air-cooling system, sixteen Aeroderivative combustion turbines, a diesel emergency fire water pump, and a black-start diesel emergency generator. Additionally, this alternative includes a 3- to 4-MW solar panel construction and 100-MW BESS for powering facilities on-site and potentially adding generation to the grid.

3.7.2.3.1.1 Construction Effects

Prior to construction of the CC/Aero CT Plant, an air quality construction permit would be applied for through the TDEC to allow construction and begin operations. The plant construction is expected to occur over 30 acres with an additional 10 to 20 acres used for equipment laydown and mobilization. Large equipment could be delivered by rail or barge with smaller items arriving by truck. Minor modifications to the current barge unloading facilities would consist of grading and creation of dirt/rock ramping to the nose of the barge. Emissions from material delivery and unloading by rail and barge would consist of fugitive dust and particulate matter, including CO, NO_x, SO_2, VOCs, and CO_2 emissions from combustion of fuels for material transport. These emissions are expected to be minor, and the rail and barge mobile sources would follow the applicable USEPA emissions standards for locomotive engines and marine diesel engines, respectively.

Construction of the CC/Aero CT Plant will include use of on-road construction vehicles/trucks and off-road construction equipment for transporting the smaller building/equipment materials to the Reservation and erecting the facilities. Limited land clearing, i.e., clearing and grubbing of trees, and grading activities would occur. Construction emissions are expected from gasoline and diesel fuel combustion within internal combustion engines for on-road vehicles/trucks and off-road equipment. These engines would generate local emissions of particulate matter, CO, NO_x, SO_2, VOCs, and CO_2, during their operation. New emission control technologies and fuel mixtures have significantly reduced vehicle and construction equipment emissions. These vehicles and equipment would comply with the USEPA mobile source regulations in 40 CFR Part 85 for on-road engines and 40 CFR Part 1039 for non-road engines. These regulations include requiring a maximum sulfur content in diesel fuel of 15 ppm. A maximum of 600 workers would be employed on-site during peak construction activity. Their commuting vehicle emissions would be minor compared to the other construction activity emissions.

Fugitive dust/particulate matter emissions would be generated during soil excavation and disturbance and truck traffic over paved and unpaved roads/areas. The largest fraction of fugitive dust emissions would be deposited in the immediate vicinity of the construction area. The smaller particulates would travel a little farther from the immediate construction area; however, those emissions are expected to be minor. The closest residence to the nearest location for the CC/Aero CT Plant construction area is located approximately 0.35 miles to the northeast across the Emory River. TVA and its contractors would comply with TDEC Air Pollution Control Rule 1200-3-8, which requires reasonable precautions to prevent PM from becoming airborne. In addition, dust control actions, including application of wetting agents or soil stabilization products on exposed soils and unpaved roads/travel areas, would be implemented to reduce fugitive dust/particulate emissions. Considering the distances from the proposed CC/Aero CT Plant construction activities, the residential receptors are unlikely to be largely impacted by fugitive dust emissions.

Overall, the CC/Aero CT Plant construction activities are expected to have temporary, localized, and minor adverse effects on air quality and no direct or indirect effect on regional climate change. Emissions will occur in an attainment/maintenance area where current ambient levels of criteria pollutants are below ambient air quality standards. Adverse impacts to these ambient levels due to construction activities are expected to be minor and temporary.

3.7.2.3.1.2 Operations Effects

The replacement of KIF coal-fired plant operations with natural gas-fired CC and dual-fuel Aeroderivative CT plant operations is expected to have permanent, moderate, beneficial effects on local air quality with respect to most criteria pollutants, i.e., SO_2, NO_x, PM_{10}, and $PM_{2.5}$. When operations begin in 2028, the decrease in SO_2, NO_x, PM_{10}, and $PM_{2.5}$ operational emissions at the KIF facility are estimated at approximately 1,365, 620, 225, and 163 tons/year compared to the 2018 to 2020 averaged emissions, respectively. There would also be elimination of hydrogen fluoride (4.3 tons/year compared to 2015 emissions) and hydrochloric acid mist emissions (48.5 tons/year compared to 2015 emissions) and reductions in mercury and lead emissions along with reductions in other HAP emissions. There are anticipated to be increases in annual emissions of CO (128.4 tons/year), VOCs (38.5 tons/year), and NH_3 (50.3) emissions. Refer to Table 3.7-3 for the net change in operational emissions for all calculated pollutants under Alternative A, and to Appendix H which provides the emissions calculations.

The impacts of the increases in VOC emissions would be addressed during the air permitting process for the new CC/Aero CT Plant to ensure ambient air quality standards and allowable incremental increases in pollutant concentrations would not be exceeded beyond the KIF property boundary. The air quality analysis conducted during this permitting process would determine if addressing these increases would require plant design changes (e.g., changes in stack parameters, addition of further emissions controls) or result in appropriate limitations being placed in the permit to maintain ambient air quality impacts below current standards and significant impact levels. The estimated increases in VOC and NH_3 emissions, as precursors to $PM_{2.5}$, do not individually exceed the General Conformity de minimis value of 100 tons/year. In addition, the USEPA did not consider VOC and NH_3 as significant precursor contributors to the $PM_{2.5}$ nonattainment area that includes Roane County (82 FR 24636). Therefore, VOC and NH_3 emissions would not need to be addressed for General Conformity purposes based on the definition of a “precursor of a criteria pollutant” in 40 CFR 93, Subpart B. The new CC/Aero CT Plant is potentially a HAP major source; however, that designation will ultimately depend on the emissions guarantees provided by the manufacturer during the air permitting process, when more specific information on HAP emissions from the turbine manufacturer will be available.

An air construction permit approval and compliance with its terms and conditions, in combination with compliance with other requirements, minimize the risk of large air quality effects. Depending on actual equipment sizes, manufacturer’s specifications for each major pollutant, and operational limitations that may be requested, the emissions may trigger a PSD permit modification for the new CC/Aero CT Plant. In that case, applicable BACT will be included in and implemented through permit conditions, where required by PSD requirements. Compliance with the PSD permit terms and conditions assures air quality impacts will not exceed the NAAQS. In the event that the facility is able to net out of PSD review based on emission reductions from the retiring coal plant, any such reductions would be made enforceable through applicable air permits and thereby ensure air quality is not adversely affected.

Roane County is approximately 58 kilometers, i.e. 36 miles, from a federal Class I protected area or national forest. However, the implementation of Alternative A is expected to result in a large overall reduction in combined emissions of the four Regional Haze/Visibility regulated pollutants: NOx, PM_{10}, SO_2, and sulfuric acid. This change is a beneficial impact to nearby Class I protected areas (USEPA 2021e). Therefore, no regional haze requirements or PSD Class I effects analyses would apply under the permitting for construction of the new CC plant (TVA 2021d).

With respect to climate change, the impacts of decreases in CO_2-e emissions regarding climate change are addressed further below under GHG Effects. Table 3.7-3 provides a comparison of estimated pollutant operational emissions for each alternative, both before and after implementation, and the net change in emissions. These emissions are based on projected average, annual, and lifetime electricity generation. Actual emissions could vary and at times be higher, but they would be accounted for during the construction air permitting process to ensure air quality ambient standards will be met.

Table 3.7-3. KIF Coal Retirement/Replacement EIS - Operational Air Emissions Comparisons - Only Direct Effects to TVA Facilities

Pollutant (Abbreviation)	No Action	Alternative A				Alternative B
	KIF 3-Year [2] Avg. Operational Emissions (tons/yr)	Proposed CC Plant Operational Emissions (tons/yr)	Proposed Aero CT Operational Emissions (tons/yr)	Total Kingston CC/Aero CT Plant Operational Emissions (tons/yr)	Net Change in Operational Emissions (tons/yr)	Net Change in Solar/Battery Storage Operational Emissions (tons/yr)
Particulate Matter/ Total Suspended Particulate - Filterable only (PM/TSP)	185.0	41.8	8.0	49.7	-135.3	-185.0
Total PM<10 microns - Filterable + Condensible (PM_{10})	328.7	73.6	29.4	103.1	-225.6	-328.7
Total PM<2.5 microns - Filterable + Condensible ($PM_{2.5}$)	266.3	73.6	29.4	103.1	-163.2	-266.3
Sulfur Dioxide (SO_2)	1,374.3	6.5	2.2	8.6	-1,365.6	-1,374.3
Nitrogen Oxides (Nox)	1,038.7	269.4	149.3	418.6	-620.1	-1,038.7
Carbon Monoxide (CO)	381.7	170.6	339.5	510.1	128.4	-381.7
Volatile Organic Compounds (VOC)	45.7	32.2	52.0	84.2	38.5	-45.7
Sulfuric Acid (H_2SO_4)	147.3	0.0	0.0	0.0	-147.3	-147.3
Ammonia (NH_3)	12.8	63.1	0.0	63.1	50.3	-12.8
Carbon Dioxide (CO_2)	3,386,666.7	1,294,181.3	441,803.6	1,735,984.9	-1,650,681.8	-3,386,666.7
Methane (CH_4)	34.5	83.1	31.7	114.7	80.2	-34.5
Nitrous Oxide (N_2O)	54.8	28.7	11.0	39.8	-15.0	-54.8–
CO_2 equivalent - GHGs (CO_2-e)	3,403,333.3	1,304,818.9	445,886.6	1,750,705.5	-1,652,627.8	-3,403,333.3
Mercury [(1)] (Hg)	8.0E-03	No Data	No Data	No Data	-8.0E-03	-8.0E-03
Lead [(1)] (Pb)	No Data	No Data	No Data	No Data	No Data	No Data

(1) = Additional hazardous air pollutants are emitted from fossil fuel combustion but in negligible quantities, except for hydrogen fluoride (HF) and hydrogen chloride (HCl) from coal combustion. HF and HCl emissions from coal burning would be eliminated with the switch to natural gas combustion turbines. Current lead emissions data is not available but based on historical data is expected to be insignificant. Mercury emissions data for proposed sources is not available but expected to be insignificant.
(2) = Three-year average of operational emissions at the existing Kingston Fossil Plant from 2018 to 2020.
NA = Not Applicable

The future predicted emissions presented above are from the TVA facilities under each alternative. These emissions calculations for the CCs/Aero CTs were based on the following:

- Expected operational limits similar to BACT established for other, comparable CC units and associated equipment. (e.g., those established and published under the USEPA Reasonably Available Control Technology]/BACT/Lowest Achievable Emission Rate Clearinghouse [RBLC] database).
- 40 CFR Part 75, App. D, 2.3.1.1.1, default SO_2 emission rate for firing pipeline natural gas (0.0006 lbs./MMBtu), which is prescribed by USEPA for SO_2 emissions.
- Predicted annual average capacity factor of 55 percent for the CC component based on USEIA CC industry average over the last 10 years from EIA website: [https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a]. Actual CC capacity factors for any given plant in any given year may vary between about 35 and about 90 percent depending on factors such as load growth, natural gas prices, composition of the balance of TVA's generating fleet in any given year, outages, or other unforeseen circumstances.
- Predicted annual average capacity factor of 10 percent for the Aero CTs based on USEIA CT industry average over the last 10 years from EIA website: [https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a]. Based on TVA's experience and industry knowledge, actual Aero CT capacity factors for any given plant in any given year may vary between about 1% and about 35 % depending on natural gas prices and operational factors.

Where the RBLC database was used, limits were averaged; detailed emissions calculations are provided in Appendix H.

Due to NSPS requirements, more specifically 40 CFR 60 Subparts KKKK and TTTT, the new CC would require emissions controls for NO_x and emissions limitations for SO_2 and CO_2. In addition, these rules would have emissions monitoring and/or performance testing requirements, fuel, and fuel sulfur monitoring requirements, as well as maintenance, recordkeeping, and reporting requirements. Reduction of NO_x from all CC and CT units would be achieved through dry low-NO_x and/or dry low-emissions combustion systems. These inherent systems collaterally control CO and VOC emissions. Additional NO_X control for all CC (excluding CC bypass stack) and CT units would be achieved via an SCR system located in the exhaust path. Co-located with the SCR system, an oxidation catalyst would be utilized to further reduce CO and VOC emissions. The exhaust stacks would be equipped with continuous emissions monitoring systems.

After the CC/Aero CT Plant begins operation, the existing Title V operating permit will require revisions to incorporate the new plant and associated air quality requirements and remove conditions regarding the existing coal-fired power plant.

Additional beneficial air quality effects from Alternative A include the following[24]:

- Elimination of mercury emissions by switching from coal to natural gas combustion.

[24] These air quality benefits would also be realized under Alternative B but only at the Kingston Reservation.

- Elimination of hydrogen chloride and hydrogen fluoride emissions by switching from coal to natural gas combustion.
- Reduction in acid precipitation deposition due to significant SO_2 and NO_x emissions reductions.
- Visibility impairment reductions due to significantly reduced PM_{10}, NO_x, and SO_2 emissions from coal combustion, handling, and transport.

3.7.2.3.1.3 GHG Effects from Direct Emissions

As shown in Table 3.7-3 above, the estimated change in each individual annual GHG emissions and their associated CO_2-e emissions change and total net CO_2-e operational annual emissions reduction at the KIF facility from implementation of Alternative A is estimated as follows:

- Reduction of 1,650,682 tons/year CO_2 and 15 tons/year N_2O and increase of 80 tons/year CH_4.
- Reduction of 4,470 tons/year CO_2-e from N_2O and increase of 2,000 tons/year CO_2-e from CH_4.
- Total net reduction of 1,652,628 tons/year CO_2-e from GHGs.

This CO_2-e net emissions reduction would be in the first full year after the CC/Aero CT Plant would begin operation (anticipated in 2028). Commercial operation is scheduled to begin June 2027 with final acceptance in December 2027; however, the highest annual CO_2-e emissions increases begin in 2028. Similar annual reductions in CO_2-e operational emissions relative to the No Action Alternative would be experienced from that point forward. The CO_2-e operational emissions decrease is in comparison to the 2018-2020 three-year average actual CO_2-e operational emissions at KIF. However, those actual levels are below historical levels because the KIF coal-fired units are aging and experiencing increasing maintenance issues that have not allowed them to operate at their full capacity. Additionally, a coal ash spill in 2008 resulted in reduced operational capacity from that point forward. Estimated operational CO_2 emissions in 2028 under Alternative A from generation at the Kingston site would be approximately 55 percent below 2018 CO_2 emissions and 84 percent below 2008 CO_2 emissions, exceeding the Biden Administration goal of 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline (TVA 2022d). These operational emissions reductions also advance TVA's climate goals of reducing GHG emissions 70% by 2030 as set out in TVA's Strategic Intent and Guiding Principles document.

For purposes of a general correlating measure of GHG effects, emissions of CO_2 from energy consumption are being used as that data is most readily available and consistent across state, U.S., and global data sources. Based on the most recent estimates of CO_2 emissions for the state of Tennessee by the USEIA, total emissions of CO_2 for the state in 2018[25] were 94.7 million metric tons (USEIA 2021). The most recent total U.S. CO_2 emissions due to energy consumption were 4,576.3 million metric tons from USEIA data for 2020. (USEIA 2022b). The most recent total global CO_2 emissions due to energy consumption were 31,500 million metric tons from USEIA data for 2020 (USEIA 2021). Therefore, the net near-term decrease in emissions of approximately 1.5 million metric tons of CO_2/year associated with implementation of Alternative A would represent decreases of approximately 1.6 percent of total statewide emissions in 2018, approximately 0.03 percent of the total U.S. emissions in 2020, and 0.005 percent of the total global GHG emissions for 2020 (see Appendix B for these calculations). As

[25] The most recent year for available statewide emissions data.

such, the operation of Alternative A would represent a moderate beneficial reduction in future estimated GHG emissions, particularly from Tennessee's contribution to GHG emissions reductions.

Using the Biden Administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated net annual social benefit of CO_2 operational emissions reductions from implementing Alternative A in 2028 would be $105,301,463 for direct CO_2 effects. Table 3.7-4 provides the Biden Administration's social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2028, when full year operations would begin. Using the prior Administration's 2019 SCC dollar per metric ton values, adjusted for inflation, the estimated annual social benefit of carbon emissions reductions from implementing Alternative A in 2028 would be $11,554,773 for direct CO_2 effects. Table 3.7-5 provides the prior Administration's social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2028, when full year operations would begin. For both scenarios, beyond 2028 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2020 and 2050.

Table 3.7-4. Estimated Net Social Benefit of CO_2 Operational Emissions Reductions for Alternatives A and B - Only Direct Effects to TVA Facilities (2028) – Current Administration SCC Values

GHG Pollutant	(Abbrev.)	Nominal SCC Rate ($/mt) (2028)	Nominal SCC Rate ($/ton) (2028)	SCC Benefit - Alternative A (2028, Dollars)	SCC Benefit - Alternative B (2028, Dollars)
Carbon Dioxide	CO_2	$ 70	$ 64	**$ (105,301,463)**	**$ (216,044,636)**

Notes: 2028 SCC is presented as this is the first full year that Alternatives A and B are planned to begin operation. 3% discount rate used as this is the central case set by the Interagency Working Group on the Social Cost of Greenhouse Gases in their 2021 Technical Support Document. Costs based on global impacts.

Social cost of Methane and Nitrous Oxide values are not presented because they are each insignificant, <1%, with regard to direct combustion emissions from all alternatives, when compared to the social cost of carbon, i.e., CO2. However, they are calculated and presented in the GHG Life Cycle Analysis.

$ = U.S. Dollars; mt = metric tons; SCC = Social Cost of Carbon

Table 3.7-5. Net Social Benefit of CO_2 Operational Emissions Reductions for Alternatives A and B - Only Direct Effects to TVA Facilities (2028) - Prior Administration SCC Values

GHG Pollutant	(Abbrev.)	Nominal SCC Rate ($/mt) (2028)	Nominal SCC Rate ($/ton) (2028)	SCC Benefit - Alternative A (2028, Dollars)	SCC Benefit - Alternative B (2028, Dollars)
Carbon Dioxide	CO_2	$ 8	$ 7	**$ (11,554,773)**	**$ (23,706,667)**

Notes: 2028 SCC is presented as this is the first full year that Alternatives A and B are planned to begin operation. 3% discount rate used. Costs based on U.S. impacts only.

Social cost of Methane and Nitrous Oxide values are not presented because they are each insignificant, <1%, with regard to direct combustion emissions from all alternatives, when compared to the social cost of carbon, i.e., CO2. However, they are calculated and presented in the GHG Life Cycle Analysis.

$ = U.S. Dollars; mt = metric tons; SCC = Social Cost of Carbon

The CC/Aero CT Plant would also be subject to annual GHG emissions reporting to the USEPA. The annual threshold for reporting emissions is 25,000 metric tons of GHGs according to the mandatory GHG reporting rules under 40 CFR 98.

3.7.2.3.1.4 GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses

Two GHG LCAs were conducted for estimating future direct and indirect GHG emissions and associated social costs from implementing Alternative A. More detailed methodology and results for these analyses is provided in Appendix I. The first LCA is on an individual replacement resource by alternative basis (henceforth “individual”) and the second is on a TVA system-wide portfolio basis with simulated system-wide generation dispatch. The Alternative A individual LCA is described below. The system-wide LCA for Alternative A is presented in Section 3.7.2.5 and provides the Alternative A LCA emissions and SC-GHG savings compared to the No Action Alternative. The Net Present Value (NPV) of these savings and their percent reduction compared to the No Action Alternative is also presented in Section 3.7.2.5.

Estimated emissions of the three main GHG pollutants, i.e., CO_2, CH_4, and N_2O, were calculated over the entire life cycle of Alternative A and broken down into four main life cycle segments: upstream; on-site ongoing combustion; ongoing non-combustion; and downstream. The activities under each segment are described in Appendix I. The operational life cycle of Alternative A was assumed to be 30 years based on current industry assumptions for typical expected operating life of a CC natural gas plant. The resulting estimated life cycle emissions of each of the three GHGs were used to calculate the estimated future social cost of each GHG individually and the total SC-GHG. In the same manner as for GHG Effects from Direct Emissions above, the SC-GHGs were calculated using a range of SC-GHG values.

In summary, the Alternative A estimated LCA emissions of each GHG and their corresponding estimated future social costs are provided in Table 3.7-6 and Table 3.7-7. Table 3.7-6 provides the results using the Biden Administration social cost values and Table 3.7-7 provides the results using the prior Administration social cost values. Both tables also provide an NPV of the total life cycle SC-GHG for Alternative A. It is important to understand that this LCA is for the individual assets being added under each alternative and does not account for power mix changes that would occur elsewhere in the rest of the TVA system. Therefore, it only provides a portion of the TVA system wide estimated future GHG emissions that would occur under each alternative.

In comparison to Alternative B, Alternative A has a higher estimated CO_2-e life cycle emissions and associated estimated future social costs in nominal dollars. In comparison to the No Action Alternative, Alternative A has a 41 percent decrease in life cycle CO_2-e emissions and 40 percent decrease in associated estimated future social costs in nominal dollars. The total estimated life cycle SC-GHG for each alternative under Biden Administration values are: $11.8 billion – No Action Alternative; $7 billion – Alternative A; and $1.05 billion – Alternative B. The total estimated life cycle GHG social costs for each alternative under prior Administration values are: $937.5 million – No Action Alternative; $558.6 million – Alternative A; and $88.9 million – Alternative B.

Table 3.7-6. Alternative A – Estimated Life Cycle GHG Emissions and Associated Social Costs (Current Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2023 $
60,724,860	54,062	1,193	62,432,058	$6,773,028,810	$212,210,037	$51,022,839	$7,036,261,686	$1,877,487,931

Note:
NPV = Net Present Value

Table 3.7-7. Alternative A – Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2021 $
60,724,860	54,062	1,193	62,432,058	$540,017,746	$15,428,593	$3,165,867	$558,612,205	$162,861,159

Note:
NPV = Net Present Value

Carbon capture and hydrogen fuel blending technologies are not currently available to incorporate in the current plant design because these technologies have not been demonstrated at the scale necessary for utilization in the proposed CC/Aero CT Plant under Alternative A. Additionally, there is currently a lack of available storage for carbon capture and lack of available hydrogen at the scale needed to be efficient. Lastly, the instability of karst geology under the KIF property may make CCS on-site infeasible. If Alternative A is selected, TVA will ensure that the proposed plant design enables and accommodates future modifications necessary for incorporating CCS and will obtain combustion equipment that can utilize hydrogen fuel blending (at least 30 percent hydrogen) as these technologies mature. TVA anticipates the efficiency, effectiveness, scalability, and economics of these systems will improve in the future, allowing for incorporation of one or more of these technologies when adequate storage locations or pipelines or another technology for CCS are identified to implement CCS and/or the delivery of hydrogen. Additional equipment could be incorporated into the former coal plant reservation after those areas are closed and remediated. Subsequent TVA IRPs would evaluate these developments and consider opportunities to incorporate them into TVA's existing system. If a viable option is identified in the future, TVA would conduct additional analyses to determine proposed pipeline routes, costs, storage requirements, or other needs with hydrogen fuel incorporation. Assuming incorporation of CCS and hydrogen fuel blending, the reduction in CO_2 emissions could be well over 90 percent. There would be an approximate similar reduction percent in SC-GHG at the time of implementation of the GHG mitigation. Typical current estimates of CCS reduction efficiency that may be achieved in the future are at 90 percent (Massachusetts Institute of Technology [MIT] 2021). The GHG reduction from hydrogen fuel blending would depend on the percent of hydrogen fuel used and the method of producing the hydrogen. Note that burning hydrogen instead of natural gas may cause an increase in Nox emissions compared to just using natural gas.

Overall, Alternative A would provide a moderate, permanent, beneficial impact regarding GHG direct and indirect emissions in comparison to the No Action Alternative. If Alternative A were to include CCS and/or hydrogen fuel at a future date, that benefit could be further increased to a large level.

3.7.2.3.1.5 Climate Change Effects on Alternative A

The main impacts of climate change are flooding from increased precipitation and the increase in sea level due to the melting of ice resulting from increases in global temperatures. Impacts from climate change, including increases in ambient temperatures, would negatively affect combustion turbine efficiency; although the efficiency drop is estimated at 0.06 percent per degree Celsius rise above 15 degrees Celsius, or 59 degrees Fahrenheit. This could slightly increase the turbine emissions, but that increase is expected to be negligible (approximate 0.09 percent emissions increase) assuming climate change results in an overall 1.5-degree Celsius rise by 2050 (Fernandez et al. 2021). These potential increases in temperature as a result of human induced climate change and the consequential effects on Alternative A would result in a smaller net reduction in GHG emissions effects (approximately 1,487 tons/year more of CO_2e emissions) which is negligible compared to the 1.65 million tons/year of net CO_2e reductions compared to the No Action Alternative. Alternative B does not utilize turbines; therefore, this aspect of climate warming would have no effect on Alternative B.

Approximately one-third of the available area where the new CC/Aero CT Plant will reside is within a 100-year flood plain; however, the CC/Aero CT Plant infrastructure will be located outside of the 100-year floodplain, where possible. Otherwise, flood damageable facilities will be constructed above the 100-year floodplain elevation. The natural gas pipeline under Alternative A crosses the 100-year floodplain of several streams; however, operational effects due to flooding are not expected to be large as the pipeline is buried along its length. The transmission line and component upgrades would cross areas within the 100-year floodplain but conducting wires would be well above floodplain levels and other structures would be built above floodplain levels, where feasible, or other mitigation would be implemented. Operational effects on transmission lines and their components due to flooding are not expected to be large.

Extended drought conditions, should they occur, would not be expected to influence the physical infrastructure or operations under Alternative A. The proposed CC/Aero CT Plant will be air-cooled, thus reducing the need for large volumes of water for cooling and minimizing the risk to operations from drought conditions. However, the plant’s location adjacent to the Emory and Clinch rivers is expected to provide adequate water resources should they be needed, even during most expected drought conditions. TVA has developed a Climate Action Adaptation and Resiliency Plan to identify risks associated with and plan for climate change effects (TVA 2021i).).

3.7.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed solar facility construction on Kingston Reservation would generate fugitive dust, particulate emissions, and combustion emissions from fossil fuel burning in construction equipment. These emissions are expected to be temporary, localized, and have very minor effects on air quality and no direct or indirect effect on regional climate change. The operation of the solar facility is not expected to produce any emissions. The use of this solar facility to power on-site equipment is expected to have a minor benefit of reducing the TVA system wide GHG emissions, as less power generated from the CC/Aero CT Plant would need to be used to power on-site equipment and would be additional power provided instead to the grid.

3.7.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed BESS construction on Kingston Reservation would generate fugitive dust, particulate emissions, and combustion emissions from fossil fuel burning in construction equipment. However, the use of on-site heavy construction equipment for this construction is limited as much of the battery storage units only require assembly and electrical connections once delivered on-site. The construction emissions are expected to be temporary, localized, and have very minor effects on air quality and no direct or indirect effect on regional climate change. The operation of the BESS is not expected to produce any direct emissions. There would be some indirect emissions from power generated on the grid to charge these batteries; however, those emissions are accounted for in the LCAs described later in the Environmental Consequences section.

3.7.2.3.4 On-site Transmission

The paragraphs below apply to all three transmission lines and access roads (L5302, L5108, and L5383) that are part of Alternative A.

Alternative A includes construction activities to connect existing electrical transmission lines to the proposed CC/Aero CT Plant and to upgrade certain on-site and off-site transmission line equipment to accommodate the new plant. The affected area on the Kingston Reservation includes rerouting existing 161-kV transmission lines and re-terminating them into a new 161-kV substation. These activities would generate temporary and minor amounts of fugitive dust from vehicular and equipment travel over paved and unpaved roads. In addition, temporary and minor helicopter and fugitive dust emissions would occur to install the OPGW.

3.7.2.3.5 Off-site Transmission

The paragraphs below apply to all three transmission lines and access roads (L5302, L5108, and L5383) that are part of Alternative A.

Under Alternative A, TVA would make improvements to existing transmission lines located within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant facilities and switchyard. The off-site affected area consists of approximately 40 miles of transmission line upgrades, reconductoring, or installation of new OPGW along an existing 161-kV transmission line. This includes construction and clearing along unpaved roads to access certain locations for these upgrades. These activities would occur on and adjacent to the Kingston Reservation and in other parts of Anderson, Roane, and Cumberland counties. These activities would generate temporary and minor amounts of fugitive dust from vehicular and equipment travel over paved and unpaved roads. In addition, temporary and minor helicopter and fugitive dust emissions would occur to install the OPGW.

TDEC Air Pollution Control Rule 1200-3-8, which requires reasonable precautions to prevent particulate matter from becoming airborne, would apply to minimize fugitive emissions. Fugitive dust control actions would be implemented, including application of wetting agents or soil stabilization products on exposed soils and unpaved roads/travel areas.

Highway vehicles, off-road mobile equipment, and helicopters would generate minor amounts of combustion emissions, including particulate matter, CO, NO_x, SO_2, VOCs, and CO_2 from diesel, gasoline, and aviation fuel for internal combustion and turbine engines. New emission control technologies and fuel mixtures have significantly reduced vehicle and construction equipment emissions. These vehicles and equipment would comply with the USEPA mobile source regulations in 40 CFR Part 85 for on-road engines and 40 CFR Part 1039 for non-road engines. These regulations include requiring a maximum sulfur content in diesel fuel of 15 ppm. Additionally, it is expected that all vehicles would be properly maintained, which would also minimize emissions. Helicopters would comply with applicable aircraft or rotary-wing engine emissions standards.

There are typically no operational emissions from the transmission lines and associated electrical equipment. If any electrical equipment contains the GHG sulfur hexafluoride gas (e.g., electrical switchgear, circuit breakers), there is the potential for minor leaks, mostly associated with maintenance or long-term equipment degradation. Through routine preventative maintenance programs, leaking equipment would be identified and remedied or replaced. In addition, due to newer equipment, more efficient operation and maintenance techniques, and leak detection, these features would minimize sulfur hexafluoride emissions.

Overall, these transmission line construction and upgrade activities are expected to have temporary, minor effects on air quality due to temporary increased emissions and no direct or indirect effect on regional or global climate change. The operation of the transmission lines and associated equipment is expected to have permanent, minor effects on air quality due to temporary increased emissions and no direct or indirect effect on regional or global climate change.

3.7.2.3.6 Construction and Operation of Natural Gas Pipeline

Under Alternative A, this Proposed Action component includes construction and operation of approximately 122 miles of new natural gas pipeline and gas system infrastructure to supply fuel for the CC/Aero CT Plant. Natural gas compression is anticipated to be needed along the pipeline route; however, these compressors will be electric driven. There will be heaters installed at various stations along the route; however, it is expected they will be small electric or natural gas-fired and their emissions, if any, would be minor and well below air permitting thresholds. Compression at the CC plant site will be needed but it will use electric-driven motors. Any fugitive emission releases of natural gas and its constituents (mainly methane and CO_2) from the pipeline and from compression during operations are expected to be minor compared to CO_2-e emissions from natural gas combustion.

According to ETNG's Resource Report 9 (ETNG 2022j):

> Construction activities will result in emissions of fugitive dust from vehicular traffic, soil disturbance, and emissions from diesel- and gasoline-fired construction equipment. However, these air quality effects will be temporary and localized and are not expected to independently cause or largely contribute to an emission level that results in a violation of NAAQS. Large earth-moving equipment and other mobile sources are sources of combustion-related emissions, including criteria pollutants (i.e., Nox, CO, VOC, SO_2, and PM_{10}) and small amounts of HAPs. Air pollutants from the construction equipment will be limited to the immediate vicinity of the construction area and will be temporary.
>
> […]
>
> Specific data regarding the construction fugitive emissions is under development and will be provided with the final Resource Report 9 included in the Project Application. Details of the construction-related air pollutant emission calculations for the [pipeline] will be provided in the final Resource Report 9.
>
> Fugitive dust will result from equipment operations in construction areas and vehicle traffic on paved and unpaved roads and from storage piles. The amount of dust generated will be a function of construction activity, soil type, soil moisture content, wind speed, precipitation, vehicle traffic, vehicle types, and road surface characteristics. Emissions will be greater during dry periods and in areas where fine-textured soils are subject to surface activity. [ETNG] will employ proven construction-related practices to control fugitive dust, such as application of commercially available dust control agents on unpaved areas subject to frequent vehicle traffic as necessary. Additional measures that may be implemented include imposing a vehicle speed restriction on unpaved roads, routing vehicles and equipment to paved surfaces to the extent practicable and using gravel tracking pads at egress points to remove dirt from tires and tracks. Further, construction equipment will be operated only on an as-needed basis.
>
> Air emissions associated with construction of the [pipeline] will include emissions from fossil-fueled equipment. Air quality impacts from the [pipeline] construction will generally be temporary, localized, and insubstantial. Earth-moving equipment and other mobile sources may be powered by diesel or gasoline engines and are sources of combustion-related emissions including NOX, CO, VOC, SO2, PM10, PM2.5, greenhouse gas (GHG), and small quantities of HAPs. Air emissions from construction equipment will be limited to the immediate vicinity of the construction area and will be temporary ….
>
> Construction-related emission estimates are based on typical diesel-fueled construction equipment, hours of operation, and vehicle miles traveled by the supporting vehicles for each [pipeline] component. Worker commutes were assumed to originate in the nearest cities from which a workforce could be raised. The round-trip distance to and from the [pipeline] area was considered in emission calculations. The data presented in this

Resource Report is a conservative estimate, based on worst-case assumptions and [USEPA] national average MOVES3 emission factors for the year 2024 that were assumed to be representative of on-road emissions. The estimated air emissions from construction will be transient in nature with negligible impact on regional air quality.

The [pipeline] will include construction of a new electric motor driven compressor station, which will also include natural gas-fired emergency turbines. Operational emissions are expected to occur from natural gas combustion from the emergency dual-fuel turbines (to be used only when the electric-driven motor or power to supply it are unavailable), fugitives, venting, and operation of the emergency natural gas fired engine. Once the compressor station design is complete, [ETNG] will calculate operational emissions to determine compliance with emissions standards.

Air quality impacts from operation of the [pipeline and associated components] will be minimized by the use of equipment, emissions controls, and operating practices that meet or exceed [BMPS]. Measures to minimize air quality impacts include the use of an electric-driven motor for routine compressor station operations, and may include the use of the following emissions control technologies and operational and maintenance activities:

- Use of electrohydraulic and air-pneumatic valve actuators instead of gas-hydraulic actuators eliminates natural gas venting to atmosphere from working actuators.
- Addition of seal gas vent recompression and reinjection to the piping recovers natural gas that would otherwise be vented to the atmosphere.
- Addition of process vent recompression and reinjection to the piping enables the Project to reduce natural gas inventory in the compressor and connected piping prior to blowing down the unit for maintenance and other service, reducing the volume of natural gas vented to the atmosphere during maintenance blowdowns.
- Incorporation of a seal gas booster compressor enables the compressor station to maintain a pressurized hold during compressor outages, reducing the frequency of compressor unit blowdowns.

Compliance with federal and state air regulations and state permit requirements will ensure that air quality impacts will be minimized during operation of the [pipeline] facilities (ETNG 2022j).

Overall, the pipeline construction activities are expected to have temporary, localized, and minor effects on air quality and no direct or indirect effect on regional climate change. Emissions will occur in attainment areas across the entire 122-mile-long pipeline where current ambient levels of criteria pollutants are below ambient air quality standards and not expected to appreciably change due to construction and operations activities. The pipeline will traverse Roane County which is a maintenance area for $PM_{2.5}$; however, the impact to ambient air quality levels due to construction activities are expected to be minor, temporary, and localized. There is no expected impact to ambient air quality levels due to normal pipeline operations.

TVA has independently reviewed and concurs with the air-quality-related findings in ETNG's Resource Report 9 (ETNG 2022j).

3.7.2.3.7 Summary of Alternative A

TVA Actions

The construction and operation of the CC/Aero CT Plant for Alternative A is expected to have temporary, localized, and minor effects on air quality and temporary, regional, and minor effects from GHG emissions on climate change. With the decommissioning and demolition of the KIF coal-fired plant, the operation of the CC/Aero CT Plant is expected to have permanent, moderate, beneficial effects on local air quality and reductions in future regional GHG emissions are expected to have permanent, minor, beneficial effects on climate change in comparison to the No Action Alternative. The transmission line construction and upgrade activities are expected to have temporary, minor effects on air quality and no direct or indirect effect on regional climate change.

For Alternative A, the social cost benefit from CO2 operational emissions reductions is estimated to be between $11.5 million and $105 million dollars the first year of operation, in nominal dollars, and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative A life cycle social costs of GHG emissions ranges from approximately $559 million to $7 billion in nominal dollars. These values equate to between approximately $163 million and $1.9 billion in NPV to 2023 dollars.

On a TVA system-wide basis, the estimated total Alternative A life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $373 million to $4.1 billion in nominal dollars. These savings/benefit values equate to between approximately $164 million and $1.7 billion in NPV to 2023 dollars. In comparison to Alternative B, Alternative A has a higher estimated GHG life cycle emissions and associated estimated future social costs. However, other considerations, such as the need for firm, dispatchable power and the need to have this power in place by 2027, would still lead TVA to identify Alternative A as the preferred alternative.

In addition, the design of Alternative A is such that future implementation of carbon capture and storage and of hydrogen fuel blending, as these technologies become viable, could result in further significant GHG emissions reductions. Alternative A would help achieve TVA's goal of reducing GHG emissions by 70 percent by 2030 as set out in TVA’s Strategic Intent and Guiding Principles document.

Lastly, the GHG geographic emissions comparison analysis for Alternative A results in a 1.58 percent reduction in Tennessee CO_2 emissions, 0.03 percent reduction in U.S. CO_2 emissions, and 0.005 percent reduction in global CO_2 emissions. These reductions are 1.66 percent less, 0.03 percent less, and 0.005 percent less than Tennessee, U.S., and global reductions, respectively, resulting from Alternative B.

ETNG Actions - Natural Gas Pipeline and Associated Structures

The construction of the new natural gas pipeline and associated infrastructure would have temporary, localized, and minor effects on air quality.

Operation of the pipeline system and associated Hartsville Compressor Station would include construction of a new electric motor driven compressor station, which will also include natural gas-fired emergency turbines. Operational emissions are expected to occur from natural gas combustion from the emergency dual-fuel turbines (to be used only when the electric-driven motor or power to supply it are unavailable), fugitives, venting, and operation of the emergency natural gas fired engine. Since the electric motor driven compressors would be utilized during daily operation, project-specific emissions would be limited. Therefore, operational impacts to air quality would be long term but minor and periodic in nature.

3.7.2.3.8 Environmental Justice Considerations

TVA Actions

Effects to air quality that would occur because of the proposed CC/Aero CT Plant and transmission line activities would be minimized through permitting and monitoring, as described above. Moreover, these would be generally limited to the immediate Kingston vicinity, where fugitive dust and particulate emissions have some but low likelihood of becoming air borne and no EJ populations are present.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Effects to air quality that would occur because of the proposed natural gas pipeline would also be minimized through permitting and monitoring. The immediate ETNG Construction ROW vicinity, where fugitive dust and particulate emissions have some, but low likelihood of becoming air borne, may result in negligible and widely distributed impacts, though the effects may be amplified for certain EJ populations already experiencing cumulative air quality effects. Although TVA has assessed these impacts to be minor and temporary, with potentially amplified effects to identified EJ populations, ETNG is still evaluating effects of its proposed project, and TVA may update its conclusions in TVA's final EIS based on ETNG's findings.

3.7.2.4 Alternative B

3.7.2.4.1 Construction and Operations of Solar and Energy Storage

Alternative B includes construction and operation of 1,500 MW of solar and 12,700 MW of four-hour battery storage capacity at multiple locations within portions of the East Tennessee region. This would be expected to utilize an average of 7.3 acres per MW of solar capacity based on previous solar construction projects summarized in Table 3.2-1, for a total of 10,950 acres. The solar facilities include ground-mounted photovoltaic panels. The BESS facilities would consist of placing modular battery system containers, power inverters, transformers, and switchgear over concrete slabs. The battery containers are of steel construction, equipped with lithium-ion battery cells contacted together and placed in racks. They would contain an auxiliary system, HVAC system, fire protection system, auxiliary distribution board, and a lighting arrangement. The storage facilities would utilize about 15 acres per 40 MW based on TVA pilot projects, which would result in about 638 acres for 2,2700 MW of four-hour battery storage capacity.

3.7.2.4.1.1 Construction Effects

Construction of the solar and storage facilities will include use of on-road construction vehicles/trucks and off-road construction equipment for transporting the solar panels, battery modules, electrical transmission lines, concrete, and supporting mechanical and electrical infrastructure to the construction areas and erecting the facilities. Limited land clearing and grading activities would occur as construction is expected on cropland or heavily disturbed land, where the amount of clearing and grading required to prepare the site is low relative to other land types. This would provide the greatest net benefit of CO_2 emissions reductions vs. clearing forested land or heavily vegetated land. The amount of CO_2 emissions reduced from one acre of solar panels is expected to be greater than one acre of undisturbed forested land (Synapse 2022).

Construction emissions are expected from gasoline and diesel fuel combustion within internal combustion engines for on-road vehicles/trucks and off-road equipment. These engines would generate local emissions of particulate matter, including CO, NO_x, SO_2, VOCs, and CO_2, during their operation. New emission control technologies and fuel mixtures have significantly reduced vehicle and construction equipment emissions. These vehicles and equipment would comply with the USEPA mobile source regulations in 40 CFR Part 86, Part 1036, and Part 1037 for on-road engines and 40 CFR Part 1039 for non-road engines. The fuel regulations at 40 CFR Part 80 require a maximum sulfur content in diesel fuel of 15 ppm.

Fugitive dust/particulate emissions would be generated during soil excavation and disturbance and truck traffic over paved and unpaved roads/areas. The largest fraction of fugitive dust emissions would be deposited in the immediate vicinity of the construction area. The smaller particulates would travel a little farther from the immediate construction area; however, those emissions are expected to be minor and widely distributed over the multiple facility sites. TVA and its contractors would comply with TDEC Air Pollution Control Rule 1200-3-8, which requires reasonable precautions to prevent PM from becoming airborne. In addition, dust control actions, including application of wetting agents or soil stabilization products on exposed soils and unpaved roads/travel areas, would be implemented to reduce fugitive dust/particulate emissions.

Overall, the solar and storage facility construction activities are expected to have temporary, localized, and minor effects on air quality and no direct or indirect effect on regional climate change. Emissions are expected to occur in attainment areas across the East Tennessee region where current ambient levels of criteria pollutants are below ambient air quality standards and are not expected to appreciably change due to construction activities.

3.7.2.4.1.2 Operations Effects

Operation of the solar and storage facilities are not expected to produce any emissions. There may be some heating requirements for some of the ancillary structures or the battery system structures; however, the heaters are expected to have no emissions, as they would be electric. The solar and storage facilities are not expected to require emergency generators or other stationary internal combustion engines for emergency or non-emergency purposes. If some electrical equipment contains the GHG sulfur hexafluoride gas, which has a very high global warming potential, there is the potential for minor leaks, mostly associated with maintenance or long-term equipment degradation. Minimal equipment is anticipated to contain sulfur hexafluoride and the potential for leaks would be very small. In addition, due to newer equipment, more efficient operation and maintenance techniques, and leak detection, these features would minimize sulfur hexafluoride emissions.

The solar and storage facility operations are expected to have permanent, moderate, beneficial effects on air quality in comparison to the No Action Alternative. The decrease in SO_2, NO_x, CO, PM, PM_{10}, $PM_{2.5}$, and VOC operational emissions at the KIF facility are estimated at approximately 1,374 tons/year, 1,038 tons/year, 382 tons/year, 185 tons/year, 328 tons/year, 266 tons/year, and 45 tons/year, respectively; see Table 3.7-3 and Appendix H for these calculations). There would also be elimination of hydrogen fluoride, and hydrogen chloride emissions, mercury, and lead emissions, along with other HAP emissions. The detailed emissions calculations are provided in Appendix H.

The solar and storage facilities are not expected to require an air construction or operating permit for stationary sources of emissions.

3.7.2.4.1.3 GHG Effects from Direct Emissions

As shown in Table 3.7-3, the estimated decrease in CO_2-e operational emissions at the KIF facility from implementation of Alternative B would be 3,403,333 tons in the first full year when all solar and storage facilities would begin operation (anticipated in 2028). Inputs to TVA's future power generation model were based on, it was assumed that commercial operation would begin approximately June 2027 with final acceptance in December 2027. The maximum annual CO_2-e emissions reductions would begin in 2028. Similar annual reductions in CO_2-e operational emissions would be experienced from that point forward. The percentage net reduction in actual operational CO_2-e emissions due to Alternative B would be 100 percent by 2035, exceeding the Biden Administration's goal of a 65 percent reduction in Scope 1 GHG emissions by 2035 from a 2008 baseline. These operational emissions reductions also advance TVA's climate goals of reducing GHG emissions 70% by 2030 as set out in TVA's Strategic Intent and Guiding Principles document (TVA 2021h). However, new solar facilities and the associated transmission upgrades could not be built and operational within the modeled timeframe; and would require additional time for completion of permitting, design, and construction phases; and do not meet the purpose and need to have firm, dispatchable generation in place by the end of 2027 when the Kington coal units are retired.

For purposes of a general correlating measure of GHG effects, the estimated net decrease in emissions of approximately 3.1 million metric tons of CO_2/year associated with implementation of Alternative B would represent approximately 3.2 percent of total statewide emissions in 2018, approximately 0.07 percent of the total U.S. emissions in 2020, and 0.01 percent of the total global GHG emissions for 2020 (see Appendix H for these calculations). As such, the operation of Alternative B would represent a benefit to climate change, particularly from Tennessee's contribution to GHG emissions reductions.

Using the Biden administration's 2021 SCC dollar per metric ton values, adjusted for inflation, the estimated annual net social benefit of CO_2 operational emissions reductions from implementing Alternative B would be $216,044,636 in 2028 for direct CO_2 effects in comparison to the No Action Alternative. Table 3.7-4 provides the Biden Administration's net social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2028, when full year operations would begin. Using the prior Administration's 2019 SCC dollar per metric ton values, adjusted for inflation, the estimated annual net social benefit of carbon emissions reductions from implementing Alternative B would be $23,706,667 in 2028 for direct CO_2 effects in comparison to the No Action Alternative. Table 3.7-5 provides the prior Administration's net social benefit, in dollars, of direct effect CO_2 operational emissions reductions for each alternative in 2028, when full year operations would begin. Beyond 2028 and at least through 2050, the net social benefit of CO_2 operational emissions reductions would increase year over year based on the increase in SCC rates ($/ton) between 2020 and 2050.

3.7.2.4.1.4 GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses
Two GHG LCAs were conducted for estimating future direct and indirect GHG emissions and associated social costs from implementing Alternative B. More detailed methodology and results for these analyses is provided in Appendix I. The first LCA is on an individual replacement resource by alternative basis (henceforth "individual") and the second is on a TVA system-wide portfolio basis with simulated system-wide generation dispatch. The Alternative B individual LCA is described below and includes all upstream (e.g. raw material acquisition and components manufacturing and Alternative B construction activities) and downstream (e.g. future demolition/decommissioning at end of life) GHG emissions. The system-wide LCA for Alternative B is presented in Section 3.7.2.5 and provides the Alternative B LCA emissions and SC-GHG savings compared to the No Action Alternative. The NPV of these savings and their percent reduction compared to the No Action Alternative is also presented in Section 3.7.2.5.

Estimated emissions of the three main GHG pollutants, i.e., CO2, CH4, and N2O, were calculated over the entire life cycle of Alternative B broken down into four main life cycle segments: upstream; on-site ongoing combustion; ongoing non-combustion; and downstream. The activities under each segment are described in Appendix I. The operational life cycle of Alternative B was assumed to be 20 years; however, emissions and associated social costs were prorated to 30 years to provide a consistent comparison to the other alternatives. The resulting estimated life cycle emissions of each of the three GHGs were used to calculate the social cost of each GHG individually and the total SC-GHGs. In the same manner as for GHG Effects from Direct Emissions above, the social costs of GHGs were calculated using a range of GHG social cost rates.

In summary, the Alternative B estimated individual life cycle analysis emissions of each GHG and their corresponding estimated future social costs are provided in Table 3.7-8 and Table 3.7-9. Table 3.7-8 provides the results using the Biden Administration social cost values and Table 3.7-9 provides the results using the prior Administration social cost values. Both tables also provide a NPV of the total life cycle SC-GHG for Alternative B. In comparison to Alternative A, Alternative B's estimated CO_2-e life cycle emissions and associated costs, in nominal dollars, are less than Alternative A. In comparison to the No Action Alternative, Alternative B has an estimated 91 percent decrease in life cycle CO_2-e emissions and 92 percent decrease in associated estimated future social costs, in nominal dollars. The total estimated individual life cycle SC-GHG for each alternative under Biden Administration values are: $11.8 billion – No Action Alternative; $7 billion – Alternative A; and $1.05 billion – Alternative B. The total estimated life cycle SC-GHG for each alternative under prior Administration values are: $937.5 million – No Action Alternative; $558.6 million – Alternative A; and $88.9 million – Alternative B. It is important to note that these GHG individual LCA emissions and SC-GHG are only an individual site-based analysis and do not consider how the whole TVA system or the entire electricity grid would emit under Alternative B. Therefore, the GHG emissions and social cost benefits of Alternative B are overstated in this LCA.

Table 3.7-8. Alternative B - Estimated Life Cycle GHG Emissions and Associated Social Costs (Biden Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2023 $
10,658,453	38	0.4	10,659,518	$1,047,046,892	$127,010	$13,295	$1,047,187,197	$703,633,735

Note:
NPV = Net Present Value

Table 3.7-9. Alternative B - Estimated Life Cycle GHG Emissions and Associated Social Costs (Prior Administration Values, 3% Discount Rate)

Total Life Cycle CO_2 Emissions, tons	Total Life Cycle CH_4 Emissions, tons	Total Life Cycle N_2O Emissions, tons	Total Life Cycle CO_2-e Emissions, tons	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHGs Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2023 $
10,658,453	38	0.4	10,659,518	$88,900,898	$10,007	$887	$88,911,792	$61,272,314

Note:
NPV = Net Present Value

3.7.2.4.1.5 Climate Change Effects on Alternative B

The main impacts of climate change are the intense heatwaves, more severe storms, and the increase in sea level due to the melting of ice based on increases in global temperatures. Impacts from climate change, including increases in flooding events and severity, are not expected to have an effect on the physical infrastructure or operations for Alternative B. Solar/storage facilities would be located to avoid 100-year flood plains, where possible, or constructed at least one foot above the 100-year flood plain level for components that are flood-damageable. Refer to the flood mitigation measures for Alternative B provided in Section 2.3 of this EIS.

Extended drought conditions, should they occur, are not expected to affect the physical infrastructure or operations of the solar and storage facilities as they have minimal water requirements. Extended heat waves would reduce the efficiency of PV facilities and the amount of electricity they generate. Similarly, extended heat waves would reduce the efficiency of storage facilities by increasing their cooling system energy requirements. TVA has developed a Climate Action Adaptation and Resiliency Plan to identify risks associated with and plan for climate change effects (TVA 2021i).

3.7.2.4.2 Transmission and Other Components

Alternative B includes construction activities to connect existing electrical transmission lines to the multiple solar and battery storage facilities and to upgrade local transmission line equipment to accommodate the new facilities. These activities would occur within portions of East Tennessee and are assumed to occur in attainment areas. Based on past TVA solar projects, new transmission interconnection lines to each solar and storage facility are expected to be short and the new lines and other transmission system upgrades would occupy limited acreage.

Fugitive dust/particulate emissions would be generated during soil disturbance activities and vehicle/truck traffic over paved and unpaved roads/areas. The largest fraction of fugitive dust emissions would be deposited in the immediate vicinity of the construction area. The smaller particulates would travel a little farther from the immediate construction area; however, those emissions are expected to be minor and widely distributed over the entire East Tennessee area. TVA and its contractors would comply with TDEC Air Pollution Control Rule 1200-3-8, which requires reasonable precautions to prevent PM from becoming airborne. In addition, dust control actions, including application of wetting agents or soil stabilization products on exposed soils and unpaved roads/travel areas, would be implemented to reduce fugitive dust/particulate emissions.

Highway vehicles and off-road construction equipment (e.g., bulldozers, backhoes, bucket trucks, boom trucks, forklifts, trenching equipment) would generate minor amounts of combustion emissions including particulate matter, such as CO, NO_x, SO_2, VOCs, and CO_2 from diesel and gasoline fueled internal combustion engines. These emissions would be widely distributed over the entire East Tennessee area. New emission control technologies and fuel mixtures have significantly reduced vehicle and construction equipment emissions. These vehicles and equipment would comply with the USEPA mobile source regulations in 40 CFR Part 85 for on-road engines and 40 CFR Part 1039 for non-road engines. These regulations include requiring a maximum sulfur content in diesel fuel of 15 ppm. Additionally, it is expected that all vehicles would be properly maintained, which would also reduce emissions.

There are typically no operational emissions from the transmission lines and associated electrical equipment. If some electrical equipment contains the GHG sulfur hexafluoride gas (e.g., electrical switchgear, circuit breakers), there is the potential for minor leaks, mostly associated with maintenance or long-term equipment degradation. Through routine preventative maintenance programs, leaking equipment would be identified and remedied or replaced. In addition, due to newer equipment, more efficient operation and maintenance techniques, and leak detection, these features would minimize sulfur hexafluoride emissions.

Overall, these transmission line construction and upgrade activities are expected to have temporary, minor effects on air quality and no direct or indirect effect on regional climate change. Construction emissions are expected to occur in attainment areas across the East Tennessee area where current ambient levels of criteria pollutants are below ambient air quality standards and are not expected to appreciably change due to construction activities. The operation of the solar and battery storage transmission lines and associated equipment would not generate any continuous emissions. Their operation is expected to have permanent, minor, or negligible effects on air quality and no direct or indirect effect on regional climate change.

3.7.2.4.3 Summary of Alternative B

The construction of multiple solar (assuming fifteen 100-MW sites) and battery storage systems over large areas of East Tennessee is expected to have temporary, localized, and minor effects on air quality. This construction is expected to have temporary, regional, and minor effects from GHG emissions on climate change. The operation of the solar/battery storage systems is expected to have permanent, moderate, beneficial effects on local air quality and reductions in future regional GHG emissions are expected to have permanent, moderate, beneficial effects on climate change in comparison to the No Action Alternative.

For Alternative B, the social cost benefit from CO_2 operational emissions reductions is estimated to be between $23.7 million and $216 million dollars the first year of operation, in nominal dollars, and would increase every year thereafter. On an individual replacement resource basis, the estimated total Alternative B life cycle social costs of GHG emissions ranges from approximately $88.9 million to $1.05 billion in nominal dollars. These values equate to between approximately $61.3 million and $703.6 million in NPV to 2023 dollars. On a TVA system-wide basis, the estimated total Alternative B life cycle social costs of GHG emissions in comparison to the No Action Alternative, i.e., net savings/benefit, ranges from approximately $430 million to $4.7 billion in nominal dollars. These savings/benefit values equate to between approximately $183.3 million and $1.99 billion in NPV to 2023 dollars.[26] In comparison to Alternative A on an individual replacement resource basis, Alternative B has the lower GHG life cycle emissions and associated estimated future social costs in nominal dollars. As stated previously, this individual replacement resource basis analysis is overstating the actual benefit of Alternative B compared to Alternative A and to the No Action Alternative because it is not considering emissions from the entire TVA system (e.g., grid power generated to charge the Alternative B batteries). This same comparison on a TVA system-wide basis results in Alternative B with the highest total life cycle social cost savings/benefit in comparison to the No Action Alternative but Alternative A and B are closer in comparison regarding GHG social cost savings/benefits.

Lastly, the GHG geographic emissions comparison analysis for Alternative B results in a 3.24 percent reduction in Tennessee CO_2 emissions, 0.07 percent reduction in U.S. CO_2 emissions, and 0.01 percent reduction in global CO_2 emissions. These reductions are 1.66 percent more, 0.03 percent more, and 0.005 percent more than Tennessee, U.S., and global reductions, respectively, resulting from Alternative A.

[26] A range of social costs is provided to account for using prior Administration SC values and Biden Administration SC values.

3.7.2.4.4 Environmental Justice Considerations

Effects to air quality that would occur as a result of the proposed solar and storage facilities are not anticipated to have disproportionate and adverse human health or environmental effects on EJ populations for Alternative B. Full EJ considerations would be made for each solar and storage facility once the location of these facilities has been determined.

3.7.2.5 TVA System-Wide GHG LCA and Comparison Relative to the No Action Alternative

3.7.2.5.1 TVA System-Wide Production Model

An analysis for the entire TVA-wide power system was performed using industry standard capacity planning and production cost models, Anchor Power Solution's EnCompass (Anchor Power Solutions 2023) and Energy Exemplar's Aurora (Energy Exemplar 2023). The capacity planning model develops a least-cost portfolio to meet demand and reserve margin while the production cost model simulates economic dispatch of the plan. The output includes an estimate of anticipated future emissions across the entire TVA system for each year.

Model results represent TVA's current forecast for electric load, asset performance, and commodity prices, among other things. Differences in any of these forecasts could result in higher or lower anticipated carbon emissions. Model results also represent TVA's commitment to reliably meet electric load at the lowest possible dispatch cost (in alignment with Section 113 of the Energy Policy Act of 1992), currently without a penalty applied to unit carbon emissions. Future regulatory requirements or incentives would likely result in lower emissions than these estimates, depending on those requirements and TVA's fleet composition at the time. The differences between each alternative are specific to the decision to retire or not retire Kingston Fossil Plant and the associated replacement generation outlined in each alternative. Each alternative has subsequent impacts for other decisions in the future. Given this, there will be variations in simulated dispatch, which will result in differences in emissions, driven by the dynamic nature of power system modeling. The additional natural gas-fired generating capacity included in Alternative A would not preclude higher levels of solar additions beyond the currently planned 10,000 MW by 2035. A regulatory environment that places limits on carbon emissions, or carbon-emitting generation, is likely to make renewable resources more economically viable over the long term, even if higher volumes of renewable resources result in temporary curtailments of wind or solar resources (i.e., reduction of power output below what the resource could have otherwise produced) to match demand during periods of low electric load. However, the need for firm, dispatchable generation, such as natural gas-fired generation, to backfill intermittent renewable resources will remain.

3.7.2.5.2 TVA System-Wide GHG LCA and SC-GHGs

Similar to the manner in which the SC-GHG analysis is presented for an individual replacement resource by alternative basis, it is more thorough to prepare a TVA system-wide life cycle analysis. The system-wide view provides critical context to how the specific resource retirements and replacements, underpinning the assumptions of each of the proposed Action Alternatives, integrates into the system overall. Developing a TVA system-wide life cycle analysis reflects TVA's broader asset strategy and Target Power Supply Mix set by the 2019 IRP. A TVA system-wide comparison of emissions is the most effective way to accurately identify incremental emission differences between the alternatives because it illustrates how the entire TVA system is expected to operate with each alternative.

The replacement generation assets proposed in each of the action alternatives serve fundamentally different roles in the context of the larger TVA system in cost-effectively meeting electric load requirements. The CC plant proposed in Alternative A would be one of the most fuel-efficient CC plants in the TVA system and, as such, is likely to be dispatched frequently in baseload or intermediate operations in the near term to reduce total system costs for TVA ratepayers. The simple cycle CT plant in Alternative A would be among the most efficient peaking units in the TVA system; however, they would almost always be dispatched after all existing CC, nuclear, and coal units handle baseload and intermediate operations. Dispatch order is based on least-cost dispatch, where less expensive variable cost generators are put into service generally before more expensive ones to create the lowest possible average cost of electricity at that time. Hydropower, nuclear, and many other gas CC generators, due to gas transport costs, would be dispatched before Kingston unless needed for local transmission support. It is anticipated that Kingston units would have less than full utilization across the year, but this is a dynamic process depending on many factors including outages, fuel cost, and loads.

The CT plants would then be used for peaking operations, which refers to units only used for more limited durations during periods of high electric load. The solar and storage proposed in Alternative B would generate and dispatch in yet another, completely different manner. The solar resources are intermittent in nature and only available during daylight hours and are also affected by cloud cover. While the battery storage is fully dispatchable, it is energy limited (i.e., only able to store up to four hours per day of energy at full output). TVA would seek to optimize the use of these solar and storage resources; however, there would be some hours of operation where neither of these resources would be available and therefore TVA would be forced to rely on the existing fleet of nuclear, hydro, coal and gas units to meet generation needs. Only a full system-wide comparison of the alternatives will accurately account for these differences.

The results of the system-wide life cycle analysis for each alternative are presented in Table 3.7-10 and Table 3.7-11 below. Each action alternative is compared against the No Action Alternative in portraying the social cost of greenhouse gas emissions – CO_2, CH_4, and N_2O. The costs are presented utilizing both the Biden Administration 2020 SCC rate of $51 per metric ton at a 3 percent discount rate (addressing global effects) and the prior Administration 2020 SCC rate of $7 per metric ton at a 3 percent discount rate (addressing domestic effects) to provide an illustration of the uncertainty that exists in these costs. Compared to the No Action Alternative, Alternative B generates the most cost savings followed by Alternative A. Based on Biden administration values and on an NPV basis presented in 2023 dollars, the analysis reflects about $1.99 billion of savings for Alternative B relative to the No Action Alternative. Alternative A reflects about $1.75 billion of savings relative to the No Action Alternative, and about $245 million less savings than Alternative B. CO_2 is the most impactful greenhouse gas in the analysis representing about 95% of total cost savings presented by each action alternative compared to the No Action Alternative. Notwithstanding the lower savings ($245 million) from Alternative A as compared to the No Action Alternative, other considerations, such as the need to have firm, dispatchable power in place by 2027, would still lead TVA to identify Alternative A as the preferred alternative. More details regarding the TVA system wide GHG LCA with emissions and associated social cost calculations are provided in Appendix I.

Table 3.7-10. TVA System-Wide Estimated Social Cost of Life Cycle GHG Emissions for Action Alternatives Compared to the No Action Alternative, by Life Cycle Phase (Current Administration)

Proposed Action Alternatives	One-Time Upstream (Nominal $)	Ongoing Combustion (Nominal $)	Ongoing Non-Combustion (Nominal $)	Methane Leakage (Nominal $)	One-Time Downstream (Nominal $)	Total (Nominal $)	NPV (2023 $)
Alternative A							
CO_2	5,486,517	(4,336,013,433)	357,222,165	NA	385,283	(3,972,919,469)	(1,704,499,984)
CH_4	603	4	(14,703)	119	51	(13,926)	(5,767)
N2O	66	0	(100,218,383)	NA	5	(100,218,313)	(42,614,234)
Alternative A Total	**5,487,185**	**(4,336,013,429)**	**256,989,078**	**119**	**385,339**	**(4,073,151,708)**	**(1,747,119,986)**
Alternative B							
CO_2	521,945,210	(5,357,969,807)	105,516,275	NA	162,573,650	(4,567,934,672)	(1,928,209,351)
CH_4	57,331	2	(49,829,438)	140	101,738	(49,670,227)	(21,046,183)
N2O	6,235	0	(101,139,679)	NA	2,135	(101,131,309)	(43,016,766)
Alternative B Total	**522,008,776**	**(5,357,969,806)**	**(45,452,842)**	**140**	**162,677,523**	**(4,718,736,208)**	**(1,992,272,300)**

Table 3.7-11. TVA System-Wide Estimated Social Cost of Life Cycle GHG Emissions for Action Alternatives Compared to the No Action Alternative, by Life Cycle Phase (Prior Administration)

Proposed Action Alternatives	One-Time Upstream (Nominal $)	Ongoing Combustion (Nominal $)	Ongoing Non-Combustion (Nominal $)	Methane Leakage (Nominal $)	One-Time Downstream (Nominal $)	Total (Nominal $)	NPV (2023 $)
Alternative A							
CO_2	624,487	(399,720,227)	32,847,241	NA	26,616	(366,221,883)	(161,166,263)
CH_4	65	0	(1,295)	10	3	(1,216)	(514)
N2O	6	0	(7,297,005)	NA	0	(7,296,999)	(3,207,107)
Alternative A Total	**624,558**	**(399,720,227)**	**25,548,941**	**10**	**26,619**	**(373,520,098)**	**(164,373,884)**
Alternative B							
CO_2	59,408,876	(498,495,872)	9,072,711	NA	11,231,010	(418,783,275)	(178,196,858)
CH_4	43,901	0	(4,375,473)	12	5,732	(4,325,827)	(1,869,998)
N2O	4,752	0	(7,366,243)	NA	109	(7,361,382)	(3,235,163)
Alternative B Total	**59,457,530**	**(498,495,872)**	**(2,669,005)**	**12**	**11,236,851**	**(430,470,484)**	**(183,302,019)**

3.8 Biological Environment

3.8.1 Vegetation

Vegetation in the form of trees, shrubs, vines, and herbaceous cover provides habitat and food resources for birds, mammals, reptiles, amphibians, and insects. Vegetation also supports soil and nutrient cycles and provides ecosystem services, such as food, fresh water, fuel, fiber, and medicines to human populations (MSU, n.d.). The federal Plant Protection Act of 2000 consolidated previous legislation and authorized the U.S. Department of Agriculture (USDA) to issue regulations to prevent the introduction and movement of identified plant pests and noxious weeds. EO 13112—Invasive Species directs federal agencies to prevent the introduction of invasive species (both plants and animals), control their populations, restore invaded ecosystems, and take other related actions. EO 13751—Safeguarding the Nation from the Effects of Invasive Species amends EO 13112 and directs actions to continue coordinated federal prevention and control efforts related to invasive species. Agencies are also directed to incorporate consideration of human and environmental health, climate change, technological innovation, and other emerging priorities into their efforts to address invasive species (USDA 2018a).

3.8.1.1 Affected Environment

3.8.1.1.1 Kingston Reservation (No Action and D4 Activities)

The Kingston Reservation and surrounding areas are located within the Southern Limestone/Dolomite Valleys and the Rolling Hills Ecoregion, a subdivision of the Ridge and Valley Ecoregion (Griffith et al. 1998). The Ridge and Valley Ecoregion occurs between the Blue Ridge Mountains to the east and the Cumberland Plateau to the west and is a relatively low-lying region made up of roughly parallel ridges and valleys that were formed through extreme folding and faulting events in the past. The Southern Limestone/Dolomite Valleys and the Rolling Hills Ecoregion is a heterogeneous subregion composed predominantly of limestone and cherty dolomite. Landforms are mostly undulating valleys and rounded ridges and hills, with many caves and springs. Soils vary in productivity and land cover types include oak-hickory and oak-pine forests, pastures, intensive agriculture, and urban and industrial areas.

Comprehensive environmental surveys were completed on the Kingston Reservation during the summer of 2019, including a survey of vegetative communities (Appendix J). Vegetative communities on and around the Kingston Reservation are largely a function of the land use history of the site, of which has been heavily disturbed by the construction, operation, and maintenance of the generation and transmission infrastructure present on the Reservation (TVA 2020c). In general, the most heavily disturbed and degraded habitats are currently covered with herbaceous vegetation, early successional plant habitats, and scattered areas of forest.

Based on the 2019 field surveys and interpretation of aerial photos of the Kingston Reservation, 119 acres of the reservation are unvegetated and 73 discrete areas of habitat were delineated representing 10 vegetation communities (Figure 3.8-1 and Table 3.8-1). Most of these areas consist of herbaceous vegetation dominated by non-native plant species that possesses little conservation value and have no potential to support state or federally listed plant species or unique plant communities (TVA 2020c). Some areas of herbaceous vegetation, principally along transmission line ROW, contain significant populations of native plants but constitute marginally intact habitat. Most herbaceous communities and existing ROWs are populated with non-native and invasive species such as tall fescue, sericea lespedeza, *Bromus* spp., clovers, autumn olive, and Johnson grass. Native plants in ROW areas, although less abundant than non-native species, include dogbane, common milkweed, blackberry, yellow wingstem, white wingstem, and poverty oatgrass. Several of the forested tracts on the Kingston Reservation contain overstory trees, a shrub layer of invasive Chinese privet, and minimal herbaceous layer in the understory. Ruderal areas consisted of sparse, weedy species colonizing highly disturbed areas, such as ash disposal areas. Manicured lawns were identified as areas maintained and regularly mowed. Herbaceous habitats represent areas with herbaceous vegetation that includes greater coverage than ruderal areas and are not mowed like manicured lawn. Overstory vegetation in deciduous forested areas comprise common species such as sweetgum, yellow-poplar, black cherry, red maple, American beech, white ash, white oak, hickories, and basswood, sometimes with a shrub layer containing Eastern redbud, dogwood, and pawpaw. Mixed evergreen/deciduous forest on-site also contain loblolly pine, tree-of-heaven, and sugarberry, as well as invasives such as Japanese stiltgrass and multiflora rose. At least an equal proportion of forest on the Reservation is heavily fragmented, degraded by non-native species infestations, and contains small-diameter trees indicative of previous site disturbances.

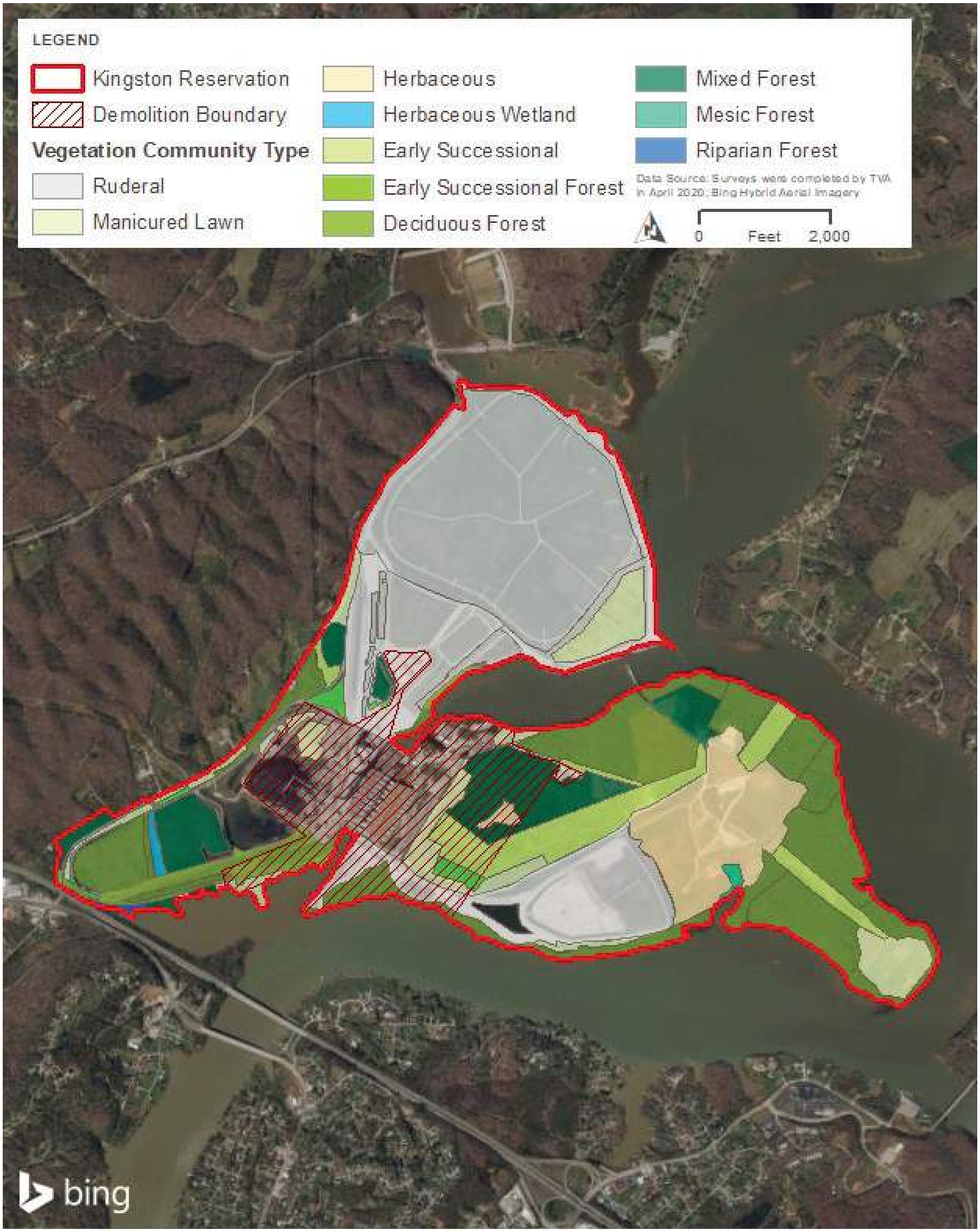

Figure 3.8-1. Vegetation Communities Observed on the Kingston Reservation

Table 3.8-1. Summary of Vegetation Communities Present on Kingston Reservation

Vegetation Community	Number of Discrete Areas	Total Acres	Percent of Total Area[1]
Ruderal	14	468.2	38.3
Manicured Lawn	15	89.7	7.3
Herbaceous	2	95.6	7.8
Early Successional	5	71.6	5.9
Early Successional Forest	6	10.3	0.8
Mixed Forest	8	97.4	8.0
Deciduous Forest	17	264.4	21.6
Mesic Forest	1	2.3	0.2
Riparian Forest	1	1.9	0.2
Herbaceous Wetland	1	3.0	0.2
Total	**73**	**1,104.4**	**90.3**

[1]Percent of Total Area is percent of vegetated area on the site. Remaining area (i.e., 9.7 percent of Kingston Reservation) is unvegetated.

Invasive Plant Species

No federal-noxious weeds (as listed by the USDA) were observed within the Kingston Reservation, but several non-native invasive plant species characterized by the Tennessee Invasive Plant Council as Established Threat (i.e., those the Council perceives to be archetypical invasive weeds known to every land manager as well as having broad distributions through Tennessee) were observed in both herbaceous and forested habitats on Kingston Reservation (TVA 2020c; TIPC 2022; USDA 2023). Species considered Established Threats that were observed on the Kingston Reservation include autumn olive, Chinese lespedeza, Chinese privet, Japanese honeysuckle, Japanese stiltgrass, Johnson grass, kudzu, multiflora rose, sericea lespedeza, and tree-of-heaven.

3.8.1.1.2 Alternative A

3.8.1.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Based on the survey completed in summer 2019, almost the entire proposed CC/Aero CT Plant site is vegetated (99.6 percent). The site consists primarily of heavily disturbed, herbaceous vegetative plant community (43.7 acres, 79.5 percent); the remaining vegetation types each represent less than 10 percent of the total CC/Aero CT Plant site (Table 3.8-2). Similarly, the majority of the switchyard also consists of herbaceous vegetation cover (8.3 acres, 96.5 percent), with the remaining 0.3 acre (3.5 percent) consisting of deciduous forested area. Previous permitted land disturbing activities have occurred in this area since the time of the 2019 survey; therefore, parts of the primary herbaceous area presented in Figure 3.8-2 may more recently represent ruderal or barren conditions.

Table 3.8-2. Summary of Vegetation Communities within the Alternative A Proposed CC/Aero CT Plant Site

Vegetation Community	Vegetated Area (acres)	Percent of Total Area[1]
Overall Proposed CC/Aero CT Plant Site		
Herbaceous	43.7	79.5
Ruderal	4.5	8.2
Deciduous Forest	4.1	7.5
Mesic Forest	2.3	4.2
Early Successional	0.1	0.2
Total[2]	**54.7**	**99.6**
Proposed Switchyard Footprint		
Herbaceous	8.3	96.5
Deciduous Forest	0.3	3.5
Total[2]	**8.5***	**100.0**

[1]Percent of Total Area is percent of vegetated area within the site proposed actions. Remaining area (i.e., 0.4 percent of the Overall Proposed CC/Aero CT Plant Site) is unvegetated.
[2]Total Percent may vary slightly due to rounding.
*Note: The total vegetated acres within the proposed switchyard footprint is 8.5 acres, the individual contributions from herbaceous and deciduous vegetation types result in a total of 8.6 due to rounding.

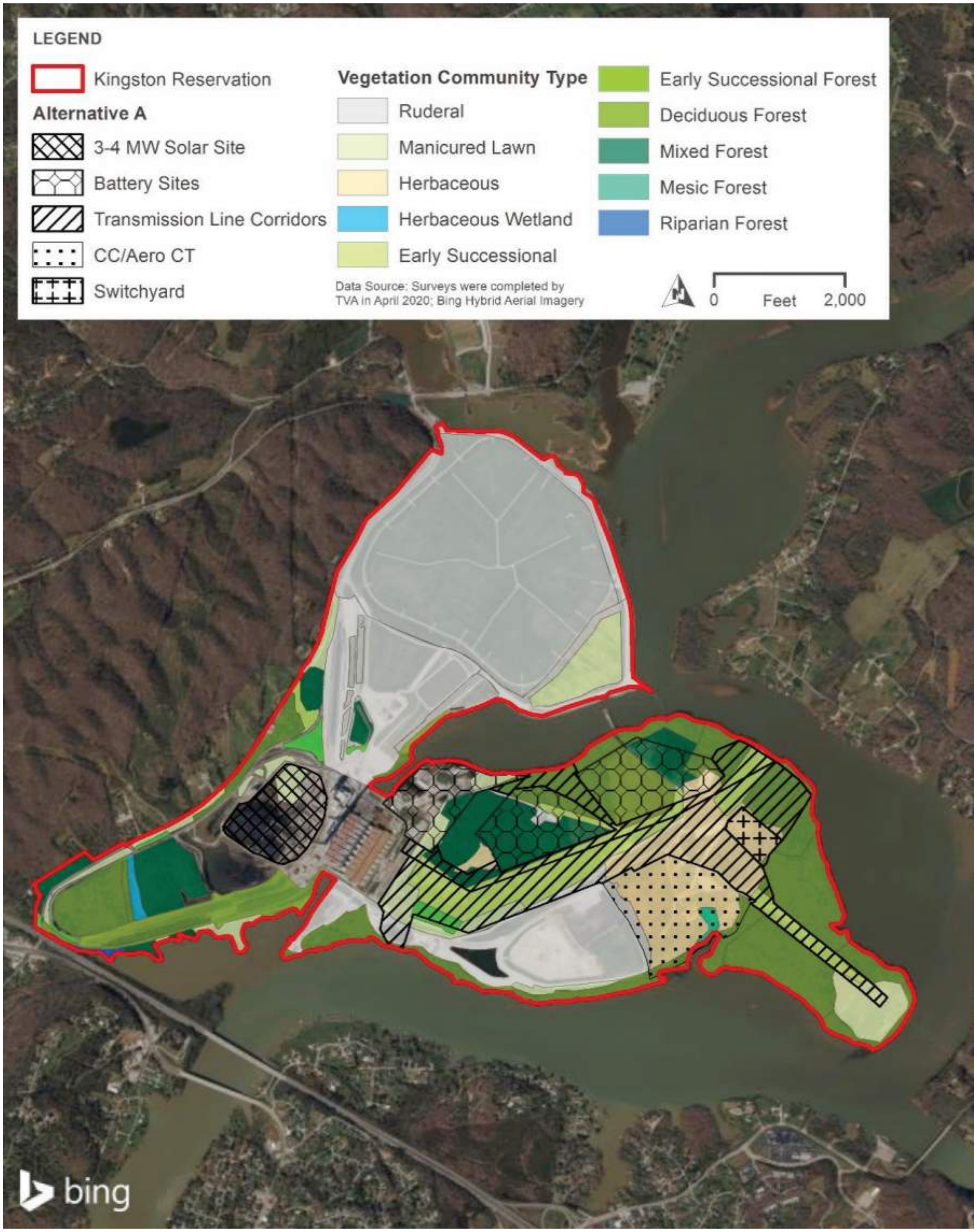

Figure 3.8-2. Vegetation Communities on the Proposed Alternative A Components on the Kingston Reservation

3.8.1.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW-Solar Facility site is currently used primarily as a coal storage yard and associated infrastructure for the existing KIF fossil units (Figure 3.8-2). Approximately 4.8 acres of the 35-acre site is manicured lawn.

3.8.1.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

TVA has identified three potential battery site locations generally northwest of the proposed CC/Aero CT Plant (Figure 3.8-2). Battery Site 1 is located on a previously developed and an actively managed area with an overall vegetation coverage of 32.7 percent consisting primarily of manicured lawn (6.0 acres, 20 percent) and multiple storage buildings that would be demolished during the D4 process. Surrounding the buildings and along the northern and northwestern shoreline of the Battery Site 1 footprint are several small areas with mature riparian hardwood and evergreen tree species (3.5 acres of deciduous and mixed forest, 11.7 percent). Similar small areas of mature trees surround the outer perimeter of the Battery Site 1 footprint (Table 3.8-3)

Table 3.8-3. Summary of Vegetation Communities within the 100-MW BESS Sites

Vegetation Community	Vegetated Area (acres)	Percent of Total Area[1]
Battery Site 1		
Manicured Lawn	6.0	20.0
Mixed Forest	3.0	10.0
Deciduous Forest	0.5	1.7
Ruderal	0.3	1.0
Total[2]	**9.8**	**32.7**
Battery Site 2		
Mixed Forest	24.7	70.6
Deciduous Forest	5.8	16.6
Early Successional	2.7	7.7
Ruderal	1.8	5.1
Herbaceous	<0.1	0.3
Total[2]	**35.0**	**100.0**
Battery Site 3		
Deciduous Forest	27.1	67.8
Mixed Forest	9.1	22.8
Herbaceous	3.2	8.0
Early Successional	0.7	1.8
Total[2]	**40.0**	**100.0**

[1]Percent of Total Area is percent of vegetated area within the site proposed actions. Remaining area (i.e., 67.3 percent of Battery Site 1) is unvegetated.
[2]Total acreage and percent varies slightly due to rounding

Battery Site 2 is predominantly undisturbed and consists primarily of mixed forest (24.7 acres, 70.6 percent) with a relatively small area of deciduous forest (5.8 acres, 16.6 percent) in the northeast corner of the boundary. The Battery Site 2 footprint also contains 2.7 acres of early successional habitat (7.7 percent), 0.03 acre of herbaceous grassland (0.3 percent), and 1.8 acres of heavily disturbed and sparsely vegetated ruderal habitat (5.1 percent).

Battery Site 3 is mostly undisturbed and consists of 27.1 acres of deciduous forest (67.8 percent) and 9.1 acres of mixed forest (22.8 percent). The remaining area also includes 3.2 acres of herbaceous grassland (8 percent) and 0.7 acre of early successional vegetation (1.8 percent).

3.8.1.1.2.4 On-site Transmission Upgrades

The footprint for the battery transmission line connections is dominated by forested areas (17.6 acres of deciduous and 6.8 acres of mixed forest, 58.9 percent combined total) and early successional habitat (13.6 acres, 32.9 percent) (Table 3.8-4).

Table 3.8-4. Summary of Vegetation Communities within the Alternative A Battery Transmission Line Connections

Vegetation Community	Vegetated Area (acres)	Percent of Total Area[1]
Deciduous Forest	17.6	42.5
Early Successional	13.6	32.9
Mixed Forest	6.8	16.4
Herbaceous	2.5	6.0
Manicured Lawn	1.0	2.4
Ruderal	< 0.10	0.2
Total[2]	**41.4**	**100**

[1]Percent of Total Area is percent of vegetated area within the site proposed actions.
[2]Total Percent varies slightly due to rounding

Vegetation within the on-site transmission line corridors proposed for upgrades on Kingston Reservation under Alternative A is dominated by early successional and herbaceous habitat types (totaling 86.4 acres, 67.5 percent) with smaller areas of forested habitat (18.4 acres, 14.4 percent) (Table 3.8-5). Manicured lawn is also substantial at 10.9 percent of the total area (13.9 acres).

Table 3.8-5. Summary of Vegetation Communities within the Alternative A On-site Transmission Upgrades

Vegetation Community	Vegetated Area (acres)	Percent of Total Area[1]
Early Successional	51.2	40.0
Herbaceous	35.2	27.5
Deciduous Forest	18.4	14.4
Manicured Lawn	13.9	10.9
Ruderal	6.9	5.4
Early Successional Forest	3.1	2.4
Mixed Forest	<0.1	0.1
Total[2]	**128.8**	**100.0**

[1]Percent of Total Area is percent of vegetated area within the site proposed actions.
[2]Total Percent varies slightly due to rounding

3.8.1.1.2.5 Off-site Transmission Line Upgrades

Eastern Transmission Corridor

The Eastern Transmission Corridors cross the Southern Limestone/Dolomite Valleys and the Rolling Hills Ecoregion, a subdivision of the Ridge and Valley ecoregion. The Southern Limestone/Dolomite Valleys are characterized as having undulated to rolling valleys with rounded hills with cropland/pastures, mixed forests, some pine plantations, rural residential, urban, and industrial areas. Appalachian oak forest, bottomland oak forests, mesophytic forests, and cedar glades are the natural community types (Griffith et al. 1998). Appalachian oak forests in the Ridge and Valley comprise several oak species (chestnut, red, white, scarlet, and black oaks), hickories, maples, and some tulip poplar and sweet birch (Martin et al. 1993a). Mixed mesophytic forests are described for the Western Transmission Corridor above. Species found in bottomland hardwood forest sites are those adapted to saturated or inundated conditions, and forest composition varies depending on the duration of saturated or flooded conditions (Martin et al. 1993b). In areas where recent changes have occurred, early successional vegetation such as black willow, eastern cottonwood, river birch, sand silver maple are present.

Sloughs, oxbows, and swamps with longer hydroperiods have species adapted to deepwater areas, including water tupelo, bald cypress, and water elm. In poorly drained areas, overcup oak, water hickory, green ash, American elm, sugarberry, hackberry, laurel oak, and red maple are found. Ridges in low areas may be dominated by sweetgum, willow oak, and water oak. Areas with the shortest hydroperiods have cherrybark oak, swamp chestnut oak, hickories, and black gum (Griffith et al. 1998).

A field survey was completed in June 2022 of the vegetation communities within the Eastern Transmission Corridor (L5108 and L5302) and Western Transmission Corridor (L5383) (HDR 2022b). TVA later determined the potential need for additional transmission upgrades within the Eastern Transmission Corridor for L5116, L5280, and L5381 for Alternative A. While additional field surveys for these areas have not yet been completed. TVA included analysis of impacts to biological resources in these additional areas based on desktop analysis of publicly available data. As such, the analyses of vegetation communities of the Eastern Transmission Corridor presented in this draft EIS is subdivided based on the source of the data used:

- L5108 and L5302 — based on analysis of field survey results and other available publicly available data; and
- L5116, L5280, and L5381 — based on desktop analysis of publicly available data.

Lines 5108 and 5302 – Data from Field Surveys

Based on the botanical field surveys (Appendix L), L5108 and L5302 of the Eastern Transmission Corridor consists primarily of fields (i.e., pasture/hay or herbaceous vegetation; 72.4 percent), forested land (deciduous, evergreen, and mixed; 17.1 percent), maintained lawn or access roads (9.4 percent), and an area of kudzu infestation (1.2 percent) (Table 3.8-6). The majority of the forested area occurs along the edges of existing access road areas. Figures are provided with the report in Appendix L.

Table 3.8-6. Vegetation Communities and/or Land Uses along L5108 and L5302 of the Eastern Transmission Corridor under Alternative A

Vegetation Community	Total Area (acres)	Percent of Vegetated Area
Dry Herbaceous	656.0	63.7

Vegetation Community	Total Area (acres)	Percent of Vegetated Area
Forest Land	175.7	17.1
Maintained Lawn	77.7	7.5
Wet Herbaceous	67.7	6.6
Hay/Pasture	21.9	2.1
Pasture/Maintained Lawn	14.2	1.4
Kudzu Infested	12.1	1.2
Maintained Access Road	4.7	0.5
Total	**1,030.0**	**100.0**

Lines 5116, 5280, and 5381 – Data from Desktop Sources

A desktop-based geospatial assessment of plant communities throughout these portions of the Eastern Transmission Corridor was completed using existing land use classifications. Additionally, botanical field surveys are currently underway along these lines. Based on the desktop review, the land along L5116, L5280, and L5381 consists primarily of fields (i.e., pasture/hay or herbaceous vegetation; 38.0 percent), forested land (deciduous, evergreen, and mixed; 31.5 percent), and developed areas (i.e., residential areas and public roads; 21.7 percent) (Table 3.8-7). Figures are provided in Land Use, Section 3.10.1.2.5.1.

Table 3.8-7. Vegetation Communities and/or Land Uses along L5116, L5280, and L5381 of the Eastern Transmission Corridor under Alternative A

Vegetation Community	Total Area (acres)	Percent of Vegetated Area
Hay/Pasture	172.6	35.3
Forest Land	143.4	29.3
Developed (low, medium, and high intensity)	59.4	12.2
Developed (open space)	46.3	9.5
Scrub-Shrub	41.1	8.4
Dry Herbaceous	13.1	2.7
Mixed Forest	9.3	1.9
Evergreen Forest	1.5	0.3
Woody Wetlands	1.5	0.3
Wet Herbaceous	0.4	0.1
Barren Land	0.1	< 0.1
Total	**488.6**	**100.0**

3.8.1.1.2.5.1 Western Transmission Corridor

Line 5383 - Data from Field Surveys

Proposed upgrades to L5385 within the Western Transmission Corridor cross the Cumberland Plateau, a subdivision of the Southwestern Appalachians Ecoregion. The Cumberland Plateau is characterized as having undulated and rolling landforms and some open mountains with most areas forested, timber and coal mining activities, some cropland and pasture, and wildlife areas. Mixed oak and mesophytic forests are the natural community types. Mixed oak forests contain a variety of oaks, hickories, maples, American beech, black cherry, black walnut, elm, tulip poplar, flowering dogwood, and shortleaf pine (Martin et al. 1993a). Mixed mesophytic forests in the region contain sugar maple, American beech, American basswood, hickories, oaks, eastern hemlock, tulip poplar, and white ash.

Based on botanical field surveys (HDR 2022c), the majority of the Western Transmission Corridor consists of fields (i.e., pasture/hay, and wet and dry herbaceous vegetation; 88.6 percent), with the remaining portion consisting of forested (deciduous and mixed) land (9.9 percent) and maintained areas (1.7 percent) (Table 3.8-8). The majority of the forested area occurs along the edges of access roads. Figures are provided with the report in Appendix L.

Table 3.8-8. Vegetation Types and/or Land Uses along the Western Portion of the Alternative A Transmission Corridor

Vegetation Types	Total Area (acres)	Percent of Vegetated Area
Hay/Pasture	83.4	66.3
Dry Herbaceous	18.2	14.5
Wet Herbaceous	9.8	7.8
Wet Deciduous	9.0	7.2
Dry Deciduous	3.3	2.7
Maintained Lawn	2.1	1.7
Total[1]	**125.8**	**100.0**

[1]Total Percent varies slightly due to rounding

3.8.1.1.2.6 Construction and Operation of a Natural Gas Pipeline

Information regarding vegetation types within the ETNG Construction ROW was obtained from a desktop review of aerial photography, existing land use classifications, and results of environmental field surveys completed to-date by ETNG (ETNG 2022d). From east to west, the ETNG Construction ROW encompasses portions of the following USEPA Level IV Ecoregions: Outer Nashville Basin, Eastern Highland Rim, Plateau Escarpment, Cumberland Plateau, Southern Limestone/Dolomite Valleys and Low Rolling Hills, and Southern Dissected Ridge and Knob (Griffith et al. 1997; ETNG 2022d).

ETNG's Resource Report 3 (ETNG 2022d), which TVA has independently reviewed, provides the following description of vegetation types in the proposed ETNG Construction ROW:

> The Outer Nashville Basin ecoregion plant communities include cedar glades and thickets, cedar-hardwood forests, and deciduous forests. Pasture and hay fields are common with few row crops. The soils are generally shallow and thus cropland is generally in small tracts on terraces or narrow bottoms (Griffith et al. 1997).
>
> The vegetation of the Eastern Highland Rim is primarily oak-hickory forests. The area is transitional between the oak-hickory in the west and mixed mesophytic forests of the Cumberland Plateau to the east. The forest communities are xeric and sub-xeric oak-hickory forests; mesic upland forests of tulip poplar (*Liriodendron tulipifera*),

maple (*Acer* spp.), and beech (*Fagus grandifolia*); mixed mesophytic forests of maples, beech, white oak (*Quercus alba*), walnut (*Juglans* spp.), yellow buckeye (*Aesculus flava*), and white basswood (*Tilia americana* var. *heterophylla*); bottomland forests of sliver maple (*Acer saccharinum*), box elder (*A. negundo*), red maple (*A. rubrum*), sycamore (*Platanus occidentalis*), and slippery elm (*Ulmus rubra*), and rare eastern hemlock (*Tsuga canadensis*) forests that have a mixed mesophytic component (Griffith et al. 1997).

The Plateau Escarpment and Cumberland Plateau regions of the Southwest Appalachian Region are known for high-gradient streams and deep ravines and gorges with a variety of microclimates. Vegetation includes mixed oak (*Quercus* spp.) on upper slopes, mixed mesophytic forest on the middle and lower slopes made up of beech, tulip poplar, sugar maple (*Acer saccharum*), white basswood ash (*Fraxinus* spp.), and hemlock along rocky stream sides and river birch (*Betula nigra*) along floodplain terraces (Griffith et al. 1997). The Cumberland Plateau is primarily mixed oak and oak-hickory communities. White oak is most common, but scarlet oak (*Quercus coccinea*) and black oak (*Q. velutina*) are frequently observed. Upper slopes can be associated with Virginia pine (*Pinus virginiana*) as well as old fields and cliff edges.

Common vegetation in the Southern Limestone/Dolomite Valleys and Low Rolling Hills include white oak forests, bottomland oak forests, and sycamore-ash-elm riparian forests. Pine plantations occur in some areas of the ecoregion. Grassland barrens are also common in non-forested areas (Griffith et al. 1997).

The Southern Dissected Ridges and Knobs include oak and pine (*Pinus* spp.) forests typically occurring at higher elevations and white oak, mixed mesophytic and tulip poplars forests on the middle and lower slopes. Limited agriculture includes pastures and cropland where slopes are less steep (Griffith et al. 1997).

Vegetation types in the proposed ETNG Construction ROW were determined by ETNG through a review of NRCS Land Use Cover Data (NRCS 2022) and 2022 field surveys and are summarized in Table 3.8-9 and Appendix D-5. The survey area primarily consisted of agricultural land (45.9 percent) and forested habitats (40.2 percent).

Table 3.8-9. Vegetation Communities Affected by Construction and Operation within ETNG Construction ROW[1]

Study Area Component	Available Habitat Area (acres) by Type Located in the ETNG Construction ROW			Percent Total[3]
	Pipeline Corridor[2]	Hartsville CS	Total	
Agriculture	791.0	64.8	855.8	45.9
Bottomland Hardwood	2.8	0.0	2.8	0.2
Deciduous Forest	94.8	0.6	95.4	5.1
Upland Herbaceous/Shrub	230.2	0.1	230.3	12.4

Study Area Component	Available Habitat Area (acres) by Type Located in the ETNG Construction ROW			Percent Total[3]
	Pipeline Corridor[2]	Hartsville CS	Total	
Mixed Forest	484.6	0.0	484.6	26.0
Evergreen Forest	167.1	1.3	168.4	9.0
Wetland	26.0	0.1	26.1	1.4
Total[1,2]	**1,796.5**	**66.9**	**1,863.4**	**100**

Source: ETNG 2022d; NRCS 2022
[1] The totals shown in this table do not include non-native vegetated land such as industrial and residential areas, or open water.
[2] The impacts to vegetation for certain Project facilities, namely staging areas, the Kingston M&R Station, and Harriman Lateral Crossover are still being evaluated by ETNG.
[3] Total Percent varies slightly due to rounding

Invasive Plant Species

Invasive plant species identified within the ETNG Construction ROW during 2022 biological field surveys are listed in Table 3.8-10.

Table 3.8-10. Invasive Plants Identified within the ETNG Construction ROW by County

Species		County						
Scientific Name	**Common Name**	**Trousdale**	**Smith**	**Jackson**	**Putnam**	**Overton**	**Fentress**	**Morgan**
Chinese privet	*Ligustrum sinense*	X	X	X	X	X	X	X
Common privet, European privet	*Ligustrum vulgare*		X		X			
Amur honeysuckle	*Lonicera maackii*							X
Morrow's bush honeysuckle	*Lonicera morrowii*		X					X
Multiflora rose	*Rosa multiflora*	X	X	X	X	X	X	X
Autumn olive	*Elaeagnus umbellata*				X			X

Source: ETNG 2022d

3.8.1.1.3 Alternative B

The East Tennessee TVA Power Service Area primarily lies within the Interior Plateau, Southwestern Appalachian, and Central Appalachian ecoregions. The Interior Plateau ecoregion is further subdivided by the Western Highland Rim, Eastern Highland Rim, and Western Pennyroyal Karst (Griffith et al. 1998). The Southwestern Appalachian ecoregion is further subdivided by the Plateau Escarpment, Sequatchie Valley, and the Cumberland Plateau. The Central Appalachian ecoregion is further subdivided into the Cumberland Mountains.

The Interior Plateau is a diverse ecoregion with natural vegetation, primarily oak-hickory forest, with some areas of bluestem prairie and cedar glades. The Western Highland Rim is characterized by rolling terrain of open hills and oak-hickory forests. The Eastern Highland Rim has more level terrain than the Western Highland Rim, with landforms characterized as "tablelands" of moderate relief and irregular plains. Natural vegetation in this region is transitional between the oak-hickory type to the west and the mixed mesophytic forests to the east. Many bottomland hardwood forests that were formerly abundant have been inundated by large impoundments. The Western Pennyroyal Karst has irregular plains and mostly gently rolling and weakly dissected karst sinkholes and depressions. Natural vegetation in this region consists of oak-hickory forest and bluestem prairie (Griffith et al. 1998).

The Southwestern Appalachian contains a mosaic of forest and woodland with some cropland and pasture (Griffith et al. 1998). The Plateau Escarpment is characterized by having long, steep mountainsides, some vertical cliffs near the top of escarpment. Natural vegetation in this region contains mixed oak and chestnut oak on upper slopes and mixed mesophytic forests on lower slopes. The Sequatchie Valley is characterized by an undulating to hilly 4-mile-wide linear valley, some bottomland and low terraces, and small alluvial fans. Natural vegetation in this region contains Appalachian oak forests (mixed oaks, hickory, pine, poplar, birch, and maple). The Cumberland Plateau is characterized by undulating and rolling tableland with some open low mountains. Natural vegetation consists of mixed oak forest on uplands and mixed mesophytic forests in ravines and gorges (Griffith et al. 1998).

The Central Appalachian consists of high hills and low mountains covered by mixed mesophytic forest with areas of Appalachian oak and northern hardwood forests (Griffith et al. 1998). The Cumberland Mountains are characterized by low mountains with long, steep slopes, narrow to uneven crests, and narrow, winding valleys. Natural vegetation in this region contains mixed mesophytic forest.

The major forest communities in the East Tennessee TVA region include mesophytic forest, Appalachian oak forest, and oak-hickory forest. The mesophytic forest is the most diverse, with 162 tree species. Mesophytic forests are among the most biologically rich systems of the temperate regions of the world (Martin et al. 1993a). While canopy dominance is shared by several species, red maple and white oak have the highest average importance values. A distinct section of the mesophytic forest, the Appalachian oak section, is dominated by several species of oak, including black, chestnut, northern red, scarlet, and white oaks. The bottomland forests in this region are dominated by American elm, bald cypress, green ash, sugarberry, and sweetgum.

3.8.1.2 Environmental Consequences

3.8.1.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate KIF as part of the TVA generation portfolio (see Section 2.1.2). TVA would implement all planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be reviewed in subsequent NEPA analysis. As a result, no new work would be conducted that could potentially alter Project-related environmental conditions within each plant. Therefore, there would be no direct or indirect effects to vegetation communities because there would be no physical changes to the current conditions.

3.8.1.2.2 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

Most of the vegetation community types on the Kingston Reservation consist of heavily disturbed habitats with little conservation value (TVA 2020c), including species such as brome grasses, autumn olive, Johnson grass, tall fescue, sericea lespedeza, dogbane, common milkweed, blackberry, yellow wingstem, white wingstem, and poverty oatgrasses. Much of the area within the demolition boundary is developed and/or unvegetated (108.6 acres, 45.2 percent) or low-quality habitat with high densities of weedy species or maintained areas (i.e., ruderal, manicured lawn, or herbaceous plant communities) (58.6 acres, 24.4 percent) (Figure 3.8-1). Vegetated areas within the demolition boundary primarily consist of forested areas (61 acres, 25 percent, consisting of deciduous forest, early successional forest, and mixed forest areas) and manicured lawn (24 acres, 10 percent). Forested areas (deciduous and mixed forest) are present on the eastern side of the demolition boundary and along parts of the Clinch River on the southern boundary. Many forested areas are generally highly disturbed habitat supporting many non-native species such as Chinese privet, and not likely to hold high value for wildlife, except for a forested strip along the Clinch River which contains some mature hardwood forest.

Removal of on-site buildings and structures would involve demolition to three feet below final grade via mechanical destruction and/or explosives. All buildings and structures with below grade features would be backfilled. Vegetation may colonize areas with sufficient soil following deconstruction and removal of the existing facility and would likely comprise similar species to those currently observed in ruderal open areas. No cumulative effects to vegetation are anticipated.

3.8.1.2.2.1 Environmental Justice Considerations

Effects to vegetation that would occur because of KIF coal facility retirement and D4 activities are not anticipated to have disproportionate and adverse human health or environmental effects on EJ populations as TVA would implement appropriate mitigation measures per their BMP Plan. These effects would be minor and limited to the TVA-owned reservation, where no residential populations are present.

3.8.1.2.3 Alternative A

3.8.1.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Approximately 54.7 acres of vegetation within the proposed CC/Aero CT Plant site and 8.5 acres of vegetation within the proposed switchyard footprint would be impacted due to permanent clearing of vegetation (Figure 3.8-2). These areas primarily consist of heavily disturbed herbaceous or ruderal plant communities, which maintain little habitat value for wildlife. Effects to vegetation in these areas would generally result from earthmoving and vegetation clearing activities associated with the construction of the proposed Alternative A components. To prevent the introduction and spread of invasive species, disturbed areas on all action alternatives would be revegetated with native or non-invasive plant species.

3.8.1.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

Construction and installation of the 3- to 4-MW Solar Facility would have the potential to permanently impact 4.81 acres of the manicured lawn. This area has been previously disturbed and is maintained regularly. The remaining 30.1 acres impacted are generally devoid of vegetation with land use consisting of coal storage and associated infrastructure. Vegetation seeding would occur after construction is completed and the solar facility is operational. Native species less than 12 inches in height would be seeded in the solar array area with pockets of pollinator habitat outside of the array area where there is sufficient space. This would result in moderate improvement to existing conditions in this area.

3.8.1.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation
Clearing and construction of Battery Site 1 for the 100-MW BESS would result in permanent impacts to approximately 30 acres, the majority of which has been previously disturbed. This includes 6.0 acres of manicured lawn, 3.0 acres of mixed forest, 0.5 acre of deciduous forest, and 0.3 acre of sparsely vegetated ruderal habitat. The remaining 21.4 acres consists of non-vegetated areas.

If Battery Site 2 is selected, it would potentially result in permanent impacts to approximately 35 acres of vegetated area for clearing of the site and construction of the battery facility. This includes 24.7 acres of mixed forest, 5.8 acres of deciduous forest, 2.7 acres of early successional habitat, 0.03 acre of herbaceous vegetation, and 1.8 acres of sparsely vegetated ruderal area.

Battery Site 3 would potentially result in permanent impacts to approximately 40 acres of vegetated land through clearing and construction of the battery facility. This includes 27.1 acres of deciduous forest, 9.1 acres of mixed forest, 3.2 acres of herbaceous vegetation, and 0.7 acre of early successional habitat.

3.8.1.2.3.4 On-site Transmission Upgrades
Construction of the 100-MW BESS under Alternative A would include the addition of battery transmission line connections that would tie into the existing on-site transmission lines on Kingston Reservation and has the potential to result in temporary impacts to 17.1 acres of low-quality habitat, including early successional vegetation, disturbed herbaceous habitat, manicured lawn, and sparsely vegetated ruderal areas. The remaining 24.4 acres of deciduous and mixed forest would be permanently impacted from clearing activities and eventually result in the conversion of forested habitat to early successional or shrub vegetation communities.

Like much of the site, vegetation around the proposed transmission line upgrades consists of highly disturbed herbaceous, ruderal, and early successional habitat (approximately 93.3 acres, 72.9 percent), forest (21.6 acres, 16.9 percent), and manicured lawn (13.9 acres, 10.9 percent). The forested habitat would be permanently converted to herbaceous/scrub-shrub habitat while, the herbaceous/early successional plant communities are expected to experience short-term, temporary impacts from disturbances during construction activities. Disturbed areas would be seeded and allowed to regenerate following construction activities.

Forested areas on the margins of the ROW may be limbed, and those crossed by the transmission lines would be cleared and converted to an herbaceous or scrub-shrub plant community to ensure the safe and reliable transmission of power from the plant to the switchyard. Vegetation within the active transmission ROW on the proposed CC/Aero CT Plant site would be managed following the TVA Transmission System Vegetation Management Program (TVA 2018a, 2020a) to assure the safe and reliable operation of the transmission facilities. Generally, areas within the transmission line ROW would be maintained as scrub-shrub and herbaceous land. Typical vegetation management activities consist of herbicide application (90 percent), mechanical control (i.e., brush hogs, equipment-mounted saws; 6 percent), and manual methods (i.e., chainsaw, handsaw; 4 percent). Tree maintenance would be limited to trees that presented an immediate hazard to the reliability of the transmission system. Localized herbicide application and mowing are the vegetation management tools that would be used most frequently to clear vegetation on the floor of the open ROW. Other manual, mechanical, and herbicide application methods, along with debris management and restoration activities would likely occur infrequently and/or do not have the potential to affect vegetation on a meaningful scale. Tree clearing along the ROW margins, if necessary, would result in a minor overall change to plant habitats present on the landscape.

3.8.1.2.3.5 Off-site Transmission Line Upgrades

Disturbance of vegetation communities for the existing transmission line off-site upgrades would be minor. Tree clearing is anticipated within forested areas that fall within margins the proposed project areas; many of these areas occur along the edges of existing access roads (TVA 2022a). Brush clearing or tree trimming to allow for the passage of equipment may be needed, but tree removal is not expected. Modifications would generally be limited to the existing 20-foot-wide access road area, and, if needed, tree trimming to allow a vertical clearance of up to 12 feet. Minor ground disturbance is expected in these areas, but, if the ground is disturbed, the access road area would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed (TVA 2022a). Areas such as pasture, agricultural fields, lawns, or developed areas would experience minor, temporary disturbance for the passage of equipment and would be returned to their former condition following upgrade activities. Areas such as pasture, agricultural fields, or lawns are often subject to herbicide methods for localized treatments of weeds by landowners, and farmland does not often contain many trees requiring control (TVA 2018a). Therefore, effects to agricultural areas would be minor.

Vegetation within the existing, active transmission ROW is generally maintained as scrub-shrub and herbaceous land which is necessary to assure the safe and reliable operation of the transmission systems. Ongoing vegetation management activities occur on a 3-year cycle and would likely consist primarily of herbicide application with mechanical control or manual methods as needed and do not have the potential to affect vegetation on a meaningful scale (TVA 2018a, 2020a). Routine tree maintenance would be limited to trees that present an “immediate hazard” and, in some instances, a “danger” or to the reliability of the transmission system. Tree clearing along the transmission line ROW margins, if necessary, would result in a minor overall change to plant habitats present on the landscape.

Localized applications of herbicide could result in some level of off-target effect (TVA 2018a). In situations where the woody stem count is high on a given ROW, even localized application of herbicides could produce substantial effects to non-target species depending on whether herbicides are broadcast over a large area or applied directly to the targeted vegetation. However, these areas of high woody stem count would be unlikely to support high-quality herbaceous habitats, usually because of site-specific conditions unrelated to TVA vegetation management (i.e., owner land use, soil type, landscape position, etc.). In drier transmission line ROW areas with rocky or sandy soils, where woody stem count is inherently lower, localized herbicide application could foster herbaceous plant communities that are rare on the landscape. These important plant habitats may be globally rare or just relatively diverse herbaceous communities, with limited distribution remaining in the southeastern U.S. Mowing would remove nearly all woody stems and can result in regrowth of high woody stem counts; however, the amount of re-growth can depend on conditions on the ground (TVA 2018a). For example, in drier areas with sandy or rocky soils, the rate of tree establishment and growth is relatively slow. In this case mowing can help to maintain high quality native plant communities. However, in all but the driest habitats in the eastern U.S., tree invasion is rapid, and woody plants quickly replace herbaceous species. In addition, repeated mowing of transmission line ROW encourages stump resprouting (sucker growth) and promotes dense stands of woody species.

This is particularly problematic in wetlands or on sites with rich soils. Using mowing alone, or as the primary mechanism for vegetation removal on ROWs, would reduce species diversity and encourage the dominance of woody plants able to proliferate through root resprouting.

TVA uses the Office-Level Sensitive Area Review (O-SAR) process to avoid effects to important plant habitats within ROWs by limiting the use of the most damaging methods in areas likely to contain grasslands dominated by native plant species (TVA 2018a). Broadcast and aerial herbicide is restricted on about 17 percent (about 41,000 acres) of TVA's ROW that are likely to contain important habitat. Manual, mechanical, and localized herbicide methods can be used in these areas and likely serve to perpetuate important herbaceous habitats found in the ROW by eliminating trees that rapidly encroach into open areas without appropriate disturbance. No rare plant habitat was identified within the transmission corridor. If rare plant communities are identified along the transmission corridor in the future, these areas would be documented in the O-SAR database and TVA biologists and operations staff would work together to ensure the habitats are protected during vegetation maintenance activities. This would ensure that the most potentially damaging tools, like broadcast herbicide, would not be used in ROW supporting important grassland habitats and that the proposed vegetation management activities would not have minor effects on terrestrial plant ecology of the region.

3.8.1.2.3.6 Construction and Operation of a Natural Gas Pipeline

During construction, the ETNG Construction ROW would be cleared of vegetation to the extent necessary to allow for safe working conditions, resulting in direct impacts to vegetation, as described in Table 3.8-11. The pipeline facilities would be located adjacent to existing pipeline ROW and other linear utilities where feasible. Collocating the pipeline with existing linear utilities helps to minimize vegetation clearing and minimizes the area of impact on forested habitat, along with reducing the occurrence of natural community segmentation.

Based on ETNG surveys, approximately 1,155 acres of vegetation would be temporarily impacted by construction activities within the proposed ETNG Construction ROW but excluding the permanent ROW (Table 3.8-10). These vegetation communities consist of agricultural (47 percent), forested (42 percent), grassland areas (10 percent), wetlands (1.0 percent), and scrub-shrub (0.4 percent). In locations where the Pipeline ROW or workspace within the ETNG Construction ROW requires clearing, trees would be cut into lengths and chipped, burned, or removed to an acceptable site. In temporary workspaces, tree stumps and rootstock would be left in place wherever possible to facilitate natural revegetation. Impacts to agricultural and grassland areas would be minor as these habitats would regenerate relatively quickly following the completion of construction activities. Impacts to forested areas would be moderate given the length of time and succession of reestablishing forest stands after removal; while temporary, this would be a long-term impact.

Approximately 723 acres of vegetation would be permanently impacted with the operation of the natural gas pipeline with a 50-foot-wide permanent ROW and associated aboveground structures (Table 3.8-11). These vegetation communities consist primarily of agricultural (45 percent), forested (37 percent), and grassland (14 percent) areas. Permanent impacts to vegetation in the ETNG Construction ROW is due to regular maintenance activities (discussed below), resulting in a permanent conversion of vegetation community type from forested to herbaceous or scrub-shrub vegetation. Therefore, impacts to herbaceous type communities and agricultural areas would be minor as they would be allowed to regenerate to original condition. Large impacts would occur to forested areas due to the permanent conversion of this habitat to herbaceous or scrub-shrub habitat through the permanently established ROW.

Table 3.8-11. Summary of Impacts to Vegetation Communities Within the ETNG Construction ROW

Component	Agricultural		Bottomland Hardwood Forest		Deciduous Forest		Evergreen Forest		Mixed Forest		Grassland		Scrub-Shrub		Wetland		Total[1]	
	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation	Construction	Operation
Pipeline Facilities	777	302	3	1	91	31	163	48	478	187	216	103	7	3	26	16	1,761	693
Access Roads	14	3	0	0	4	0	4	0	6	0	7	1	1	0	0	0	36	4
Total	**791**	**305**	**3**	**1**	**95**	**31**	**167**	**48**	**485**	**187**	**223**	**104**	**7**	**3**	**26**	**16**	**1,796**	**697**
Aboveground Facilities																		
Hartsville Compressor Station	65	16	0	0	1	0	1	0	0	0	0	0	0	0	0	0	67	16
Columbia Gulf M&R Station	8	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	4
Gainsboro Crossover	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4
Clarkrange Crossover	0	0	0	0	0	0	1	1	2	2	0	0	0	0	0	0	3	3
Aboveground Facilities Total	**76**	**23**	**0**	**0**	**1**	**0**	**2**	**1**	**2**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**81**	**26**

Source: Summarized from ETNG (2022d)
[1] Non-native vegetated land (industrial and residential) and open water is not included.
Notes: Construction impacts include impacts within the permanent ROW and therefore within the operational areas. Temporary impacts are Construction impacts minus Operation impacts.

If noxious or invasive species are identified during field surveys, ETNG would implement the following measures to minimize the potential for spreading:

- install erosion control and restoration measures described in FERC's Plan and FERC's Procedures (FERC 2013a, 2013b) to minimize the potential for spread of invasive species via displaced soils;
- use weed free mulch, where applicable, to stabilize the soil surface in accordance with ETNG's E&SCP;
- clearing and grading activities may include mowing to limit the spread of noxious weeds due to construction activities;
- set up equipment cleaning stations as needed and ensure construction equipment is clean and free of soil and debris prior to arriving on-site; and
- conduct upland and wetland restoration and post-construction monitoring.

TVA has independently reviewed and concurs with the vegetation-related findings in ETNG's Resource Report 3 (ETNG 2022d):

> Following construction, the entire natural gas pipeline ROW would be restored in accordance with the E&SCP and FERC's Plan and Procedures (FERC 2013a, 2013b). The temporary workspaces used during construction would be seeded in accordance with NRCS recommendations and landowner requests or, in wetlands, allowed to revegetate naturally in accordance with applicable permit conditions. In accordance with FERC's Plan, ETNG would monitor disturbed areas to determine the post-construction revegetation success for two growing seasons. Revegetation would be completed in accordance with permit requirements and agency and landowner recommendations, where appropriate.
>
> Routine maintenance of the natural gas pipeline ROW would be required to allow continued access for routine pipeline patrols, maintaining access in the event of emergency repairs, and visibility during aerial patrols. In upland areas, maintenance of the ROW would involve clearing the entire permanent ROW of woody vegetation. As such, the maintained permanent ROW would be subjected to mowing every three years. This maintenance would result in permanent conversion of some areas of existing upland forested vegetation to herbaceous or scrub-shrub vegetation.
>
> A new 50-foot-wide permanent easement would be maintained by ETNG. In upland areas, routine maintenance would involve clearing the entire 50-foot-wide ROW every three years. However, to facilitate periodic corrosion surveys, a 10-foot-wide strip centered on the pipeline may be mowed annually to maintain herbaceous growth. In wetlands and riparian areas, routine maintenance would be performed at a frequency necessary to maintain a 10-foot-wide corridor centered on the pipeline in an herbaceous state, and removal of trees within 15 feet of the pipeline in accordance with FERC's Procedures. Forested land would be permanently converted to herbaceous and scrub-shrub land within the permanent easement as a result of maintenance.
>
> Vegetated land within the operational areas for the compressor station and solar farm would be converted to commercial/industrial land. Operational activity at the

aboveground facilities would be limited primarily to maintenance and inspection, repair, and cleaning of equipment and associated piping. Vegetation within the aboveground facilities would be maintained by mowing, cutting, and trimming, as necessary.

Impacts on vegetation, such as agricultural lands, open lands, and herbaceous wetlands, are anticipated to be short-term and temporary, as these areas would be expected to return to preconstruction conditions within one or two growing seasons after restoration is complete. Forested impacts, however, represent the greatest potential impact on vegetation types and would include permanent conversion of forested wetlands to emergent wetlands. Temporary workspaces located in forested areas would result in temporary effects to the vegetation and would take longer to return to pre-construction, forested conditions.

3.8.1.2.3.7 Summary of Alternative A

TVA Actions

Activities associated with the retirement of KIF (i.e., D4 activities) would result in up to 131.4 acres of permanent impact, consisting of approximately half landscaped and herbaceous vegetation communities, and half forested areas. With implementation of the proposed CC/Aero CT Plant and switchyard, 3- to 4-MW Solar Facility, 100-MW BESS, On-site Transmission Lines, and Off-Site Transmission Line Upgrades, a range of 119 to 156 acres of permanent impacts to vegetation (depending on the site selection for the 100-MW Battery Facility) and 1,260.1 acres of temporary impacts to vegetation would occur. Most permanent impacts consist of forested areas that would be removed if Battery Sites 2 or 3 were selected, and forested areas that would be converted to herbaceous or scrub-shrub habitat within on-site transmission line corridors. Overall, effects to forested areas (approximately 56.1 to 88.8 acres depending on the site selection for the 100-MW Battery Facility) would be minor moderate due to the loss or conversion of habitat in these areas. Temporary impacts consist primarily of herbaceous or early successional habitat and manicured lawn, therefore, impacts to these areas would be minor as regeneration after disturbance would be short-term.

Impacts would occur to forested areas due to the permanent conversion of habitat types (i.e., forest to herbaceous, early successional, or scrub-shrub communities) throughout the on-site transmission line corridors. Permanent impacts also include the loss of vegetation in the CC/Aero CT Plant site and switchyard due to the placement of fill materials. However, a portion of new habitat would be gained with the construction of the 3- to 4-MW Solar Facility with native plant seeding and potential pollinator habitat.

Cumulative effects to vegetation on the proposed CC/Aero CT Plant site are anticipated to be minor as the majority of the site consists of previously disturbed habitat that holds little conservation value. Disturbed areas would be revegetated with native species and clearing and other vegetation management activities would be minimized to the extent possible.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Many permanent impacts would occur to vegetation communities located within the permanent ROW. As the natural gas pipeline would be primarily collocated along other existing ROWs, and the abundance of alternative habitat in the surrounding areas, the effects of vegetation removal would be moderate. Temporary impacts to herbaceous and early successional plant communities would be minor due to the short-term nature of impacts, as these areas would be reseeded with native seed and allowed to regenerate following completion of construction activities. Impacts to forested areas due to construction of the natural gas pipeline would be a moderate due to the time necessary for woody vegetation growth and recolonization of these areas.

Cumulative effects to vegetation for the ETNG Construction ROW would be moderate. The ETNG Construction ROW would be primarily collocated with existing ROWs to minimize effects of forest fragmentation. A summary of expected impacts to plant communities under Alternative A are described in Table 3.8-12.

Table 3.8-12. Summary of Estimated Vegetation Impacts for Alternative A

Alternative A Component	Impact Type	Herbaceous[1]/ Early Successional	Forest	Scrub-Shrub	Landscaped/ Manicured	Kudzu Infested	Agriculture	Total
KIF Demolition	Permanent	46.8	60.7	--	23.9	--	--	131.4
	Temporary	--	--	--	--	--	--	--
CC/Aero CT Plant and Switchyard	Permanent	56.6	6.7	--	--	--	--	63.3
	Temporary	--	--	--	--	--	--	--
3- to 4-MW Solar Facility	Permanent	34.8	--	--	--	--	--	--
	Temporary	--	--	--	4.8	--	--	4.8
100-MW BESS[2]	Permanent	0.3 – 4.6	3.5 – 36.2	--	6.0	--	--	9.8 – 46.8
	Temporary	--	--	--	--	--	--	--
On-site Transmission Lines[3]	Permanent	--	45.9	--	--	--	--	45.9
	Temporary	86.6	--	--	14.8	--	--	124.3
Off-site Transmission Lines[4]	Permanent	--	--	--	--	--	--	--
	Temporary	1,043.1	--	41.1	94.0	12.1	--	1,53.9
Total (excluding demolition)	**Permanent**	**91.7-96.0**	**56.1-88.8**	**--**	**6.0**	**--**	**--**	**119-156**
	Temporary	**1,129.7**	**--**	**--**	**118.3**	**12.1**	**--**	**1,260.1**
Natural Gas Pipeline[5]	Permanent	104.0	270.0	3.0	--	--	329.0	724.0
	Temporary	223.0	754.0	8.0	--	--	868.0	1,879.0

[1] Includes ruderal
[2] Range of values presented for the three Battery Sites
[3] Includes battery transmission line connections
[4] Includes Eastern and Western Transmission Corridors. Forested area that falls within these corridors are likely on the margins of the corridor or along access roads and will not be impacted beyond standard trimming, which is currently conducted as needed.
[5] Includes access roads and all aboveground facilities

3.8.1.2.3.8 Environmental Justice Considerations

TVA Actions

Effects to vegetation that would occur as a result of the D4 process and the proposed CC/Aero CT Plant, and from on-site transmission line activities would be minor and limited to the Kingston Reservation; these effects are not anticipated to have disproportionate or amplified environmental and human health effects on EJ populations because no human settlements are present within the Kingston Reservation. Effects to vegetation resulting from proposed upgrades to off-site transmission lines would also be minor (i.e., tree trimming, brush removal and vegetation maintenance) and as such are not anticipated to result in amplified effects toward EJ populations.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Effects occurring as a result of pipeline activities would be moderate. The ETNG Construction ROW would be primarily located adjacent to an existing pipeline corridor, which would minimize effects. The greatest impact of the ETNG Construction ROW on vegetation construction would be from the clearing of forested areas. In areas that are currently used by EJ populations, including the forested areas, there may be amplified effects on EJ populations who use resources from the forest for subsistence.

3.8.1.2.4 Alternative B

3.8.1.2.4.1 Construction and Operation of Solar and Storage Facilities

Alternative B would result in construction of solar and storage facilities that have the potential to affect vegetation communities. As noted in Table 3.2-1, TVA has evaluated typical effects associated with the development of solar facilities. Solar facilities average approximately 1.2 acres of forest clearing per MW, with a range of 0 to 15 acres per MW (Table 3.2-1). Based on the need for approximately 1,500 MW of solar facilities, approximately 1,800 acres of forest would be cleared with a maximum of 22,500 acres cleared. For 2,200 MW of BESS facilities, approximately 2,040 acres of forest would be cleared with a maximum of 25,500 acres. Impacts to herbaceous plant communities would also likely occur but cannot be estimated at this time. TVA and solar developers would minimize effects to vegetation by siting facilities on previously cleared land and configuring the solar arrays, access roads, and other infrastructure to avoid sensitive vegetation communities. BESS sites are typically small enough to be sited to avoid adverse vegetation effects. Appropriate field investigations for rare plant communities would be completed prior to land disturbing activities.

Vegetation would be maintained in the long-term by traditional mowing and trimming around structures on a regular basis, depending on growth rate. Sheep grazing may also be employed to control invasive weed outbreak.

Cumulative effects to vegetation may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA. Based on the average of 1.2 acres of forest clearing per MW, an additional 12,000 acres of vegetation would be impacted within the TVA PSA. Cumulative effects would also occur to herbaceous plant communities lost due to construction of solar arrays, BESS, or access roads. Cumulative effects to vegetation would be minimized through proper siting of solar facilities and the use of BMPs.

3.8.1.2.4.2 Transmission and Other Components

As noted in Table 3.3-1, transmission lines typically result in an average of 5.5 acres of forest clearing per mile of new line. Based on TVA's evaluation, an average of 1.7 miles of new transmission line are needed for solar facilities, which equates to approximately 141.1 acres of forest that may be impacted for all 15 solar facilities, and 159.9 acres for the 17 BESS facilities. Transmission lines would be maintained as described in Section 3.8.1.1.2.4 and Section 3.8.1.1.2.5.

Cumulative effects to vegetation may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA, which would also require additional transmission line support. Cumulative effects to vegetation would be minimized through proper siting of solar facilities and the use of BMPs.

3.8.1.2.4.3 Environmental Justice Considerations

Effects to vegetation that would occur as a result of the proposed solar facilities and transmission line activities would primarily be associated with the direct removal of forested areas. While these effects would be minor and generally limited to the immediate project sites and transmission line corridors, they may result in amplified effects to EJ populations in the surrounding areas.

3.8.2 Wildlife

Although limited information exists for direct wildlife observations for the action alternatives, inferences can be made depending on the potential types of habitat present based on field surveys (if wildlife is not directly observed) or desktop analyses. Threatened and endangered species and migratory species are included in Section 3.8.4, and therefore this section considers only those not listed with state or federal protections.

3.8.2.1 Affected Environment

3.8.2.1.1 Kingston Reservation

The terrestrial wildlife found within the Kingston Reservation is directly related to the vegetation and habitats present on-site. The Kingston Reservation is located within the Valley and Ridge ecoregion, and more specifically, the Southern Limestone/Dolomite Valley sand Low Rolling Hills and supports a variety of common wildlife species (TVA 2020c). Visual wildlife surveys have been conducted since 2011 to assess bird, reptile, and mammal populations around the Reservation.

Herbaceous fields and fragmented forests provide habitat for a variety of wildlife species across the Kingston Reservation. In herbaceous fields dominated by Johnson grass, Eastern meadowlarks, grasshopper sparrows, and savannah sparrows are common; red-tailed and red-shouldered hawks use the open areas for hunting (TVA 2020c).

Edge habitat occurs at the nexus between field and forest and allows for a diverse bird community. Birds inhabiting edges include, but are not limited to, northern bobwhite, eastern phoebe, Carolina wren, brown thrasher, white-eyed vireo, northern cardinal, indigo bunting, eastern towhee, and field and song sparrows (TVA 2020c). Small mammals and larger mammals, such as white-tailed deer and coyotes, also utilize edge habitat.

Forests on the peninsula of the Kingston Reservation range from dry oak-hickory and dry mesic oak-hickory forests to bottomland forests (TVA 2020c). Oak-hickory forests provide habitat for wild turkey, yellow-billed cuckoos, woodpeckers, eastern wood pewees, blue jays, American crows, Carolina chickadees, eastern tufted titmice, white-breasted nuthatches, and many Neotropical migrants. Mammals occurring in oak-hickory forests include deer mice, white-tailed deer, gray fox, gray squirrel, eastern chipmunk, bats, and others. Reptiles include rat snakes, five-lined skinks, eastern box turtles, and others.

Narrow bands of bottomland forests are found on the Kingston Reservation peninsula along the river margin and within wet sloughs (TVA 2020c). Birds observed in these types of areas include green and great blue herons, wood ducks, spotted sandpipers, belted kingfishers, and eastern kingbirds. Mammals specific to bottomland forests in the area include the beaver and muskrat. Because these areas typically stay wet, amphibians may be abundant. Amphibians include the American toad, spring peeper, and others. Water snakes are also typically abundant. Fringe wetlands along the Clinch River provide habitat for red eared sliders, painted turtles, and other turtle species.

A summary of wildlife observed in the vicinity of Kingston is presented in Table 3.8-13, with more detailed information provided in TVA (2020a) in Appendix J. These observations suggest that a relatively healthy wildlife community exists near KIF, and the Kingston Reservation is representative of common ecosystems in the region. However, the typical behavior of reptiles, amphibians, and mammals limits observation of these groups by visual encounter survey methods; therefore, the estimation of the presence and diversity of these taxa was also limited.

Table 3.8-13. Wildlife Observed in the Vicinity of Kingston Reservation

Wildlife	Total Animals Observed[1]	Average No. of Animals per reach[2]
Birds		
American coot	109	5.45
American crow	81	4.05
American goldfinch	2	0.1
American robin	1	0.05
Belted kingfisher	5	0.25
Black crowned night heron	1	0.05
Black duck	7	0.35
Black vulture	2	0.1
Blue jay	52	2.6
Canada goose	42	2.1
Cardinal	2	0.1
Carolina chickadee	19	0.95
Carolina wren	4	0.2
Cliff swallow	15	0.75
Common grackle	3	0.15
Domestic duck	2	0.1
Domestic goose	1	0.05
Double-crested cormorant	138	6.9
Downy woodpecker	4	0.2
Eastern bluebird	2	0.1
Eastern kingbird	1	0.05
Eastern phoebe	2	0.1
European starling	7	0.35
Great blue heron	48	2.4
Little blue heron	1	0.05

Wildlife	Total Animals Observed[1]	Average No. of Animals per reach[2]
Mallard	55	2.75
Mockingbird	22	1.1
Mourning Dove	2	0.1
Osprey	5	0.25
Pied-billed grebe	5	0.25
Red-headed woodpecker	3	0.15
Red-tailed hawk	1	0.05
Red-winged blackbird	6	0.3
Ring-billed gull	1	0.05
Rock dove	182	9.1
Ruby-throated hummingbird	1	0.05
Rufous-sided towhee	1	0.05
Turkey vulture	12	0.6
Unspecified duck	8	0.4
Unspecified perching bird	35	1.75
Western kingbird	1	0.05
Wood duck	12	0.6
Yellow-shafted flicker	7	0.35
Reptiles/Amphibians		
Eastern spiny softshell turtle	1	0.05
Common slider	11	0.55
Map turtle	93	4.65
Painted turtle	3	0.15
Red-eared turtle	1	0.05
Unspecified turtle	3	0.15
Mammals		
Eastern grey squirrel	15	0.75
White-tailed deer	4	0.2

[1] Surveys completed 2011-2013, 2015, and 2020
[2] A total of four reaches of the Clinch River were surveyed: left and right descending banks for each, Clinch RM 4.4 and 1.5

Surveys for general wildlife habitat were completed as part of the 2019 Natural Resources Survey (TVA 2020c, Appendix J). A total of 827.0 acres of habitat was identified on the Kingston Reservation as suitable for general wildlife (Figure 3.8-3).

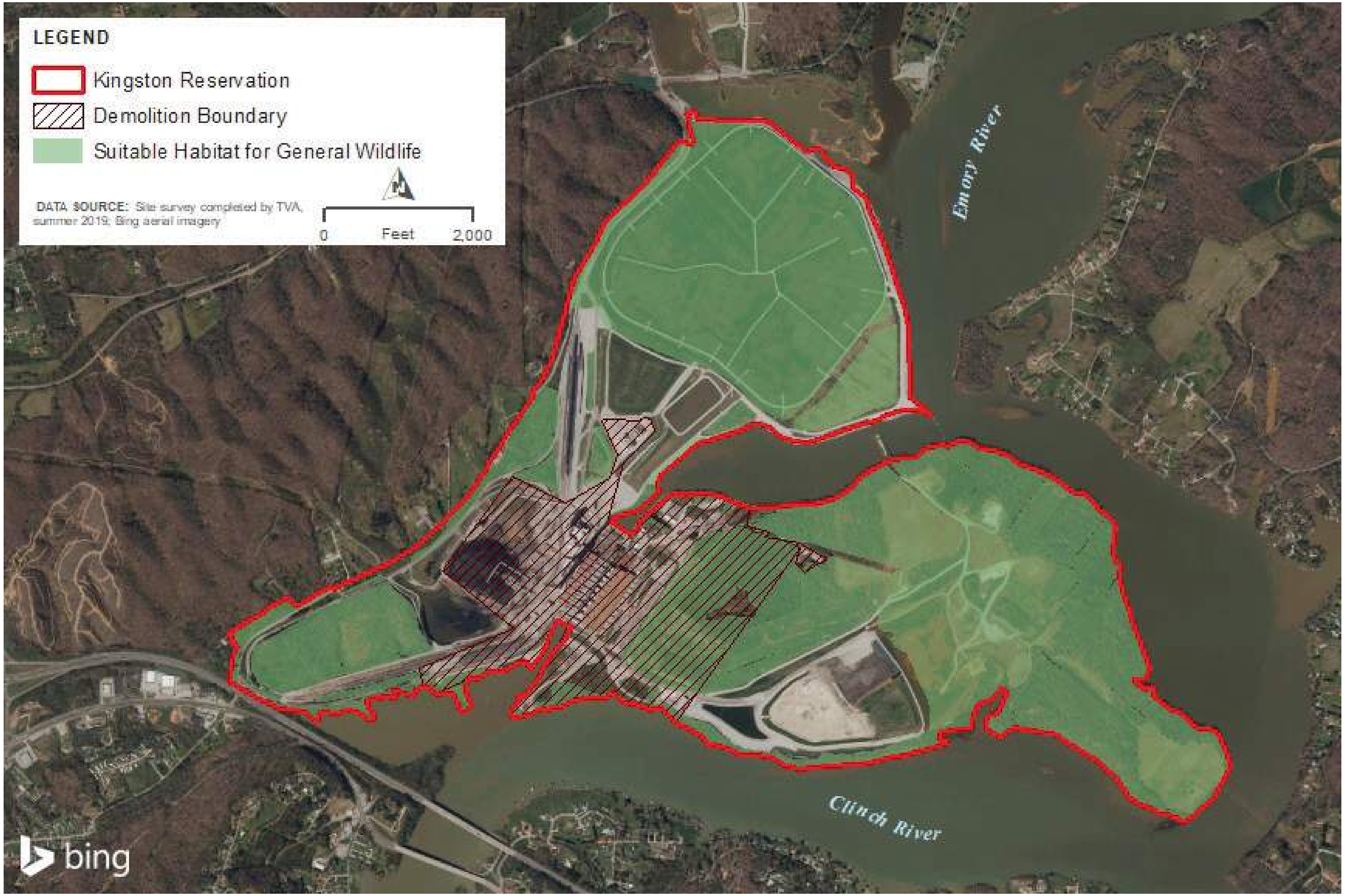

Figure 3.8-3. General Wildlife Habitat Identified on the Kingston Reservation

3.8.2.1.2 Alternative A

3.8.2.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

According to the 2019 Natural Resources Survey (TVA 2020c, Appendix J), approximately 49.9 acres (91 percent) of the proposed CC/Aero CT Plant site and the entirety of the switchyard site provides habitat for common wildlife, such as birds, reptiles, amphibians, and mammals (Figure 3.8-4).

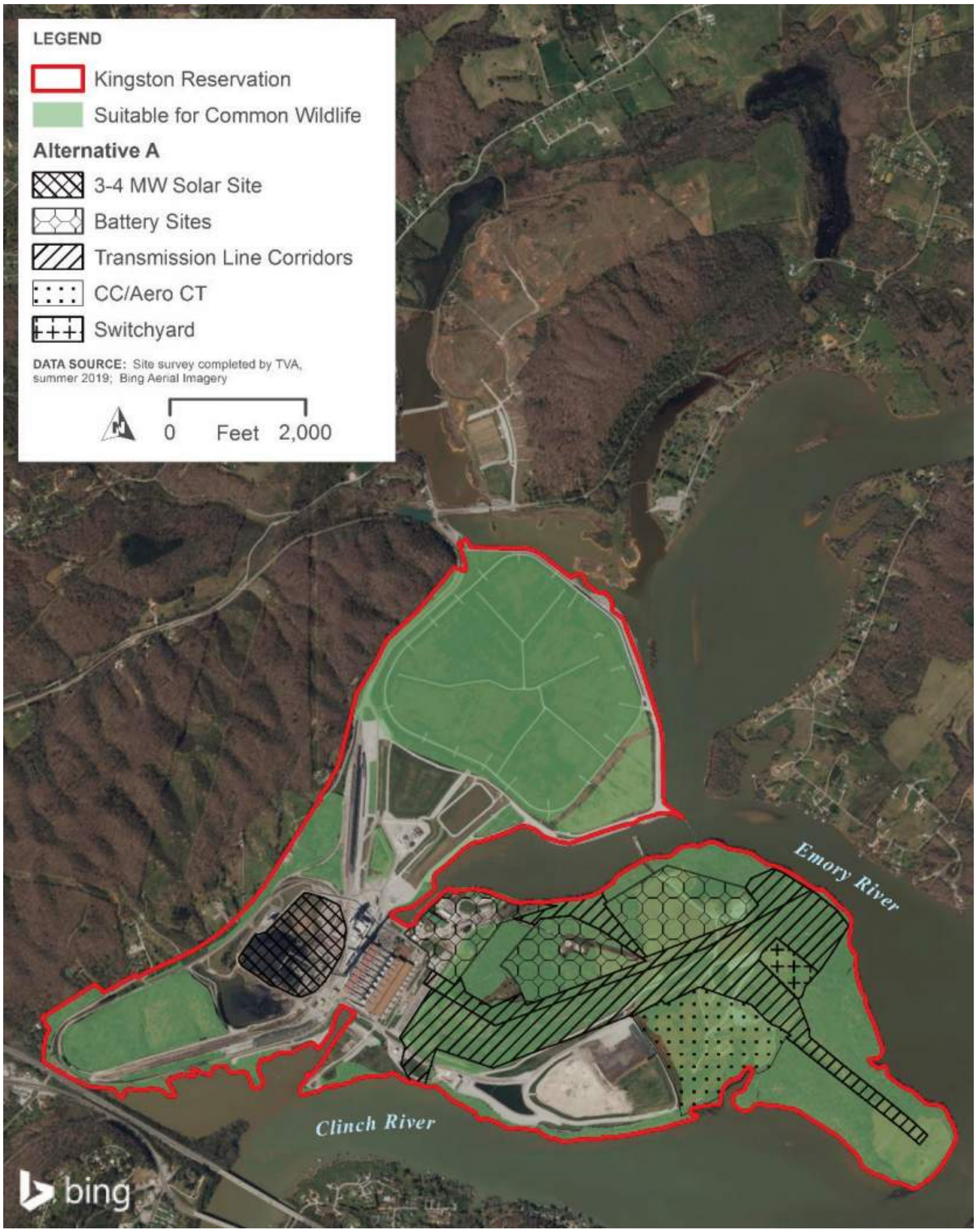

Figure 3.8-4. General Wildlife Habitat on the Proposed Combined Cycle/Aero Combustion Turbine Plant Site on the Kingston Reservation

3.8.2.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on a site that is currently used as a coal storage yard for the existing KIF fossil units except for 4.8 acres of manicured lawn (Figure 3.8-4). The coal storage yard does not provide habitat for common wildlife.

3.8.2.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

All three battery sites options provide some level of habitat for common wildlife species. Battery Site 1 provides the least amount of habitat at just 8.7 acres (29 percent of the proposed site) (Figure 3.8-4). Battery Site 2 currently provides 30.4 acres of habitat (87 percent of the proposed site), and the entire Battery Site 3 is currently considered sufficient for common wildlife species.

3.8.2.1.2.4 On-site Transmission Upgrades

The battery transmission line connections comprise an area of approximately 41 acres, of which 39.4 acres (96 percent) contains suitable habitat for common wildlife observed in the vicinity of Kingston Reservation (Figure 3.8-4).

Vegetated habitats observed along the transmission line corridor proposed for upgrades (see Section 3.8.1.1.2.5) provides 120.5 acres of habitat for common wildlife species (Figure 3.8-4).

3.8.2.1.2.5 Off-site Transmission Line Upgrades

Eastern Transmission Corridors

A field survey of terrestrial wildlife for L5108 and L5302 within the Eastern Transmission Corridor and L5383 within the Western Transmission Corridor was completed in June 2022 (HDR 2022b). TVA later determined a need for additional transmission upgrades within the Eastern Transmission Corridor for L5116, L5280, and L5381. The analysis of impacts on wildlife of these additional transmission upgrades are based on analysis of publicly available data.

As such, the analyses of terrestrial wildlife in the Eastern Transmission Corridor presented in this draft EIS is subdivided based on the source of the data used:

- L5108 and L5302 — based on analysis of field survey results and other available publicly available data; and
- L5116, L5280, and L5381 — based on desktop analysis of publicly available data.

Lines 5108 and 5302 – Data from Field Surveys

The vegetation communities present in the vicinity of the Eastern Transmission Corridors (i.e., within the Southern Limestone/Dolomite Valleys and the Rolling Hills Ecoregion, a subdivision of the Ridge and Valley Ecoregion) includes Appalachian oak, bottomland oak, and mesophytic forests, and cedar glades. According to Martin et al. (1993a), approximately 228 terrestrial vertebrate species potentially occur in Appalachian oak forests, including up to 43 species of amphibians, 32 species of reptiles, 83 species of birds, and 70 species of mammals. Amphibians in these habitats are dominated by salamanders, but also include tree toads, spadefoot, and six frog species. Reptiles consist of common box turtle, eight species of lizard, and 22 species of snakes including two types of copperhead and the timber rattlesnake. Birds are the most abundant vertebrate of the Appalachian oak forests, with greatest bird diversity occurring in the pre-vegetative closure and mature forest successional stages. Birds in these forest stages include indigo bunting, prairie warbler, northern cardinal, field sparrow, rufous-sided towhee, barred owl, wild turkey, wood thrush, ovenbird, red-eyed vireo, and scarlet tanager. Mammals are found in greatest diversity in more mature successional stages, and are numerically dominated by rodents such as mice, voles, squirrels, and chipmunks (Martin et al. 1993a).

Amphibians, reptiles, and mammals found in bottomland forests include salamanders, gray tree frog, cottonmouth, moccasin, black rat snakes, mud turtles, river otter, beaver, mink, raccoons, gray squirrels, swamp rabbits, white-tailed deer, gray fox, and bobcat (Martin et al. 1993b). Birds that may use bottomland forests for nesting or foraging consist of waterfowl such as hooded merganser, wood duck, mallards, songbirds such as prothonotary warbler, Northern parula warbler, summer tanager, yellow-throated warbler, and Carolina chickadee; and raptors and woodpeckers, such as red-shouldered hawk, barred owl, and pileated woodpecker (Martin et al. 1993a).

Mesophytic forests are described above for the Western Transmission Corridor. Fauna of cedar glades habitat is less diverse in other areas, primarily due to the desiccating heat and lack of permanent pools or streams. Except for Fowler's toad and American toads, most amphibians are not present or present temporarily. Lizards are common, as well as the five-lined skink, six-lined racerunner, black racer, ground skink, and coach-whip snake. Few birds nest on the rocky outcrops except near larger forested islands. Mammals are also restricted to the larger forested areas and consist of the woodland vole, short-tailed shrew, cottontail rabbit, gray squirrel, white-tailed deer, gray fox, and raccoon (Martin et al. 1993a).

As stated above, wildlife surveys of the off-site transmission line corridors were completed in June 2022. Wildlife and evidence of wildlife along the transmission lines are provided in Table 3.8-14.

Table 3.8-14. Wildlife Species Observed in the Off-Site Transmission Corridors within the Project Area

Species Observed (Common Name)	Observed Location (Eastern or Western Corridor)	Notes/Habitat Observed in Project Area
Birds		
Woodpecker spp.	Eastern	Flying around a tree and pecking at tree within an upland forested habitat
Wild Turkey	Eastern	Multiple times at forest edges and at the bottom of forested areas
Northern Cardinal	Both	Flying around low hanging branches within scrub shrub habitat
American Crow	Western	Flying overhead
Red-tailed Hawk	Both	Flying overhead
Killdeer	Eastern	In agricultural field on the western section of the transmission line and along roadbeds
Barred Owl	Eastern	Heard within forested areas near ponds/wetlands
Black Vulture	Both	Flying overhead along multiple areas of the transmission line
Blue Jay	Western	Flying overhead within the transmission line
Osprey Nest	Both	Observed on transmission line pole

Species Observed (Common Name)	Observed Location (Eastern or Western Corridor)	Notes/Habitat Observed in Project Area
Amphibians		
Leopard Frog	Both	In multiple streams throughout the site
Green Frog	Western	In multiple streams throughout the site
American Toad	Both	In damp forested areas throughout the site
Cricket Frog	Western	In streams and ponded areas throughout the site
Unidentified Tadpoles	Both	In many puddles and streams throughout the site.
Reptiles		
Eastern Box Turtle	Eastern	In forests near streams multiple times throughout the site
Smooth Soft Shell	Eastern	Found within East Fork Poplar Creek
Rat Snake	Eastern	Within a forest edge along the transmission line
Pond Sliders	Western	In multiple ponds across the site
Five-Lined Skinks	Both	Along forested edges with downed trees near the transmission line
Common Snapping Turtle	Western	Within stream system
Insects		
Unidentified Damselfly	Eastern	Flying over some of the smaller creek beds
Macroinvertebrates		
Caddisflies	Both	In many drainages throughout the site
Midges	Both	In many drainages throughout the site
Mayflies	Both	In many drainages throughout the site
Scuds	Both	In many drainages throughout the site
Mammals		
Armadillo	Eastern	In forested area
Raccoon	Eastern	In forested wetland
White-tailed deer	Western	Within cow pasture
Tracks/Scat/Remains		
Deer Track and Scat	Both	In several locations across the site
Raccoon Track	Eastern	In several of the creek beds throughout the site

Lines 5116, 5280, and 5381 – Data from Desktop Sources

TVA will conduct wildlife field surveys on L5116, L5280, and L5381 within the Eastern Transmission Corridors through 2023. A desktop review of the existing transmission line ROWs and access roads identified land use as primarily agricultural, with smaller portions of forested and developed areas (Section 3.8.1.1.2.5, Section 3.10.1.2.5.1). Bodies of water, such as wetlands, streams, ponds, and lakes are also present based on NHD and NWI databases (Section 3.6.2.1.2.5)

Overall, wildlife habitats present on the transmission line corridors and access roads are likely similar to that of the field surveyed portion of the Eastern Transmission Corridor (L5108 and L5302) and common to the region and, as habitats, are not unique or uncommon. The transmission corridors proposed for upgrades under Alternative A are existing ROWs; therefore, no significant land clearing is required. Tree trimming and brush removal may be required to use access roads, but no tree removal is anticipated. Many organisms can live entire life cycles within the ROW, such as songbirds, small mammals, butterflies, reptiles, and amphibians (EPRI 2002); other animals that may be more transitory are larger mammals or animals associated with forests, such as deer, bear, squirrels, rabbits, and raccoons, among many others. Ecotones, such as the edges of forests along ROWs, may also have increased wildlife diversity due to the joining of different habitat conditions (EPRI 2002).

Western Transmission Corridor

Line 5383 – Data from Field Surveys

Proposed upgrades to L5385 within the Western Transmission Corridor falls within the Southwestern Appalachians Cumberland Plateau ecoregion containing mixed oak and mixed mesophytic forests. Mixed oak forests in this region have reptiles such as box turtles, garter snake, ground skink, black rat snake, hognose snake, five-lined skink, and rough green snake; and amphibians present may include slimy salamander, dusky salamander, American toad, and spring peeper. Common birds in this habitat consist of ovenbird, black-throated green warblers, black-and-white warblers, blue jay, red-eyed vireo, wood thrush, Carolina chickadee, hairy woodpecker, and wood pewee. Mammals in mixed oak forests include small mammals such as smoky shrew, pygmy shrew, short-tailed shrew, white-footed mouse, eastern chipmunk, flying squirrel, gray squirrel, and golden mouse. Larger mammals and bats present may consist of white-tailed deer, raccoon, striped skunk, gray fox, red bat, and big brown bat (Martin et al. 1993a).

Mixed mesophytic forest support the richest and most abundant avifauna, mammalian fauna, and amphibian fauna, exceeded only by bottomland forests or marshes (Martin et al. 1993a). Mixed mesophytic forests support several reptile species such as coal skink, worm snake, copperhead, black racer, black rat snake, ring-necked snake, five-lined skink, garter snake, and box turtle. Amphibians found in these environments consist of green salamanders, cave salamanders, red-spotted newts, slimy salamanders, Fowler’s toad, American toad, gray treefrog, spring peeper, mountain chorus frog, and wood frog. Common mammals in the mixed mesophytic forests include small mammals such as white-footed mouse, short-tailed shrew, smoky shrew, eastern chipmunk, flying squirrel, gray squirrel, eastern woodrat, and hairy-tailed mole. Larger mammals and bats also present consist of red bat, opossum, big brown bat, gray fox, raccoon, striped skunk, and white-tailed deer (Martin et al. 1993a).

A desktop review of the existing transmission line ROWs and access roads identified land use as primarily agricultural, with smaller portions of forested area, and actively maintained by TVA in an herbaceous field condition. Bodies of water, such as wetlands, streams, and ponds, are also present based on NHD and NWI databases and confirmed by field reconnaissance surveys (HDR 2022b, Appendix L). Overall, wildlife habitats present on the transmission line corridors and access roads are likely common to the region and, as habitats, are not unique or uncommon. The transmission line corridors under Alternative A are existing facilities that are proposed for upgrades; therefore, no significant land clearing is required. Tree trimming and brush removal may be required to use access roads, but no tree removal is anticipated. Many organisms can live entire life cycles within the ROW, such as songbirds, small mammals, butterflies, reptiles, and amphibians (EPRI 2002); other animals that may be more transitory are larger mammals or animals associated with forests, such as deer, bear, squirrels, rabbits, raccoons, among many others. Ecotones, such as the edges of forests along ROWs, may also have increased wildlife diversity due to the joining of different habitat conditions (EPRI 2002).

Species that were either directly observed during the June 2022, field surveys within the transmission line, or whose evidence (e.g., tracks, scat, remains) was noted during the field survey are listed in Table 3.8-14.

3.8.2.1.2.6 Construction and Operation of a Natural Gas Pipeline

The proposed ETNG Construction ROW traverses terrestrial and wetland habitats that support a diversity of wildlife species (ETNG 2022d). For the purposes of this report, ETNG described wildlife habitats regionally and representative of the vegetation community structure and composition of the terrestrial and wetland habitats present within the ETNG Construction ROW.

As stated in ETNG's Resource Report 3 (ETNG 2022d):

> Dominant wildlife habitat types have been identified based on field surveys and review of available resource materials. These habitat types include upland forest, open uplands, forested wetlands, scrub-shrub wetlands, emergent wetlands, urban, and open water habitats.
>
> Upland forests are found throughout the Project area and mostly occur along the edges of the existing rights-of way. Upland forested habitats are dominated by oaks, hickories, pines, and maples. These forests provide year-round food resources, cover, and nesting habitat for a variety of wildlife species. Mast-producing oaks generate an abundance of acorns, which are exploited by a diverse group of forest species. Even in relatively developed and urbanized areas, forested patches may be inhabited by numerous wildlife species. Large wildlife species such as the white-tailed deer (*Odocoileus virginianus*) use these forested habitats for food and cover. Small mammals capitalize on the availability of the numerous nest cavities in the form of snags and felled logs. They include such species as the opossum (*Didelphis virginiana*), gray squirrel (*Sciurus carolinensis*), and raccoon (*Procyon lotor*). The abundant small mammal population in this forest habitat type provides prey for owls and hawks.
>
> A variety of songbirds use hardwood oak habitat type for all or parts of their life cycle. Many Neotropical migrants feed on the numerous insects occurring within the forest canopy. Breeding birds use a range of different nest sites, with some species nesting on the forest floor, some in the understory vegetation, and some in the tree canopy. Characteristic resident bird species in oak forests include red-bellied woodpecker (*Melanerpes carolinus*) and wild turkey (*Meleagris gallopavo*). Typical migratory species might include great crested flycatcher (*Myiarcus crinatus*) and wood thrush (*Hylocichla mustellia*).
>
> The open upland habitat types in the Project area include successional scrub-shrub areas, fields, and disturbed and/or maintained areas such as existing utility ROWs or other open space areas. Open uplands are prevalent within the Project workspaces. Early successional and grassland habitats are attractive to many wildlife species. Species such as eastern cottontail (Sylvilagus floridanus) frequently prefer shrubby, overgrown open habitats. Other early successional and grassy areas offer habitat for ground-nesting birds such as eastern meadowlark (Sturnella magna), killdeer (Charadrius vociferus), and song sparrow (*Melospiza melodia*).

Edge habitats adjacent to open space areas can create another type of habitat that is used by a distinct group of species. Examples of species that are often found along edges include the white-tailed deer, wild turkey, coyote (Canis latrans), gray fox (*Urocyon cinereoargenteus*), red fox (*Vulpes vulpes*), and eastern cottontail. Eastern box turtles (*Terrapene carolina*) travel between forest, forest edge, and open habitats. Bird species that are forest edge specialists, such as blue-winged warbler (*Vermivora pinus*), field sparrow (*Spizella pusilla*), rufous-sided towhee (*Pipilo erythrophthalmus*), and prairie warbler (*Dendroica discolor*) are often present where the upland fields border forested areas and along utility ROWs. Corridors and edges are also used by hunting raptors, such as red-tailed hawks (*Buteo jamaicensis*), American kestrels (*Falco sparverius*) and sharp-shinned hawks (*Accipiter striatus*), which feed on small mammals and birds.

Forested wetlands have a diverse assemblage of plant species and provide important food, shelter, migratory and overwintering areas, and breeding areas. Typical aquatic and wetland wildlife in forest and shrub swamps include the white-tailed deer, raccoon, cotton mouse (*Peromyscus gossypinus*), wood duck (*Aix sponsa*), prothonotary warbler (*Protonotaria citrea*), and wild turkey.

Scrub-shrub wetland habitats are typically not as structurally diverse as forested wetlands. They contain vegetation that is characteristically low and compact. Under normal conditions the vegetative structure is usually caused by surface water inundation for extended periods of time. Scrub-shrub wetlands can also be maintained by periodic maintenance (such as along existing ROWs) that removes larger trees. The plant species in a scrub-shrub wetland offer excellent nesting sites for birds. Common species include red-winged blackbird (*Agelaius phoeniceus*), pickerel frog (*Rana palustris*), and spring peeper (*Pseudacris crucifer*).

Freshwater emergent wetlands include wet meadows and emergent marshes characterized by a variety of grasses, sedges and rushes. They are often associated with areas containing standing water for extended periods of time. Common species of birds associated with emergent wetlands include red-winged blackbird, killdeer, and common grackle (*Quiscalus quiscula*). Common mammals associated with this habitat type include star-nosed mole (Condylura cristata), mink (*Neovison vison*), raccoon, and muskrat (*Ondatra zibethicus*). White-tailed deer capitalize on the abundance of grasses and forbs. A large variety of amphibians and reptiles is also commonly found within these areas such as bullfrogs (*Rana catesbeiana*), common snapping turtle (*Chelydra s. serpentina*), painted turtle (*Chrysemys picta*), and pickerel frog.

Urban environments are characterized by a low diversity of wildlife species that are tolerant of human development and activity. Common bird species in cities and residential areas include European starlings (*Sturnus vulgaris*), house sparrows (*Passer domesticus*), rock pigeons (*Columba livia*), mourning doves (Zenaidura macroura), and northern mockingbirds (*Mimus polyglottos*). The Project is not located in heavily urbanized areas, but some urban environments do occur within the Project vicinity.

ETNG reviewed the ETNG Construction ROW to identify managed wildlife habitats including National Wildlife Refuges, Wildlife Management Areas, or privately owned preserves. No National Wildlife Refuges are crossed or located within the ETNG Construction ROW. The Old

Hickory Wildlife Management Area (WMA) and Cordell Hull WMA are crossed by the Study Area. WMAs are managed by the Tennessee Wildlife Resources Agency (TWRA). Managed wildlife habitat crossed by the ETNG Construction ROW is summarized in Table 3.8-15.

Table 3.8-15. Managed Wildlife Habitat Crossed by the ETNG Construction ROW

Habitat Type/Name	Milepost Start	Milepost End	Number Crossings	Crossing Length (feet)
Old Hickory WMA	2.67	6.9	5	5,359
	3.80	3.10	150	
	3.24	3.35	1,450	
	5.45	5.59	730	
	6.15	6.84	3,600	
Cordell Hull WMA	28.0	32.0	4	6,011

The Old Hickory WMA is composed of approximately 6,000 acres of which 1,000 are accessible by land. The remainder is accessible only by boat. Habitat in this WMA consists of patches of hardwood forest of oak, hickory, and maple, and riparian forest of black willow and sycamore along the shoreline of parts of the lake. These forested areas are mixed with cropland that is flooded for waterfowl in winter. Wildlife in the Old Hickory WMA include waterfowl in winter; early successional birds in summer, including indigo bunting, northern cardinal, eastern towhee, and yellow-breasted chat; and sparrows of various species in winter. There are approximately a dozen heron rookeries around Old Hickory Lake (TWRA 2022a).

The Cordell Hull WMA is located on USACE property adjacent to the Cumberland River, spanning from the Cordell Hull Lock and Dam to the south to the Clay County and Jackson County lines to the north. This WMA includes over 200 agricultural fields consisting of crops beneficial to wildlife (primarily soybeans) and early successional habitat. Wildlife within the Cordell Hull WMA includes birds including northern cardinal, blue jays, and tufted titmouse. Neotropical migrant songbirds found along the trail include scarlet tanager and Ovenbird (TWRA 2022b).

Additional information about natural areas near the Project are provided in Section 3.9.1.2.

3.8.2.1.3 Alternative B

The East Tennessee region lies within three ecoregions: the Interior Plateau, Southwestern Appalachian, and Central Appalachian regions. Wildlife habitats in these regions include oak-hickory forests, bluestem prairie, mixed mesophytic forests, mixed oak and chestnut oak forests, Appalachian oak forests, and northern hardwood forests. Collectively, the forested areas across East Tennessee are considered Eastern Deciduous Forests and contain a number of wildlife species such as American woodcock, brown thrasher, eastern meadowlark, golden-winged warbler, great horned owl, mourning dove, northern bobwhite, ovenbird, wild turkey, wood duck, bobcat, eastern cottontail, eastern gray squirrel, gray fox, Indiana bat, white-tailed deer, eastern box turtle, and timber rattlesnake (University of Tennessee 2020).

3.8.2.2 Environmental Consequences

3.8.2.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate KIF as part of the TVA generation portfolio (see Section 2.1.2).

TVA would implement all planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be reviewed in subsequent NEPA analyses. As a result, TVA would continue to follow environmental compliance procedures for maintenance and operations. With appropriate BMPs implemented during operation and maintenance, any effects to wildlife would be minor.

3.8.2.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Approximately 72.2 acres of habitat suitable for common wildlife species is present within the boundary of the demolition area. Direct effects to common wildlife during D4 activities are the result of permanent displacement when vegetation (habitat) and/or buildings and structures are removed. Most of the vegetated areas on Kingston Reservation consist of highly disturbed vegetation communities and hold little value for wildlife except for transitory and common species, such as American crow, blue jay, Canada goose, mockingbird, and rock dove, or common mammals such as gray squirrels. Individuals who are immobile (e.g., eggs, nests, animals in hibernation) could be directly impacted. Wildlife habituated to the area are likely to move to other suitable environments off-site or outside of the demolition boundary, which are plentiful, and it is expected that they would return to the area upon Project completion.

At a minimum, wildlife using mature forested habitat would experience long-term temporary impacts from tree removal and subsequent regeneration. The majority of forested areas (49.4 acres, or 84.3 percent of forested area within the demolition boundary) are highly disturbed habitat supporting many non-native species such as Chinese privet, and not likely to hold high value for wildlife, except for a forested strip along the Clinch River which contains some mature hardwood forest. Because most of the Kingston Reservation contains highly disturbed habitat, and particularly within the demolition boundary, effects to common wildlife from D4 activities would be minor.

Cumulative effects to wildlife may occur as a result of the RFFAs of CCR management activities occurring in proximity to the proposed D4 activities but are anticipated to be minor. Tree removal would occur between November 15 and March 31 to the greatest extent possible, thereby attempting to avoid direct effects to many species of wildlife that may be breeding or nesting in these locations. Habitat removal likely would disperse mobile wildlife into surrounding areas in an attempt to find new food sources, shelter sources, and to reestablish territories. Over time, species utilizing early successional habitat are likely to return to the disturbed area following completion of construction activities.

3.8.2.2.2.1 Environmental Justice Considerations

Negative effects to wildlife in the immediate vicinity of Kingston that would occur as a result of coal facility retirement and D4 activities are not anticipated to adversely affect EJ populations because there are no human settlements on the Kingston Reservation. The addition of wildlife into surrounding suitable habitat may be beneficial to both EJ and non-EJ populations that utilize those habitats for subsistence and other purposes.

3.8.2.2.3 Alternative A

3.8.2.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Almost the entire proposed CC/Aero CT Plant site for Alternative A (including the switchyard) could provide habitat for general wildlife (58.5 acres of the 63.5-acre site) (Figure 3.8-4). It is anticipated that 49.9 acres of habitat suitable for general wildlife would be permanently impacted due to habitat removal. Habitat removal likely would displace mobile wildlife into surrounding areas in an attempt to find new food sources, shelter sources, and to reestablish territories. Tree removal at this site would occur between November 15 and March 31, to the greatest extent possible, thereby attempting to avoiding direct effects to many species of wildlife that may be breeding or nesting in these locations at other times of the year. Vegetated habitats on Kingston Reservation are generally low-quality due to prior direct and surrounding disturbance and invasion of non-native species; therefore, these areas are unlikely to hold a high abundance or diversity of wildlife. Effects to wildlife on the Kingston Reservation due to the construction of the CC/Aero CT Plant and switchyard would be minor.

3.8.2.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed area of the 3- to 4-MW Solar Facility is primarily currently used for coal storage, except for along the northern edge of the footprint where the area consists of manicured lawn (where common species such as Canada Goose, American Robin, and groundhogs could be present. Minor impacts to common wildlife during construction of the solar array would occur, primarily as a temporary loss in low-quality habitat. However, as discussed in Section 3.8.1.2.3.2, the area under and around the solar array would be seeded with native herbaceous plants and would include plant species for pollinator use. As noted in the IRP EIS (TVA 2019b), the maintenance of a permanent vegetative cover on a solar facility, particularly when composed of native plant species, can also increase local wildlife diversity (Beatty et al. 2017). As such, the construction of the 3- to 4-MW Solar Facility would result in minor beneficial effects to common wildlife and potentially pollinators on Kingston Reservation.

3.8.2.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Construction of any of the three potential Battery Site option would result in permanent habitat loss due to clearing and the addition of fill materials. Construction of Battery Site 1 would result in the loss of 8.7 acres of wildlife habitat; construction of Battery Site 2 would result in the loss of 30.5 acres of wildlife habitat; and construction of Battery Site 3 would result in the loss of 40 acres of habitat for common wildlife.

Vegetation removal and construction of the proposed 100-MW BESS sites may result in indirect effects to some common wildlife due to disturbance, which would likely disperse mobile wildlife into surrounding areas in an attempt to find new food sources, shelter sources, and to reestablish territories. As clearing activities are planned to occur outside of the breeding/nesting season (i.e., between November 15 and March 31) to the extent practicable, minor effects, if any, would occur to immobile species/life stages (i.e., eggs, juveniles, hibernating individuals).

3.8.2.2.3.4 On-site Transmission Upgrades

Approximately 39.4 acres (96 percent) of the battery transmission line connections area provides habitat for common wildlife species (Figure 3.8-4). Forested areas within the battery transmission line connections area (24.4 acres) would be permanently converted to an herbaceous or scrub-shrub vegetation community, which may alter the fauna composition utilizing this area. Wildlife within the battery transmission line connections area would be subjected to temporary disturbance during construction and during times of regular maintenance.

Upgrades to existing transmission lines on Kingston Reservation would result in the potential habitat conversion of 21.5 acres of forested habitat to herbaceous and early successional vegetation. The remaining 107.3 acres of herbaceous and early successional habitat, ruderal, and manicured lawn areas would be temporarily disturbed during upgrade activities. These activities would result in the displacement of any wildlife present during the time of construction.

Wildlife using forested areas within the battery transmission line connections or transmission line upgrades areas would experience a large direct and indirect impact due to displacement from habitat loss (if unable to use herbaceous or scrub-shrub habitat) and limited alternative habitat on Kingston Reservation. See Section 3.8.2.2.3.1 for additional detail on potential impacts to flightless and flying wildlife.

Like in other areas and associated construction activities under Alternative A, forest clearing would be conducted during the non-breeding season (between November 15 and March 31) to the extent practicable in order to avoid direct impacts to wildlife that may be immobile during nesting, roosting, or young rearing. Wildlife utilizing the transmission line areas following construction would experience minor impact from periodic disturbance due to maintenance activities. Additional information regarding regular maintenance activities along transmission line corridors is provided in Section 3.8.1.1.2.5.

The existing transmission line corridors and new battery transmission line connects would undergo regular, routine vegetation maintenance. Wildlife present in these areas would likely move out of the area during maintenance and return following completion of those activities. Continued maintenance of vegetation within the ROWs would result in periodic disturbance of wildlife in the area, which would likely return to the corridor following completion of the maintenance activities.

3.8.2.2.3.5 Off-site Transmission Line Upgrades

Wildlife within the transmission line corridors may be temporarily displaced by disturbance during upgrade activities. Habitat within the off-site transmission line corridors has the potential to be disturbed during upgrades. For the Western Transmission Corridor, that includes approximately 111.4 acres of herbaceous habitats (including hay/pasture) that may be temporarily disturbed. Similarly, the Eastern Transmission Corridor could result in temporary impacts to 1,129.7 acres of field during the proposed upgrade activities. Forested areas along the Eastern and Western Transmission Corridors would not be disturbed except by limb trimming where needed for equipment access on access roads. Impacts to wildlife during the short period of upgrade activities would be minor.

The existing Eastern and Western transmission corridors regularly undergo routine vegetation maintenance. Wildlife present in these areas move out of the area during maintenance and return following completion of those activities. This would also likely occur during the proposed transmission line upgrades. Ongoing routine maintenance of vegetation within the ROWs results in periodic disturbance of wildlife in the area, which return to the corridor following completion of the maintenance activities. This is not expected to change upon completion of upgrades to lines within the Eastern and Western Transmission Corridors.

3.8.2.2.3.6 Construction and Operation of Natural Gas Pipeline

Activities within of the ETNG Construction ROW would temporarily affect approximately 1,155 acres of vegetation due to construction activities (ETNG 2022d). Approximately 723 acres of vegetation would be permanently impacted with the operation of the natural gas pipeline and associated aboveground facilities, primarily consisting of habitat conversion. The permanent ROW would consist of a 50-foot-wide corridor maintained as an herbaceous or scrub-shrub vegetation community. A 10-foot-wide strip within the permanent corridor would be maintained as an herbaceous plant community to protect and maintain the integrity of the pipeline against woody vegetation growth. Additional information regarding vegetation impacts is included in Section 3.8.1.2.3.4.

Temporary wildlife effects are those associated with disturbance to habitats during construction, while permanent effects are those associated with conversion of forested habitats to scrub-shrub and emergent habitats, resulting from periodic maintenance of the permanent natural gas pipeline ROW (ETNG 2022d). Indirect wildlife effects associated with construction noise and increased activity should be temporary and could include abandoned reproductive efforts, displacement, and avoidance of work areas. Construction activities may result in mortality of small mammals, reptiles, and amphibians that are less mobile during clearing and grading operations.

Regionally, maintained utility ROWs can provide early successional habitats for several important game species including white-tailed deer and wild turkey. The pipeline permanent ROW may function as travel corridors for some generalist species and provide edge habitat along large, forested areas. The ROW would be revegetated with herbaceous and shrub cover would provide food, cover and breeding habitat for those species that utilize open habitats.

To minimize permanent effects to wildlife and promote the rapid stabilization and revegetation of disturbed areas, ETNG would comply with the Project E&SCP, thereby minimizing disturbance to vegetation and providing for stabilization of affected areas to mitigate direct and indirect effects to wildlife (ETNG 2022d). Following construction, workspaces outside the permanent ROW would be allowed to revert to pre-construction conditions in accordance with the FERC's Plan and Procedures (FERC 2013a, 2013b). Herbaceous and scrub-shrub habitats cleared for construction purposes and then left to naturally regenerate or contained within the permanent ROW would experience minor impacts due to the relatively short-term nature of disturbance and regrowth. There would be moderate permanent loss of trees that would occur within the ROW, which would be maintained in an early successional stage by mowing and periodic tree removal (ETNG 2022d). Temporary workspaces would be allowed to naturally revegetate via natural succession. This natural revegetation process would gradually develop a stratified vegetative cover between the ROW and adjacent habitats. ETNG would also work with the TWRA to develop seed mixes and specific restoration measures for state-managed lands. Overall, construction and operation of the pipeline facilities is expected to have minor effects to the distribution or regional abundance of wildlife species given the amount and distribution of similar habitat types available in the immediate Project area.

ETNG would coordinate with the TWRA regarding significant and sensitive wildlife habitats to develop and implement avoidance and minimization efforts. Significant and sensitive habitat may include habitats that provide breeding, rearing, nesting, or calving areas; migration routes; or high-quality cover or forage areas (e.g., large tracts of contiguous forest, mature cypress swamp, established wildlife movement corridors). Sensitive wildlife habitat typically includes, but is not limited to, existing or proposed National Wildlife Refuges, state wildlife management areas, or privately owned management areas or preserves. Significant and sensitive wildlife habitat within the natural gas pipeline ROW is listed in Table 3.8-16. As presented in the table, ETNG proposed to cross most of the significant and sensitive wildlife habitat using HDD methods, which would minimize impacts to these areas.

Table 3.8-16. Sensitive Wildlife Habitat Types Crossed by ETNG Construction ROW

County	Milepost Start	Milepost End	Crossing Length (ft)	Acreage Affected		Habitat Type
				Construction	Operation	
Trousdale	2.7	3.1	5,359	7.1	3.5	Old Hickory WMA/ Reservoir
	3.3	3.4				
	5.5	5.6				
	6.2	6.3				
	6.6	6.9				
Jackson	28.0	28.7	6.011	7.8	3.0	Cordell Hull WMA/ Reservoir
	29.3	29.5				
	29.7	29.7				
	31.5	32.0				
Morgan	101.8	101.9	97.6	TBD	TBD	Emory River – Spotfin Chub Habitat
	106.6	106.7	794	2.1	0.9	Lone Mountain State Forest

TVA has independently reviewed and concurs with the wildlife-related findings in ETNG's Resource Report 3 (ETNG 2022d).

3.8.2.2.3.7 Summary of Alternative A

TVA Actions

The proposed CC/Aero CT Plant, 3- to 4-MW Solar Facility, 100-MW BESS, and On-Site and Off-site transmission lines would cause minor temporary impacts to wildlife due to disturbance from construction activities or routine maintenance (Table 3.8-17). Depending on the battery storage option chosen, up to 92.0 acres of habitat would be permanently impacted from due to habitat removal, and up to 56.5 acres impacted due to habitat conversion, depending on the BESS site chosen. Approximately 3,799.7 acres would be temporarily impacted due to construction activities and routine maintenance. Wildlife would likely avoid areas with active construction or Project activities and disperse into nearby habitat on Kingston Reservation and along off-site transmission line corridors.

Vegetated habitats on Kingston Reservation are generally low-quality due to prior direct and surrounding disturbance and invasion of non-native species. However, removal of these habitats would have a large effect on individual wildlife using these areas since there is limited habitat outside of the proposed CC/Aero CT Plant site when considering other components of Alternative A on Kingston Reservation. Additionally, the site is located on a peninsula, bordered to the north, east, and south by the Clinch River and by developed areas (KIF) on the western side. This likely restricts the extent that many types of wildlife (i.e., flightless species) are able to disperse from the area due to disturbance and habitat loss. Effects to more mobile species, such as birds and common bats, would be minor, since they could move out of the Kingston Reservation area and use similar (or higher quality) habitat nearby and across the Clinch River. Based on aerial imagery, habitat communities across the river comprise deciduous and mixed forest, early successional habitat within maintained utility ROWs, manicured lawns, and wetlands, all of which may provide suitable habitat for birds and bats previously residing on Kingston Reservation. Overall, it is unlikely that Kingston Reservation supports a highly diverse wildlife community; however, impacts to the fauna there would be moderate due to the limitations in habitat elsewhere on Kingston Reservation if species are unable to access areas across Clinch River.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Approximately 30 acres of habitat removal are expected from the construction of the access roads and associated aboveground facilities for the natural gas pipeline. An additional 268 acres of wildlife habitat would be impacted by habitat conversion, i.e., forested to herbaceous/scrub-shrub habitat. While some of the original species may use this new habitat, other species may find this change in habitat preferable. Species such as deer, songbirds, small mammals, pollinators, reptiles, and amphibians may find beneficial habitat in the permanent ROW, similar to electric utility ROWs (EPRI 2002). Wildlife present along the alignment would experience temporary effects by construction activities (disturbance), and once operational, disturbance from routine maintenance activities. Because significant portions of habitat function would be maintained (and not eliminated) impacts to wildlife along the ETNG Construction ROW would be moderate.

Table 3.8-17. Summary of Alternative A Impacts to Wildlife Habitat

Alternative A Component		Extent of Habitat Affected (acres)[4] Temporary Impact[1]	Extent of Habitat Affected (acres)[4] Permanent Impact
KIF Retirement	Demolition	--	72.2 acres (habitat removal)
CC/Aero CT Plant[2]	CC/Aero CT Plant	--	49.9 (habitat removal)
	Switchyard	--	2.1 (habitat removal)
3- to 4-MW Solar Facility[2]		--	--
100-MW BESS[2]	Battery Site 1	--	8.7 (habitat removal)
	Battery Site 2	--	30.4 (habitat removal)
	Battery Site 3	--	40.0 (habitat removal)
On-site Transmission Lines[2]	Battery Transmission Line Connections	39.4 (short-term construction, long-term routine maintenance)	39.4 (habitat conversion)
	Transmission Line Corridor	100.4 (short-term construction)	20.1 (habitat conversion)
Off-site Transmission Lines[3]	Eastern	931.7 (short-term construction)	--
	Western	111.4 (short-term construction)	--
	Total	**3,799.7 acres**	**60.7-92.0 acres[4] (habitat removal)** **59.5 acres (habitat conversion)**
Natural Gas Pipeline[5]	Natural Gas Pipeline	1,761 (short-term construction) 425 (long-term routine maintenance)	268 (habitat conversion)
	Access Roads	36 (short-term construction)	4 (habitat removal)
	Aboveground Facilities	81 (short-term construction)	26 (habitat removal)
	Total	**2,489 acres**	**30 acres (habitat removal)** **268 acres (habitat conversion)**

[1] Typical short-term temporary impacts result from general construction activities or disturbance in habitat not needed to be cleared from transmission corridors or temporary work spaces, etc.; generally, herbaceous habitat types. Long-term routine maintenance temporary impacts are described as those habitats already existing as herbaceous or shrub, but undergoing new, regular treatments and control for utility maintenance.
[2] Acreage based on wildlife surveys (TVA 2020c)
[3] Acreage based on June 2022 wildlife surveys (Appendix L)
[4] Range depending on BESS site selection.
[5] Acreage based on vegetation communities as determined from field surveys (ETNG 2022d)

3.8.2.2.3.8 Environmental Justice Considerations

TVA Actions

Negative effects to wildlife that would occur as a result of the proposed CC/Aero CT Plant and transmission line activities would be minor and would occur where no human populations are settled. The addition of wildlife into surrounding suitable habitat may result in minor beneficial impacts to EJ and non-EJ populations that utilize those habitats for subsistence and other purposes.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Effects to wildlife that would occur because of the proposed ETNG Construction ROW would be minor and outside of TVA-owned reservations. The ETNG Construction ROW would primarily be located adjacent to an existing ETNG Construction ROW which would minimize effects to wildlife. However, habitats would be altered and wildlife would be displaced temporarily and permanently from portions of the pipeline. These effects would occur in areas where EJ populations are present and could result in amplified effects in instances where wildlife is utilized for sustenance. While displacement could result in more wildlife in nearby areas, the benefits to human populations are anticipated to be negligible.

3.8.2.2.4 Alternative B

3.8.2.2.4.1 Construction and Operations of Solar and Storage Facilities

Alternative B would result in construction activities that have the potential to affect wildlife directly and/or indirectly. TVA would minimize effects to wildlife by siting facilities on previously disturbed land, such as agricultural or silvicultural sites, or land with few sensitive wildlife habitats. As noted in the IRP EIS (TVA 2019b), the maintenance of a permanent vegetative cover on a solar facility, particularly when composed of native plant species, can also increase local wildlife diversity (Beatty et al. 2017). Traditional mowing/trimming would be performed regularly for vegetation maintenance.

Cumulative effects to wildlife may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA but would be minor through proper siting of solar facilities and the use of BMPs.

3.8.2.2.4.2 Transmission and Other Components

Based on studies performed on previous TVA solar facilities (see Table 3.3-1), an average of 1.7 miles of new transmission line are needed for each solar facility, which have the potential to affect common wildlife and their habitats. While wildlife habitats would be impacted, suitable alternate habitat likely exists in areas immediately adjacent to the proposed transmission lines. Impacts to populations of common wildlife species likely would be minor due to the proposed transmission lines. Cumulative effects to wildlife may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA, but effects would be minimized through proper siting of transmission lines and the use of BMPs.

3.8.2.2.4.3 Environmental Justice Considerations

Adverse direct and indirect effects to wildlife that would occur as a result of the proposed solar facilities and transmission line activities would be minor. The addition of wildlife into surrounding suitable habitat may result in minor beneficial impacts to EJ and non-EJ populations that utilize those habitats for subsistence and other purposes.

3.8.3 Aquatic Life

Aside from the ESA and related state laws, as well as harvest regulations established by states, the CWA is primarily the law that protects aquatic life in the United States. The CWA is a federal statute that governs the discharge of pollutants and fill materials into waters of the U.S. under Sections 401, 402, and 404. Water quality standards and NPDES discharge limits are established, in part, to protect aquatic life. CWA Section 316 regulates (a) wastewater discharges to minimize adverse effects of heat on aquatic life, and (b) the design and operation of cooling water intake structures to minimize adverse effects to aquatic life from entrainment and impingement.

3.8.3.1 Affected Environment

3.8.3.1.1 Kingston Reservation (No Action and D4 Activities)

3.8.3.1.1.1 Aquatic Life in Surface Waters on Kingston Reservation

No comprehensive biological studies have been completed for the surface waters located within the boundaries of the Kingston Reservation and an AJD has not yet been received from the USACE for verification of waters classifications; however, two perennial streams on the Kingston Reservation support aquatic life. Multiple fish were observed during 2019 surveys and one live floater mussel was observed in an unnamed stream that flows to a wetland on the southwestern portion of the Kingston Reservation, where it then drains into the Clinch River (TVA 2021e). The other stream containing aquatic life on the Kingston Reservation is a man-made/altered channel which flows along a road and through three detention ponds to the Clinch River. During the 2019 surveys this stream contained snails, eggs, and leaches. The perennial streams flow to the Clinch River, where many studies have been completed related to KIF operations (intake and discharge activities). Although not surveyed for aquatic species, wetlands or ponds on the Kingston Reservation may also provide habitat for crustaceans, reptiles, or amphibians when their specific habitat conditions exist.

3.8.3.1.1.2 Aquatic Life in Surface Waters Near Kingston Reservation

Apart from aquatic habitat[27] quantity and quality, effects from powerplant operations, such as thermal discharge effects, can also influence the aquatic biota in the Clinch River near the existing KIF discharge canal, as identified in Figure 1.1-1. In addition to the Section 316(a) requirements, which regulate thermal discharges of pollutants from point sources (including thermal discharges), the more recent CWA Section 316(b) rule for existing facilities established in 2014 also requires consideration of effects to aquatic biota from withdrawal of water through cooling water intake structures in order to allow an inclusive evaluation by the NPDES Director during the NPDES permit renewal cycle.

Long-term monitoring and comprehensive Section 316(a) demonstration-related studies have been performed for the existing KIF Plant since the mid-1970s to support establishment of the initial and current alternate thermal limit for KIF thermal discharge (TVA 2021e; Appendix M). Sampling has included phytoplankton, periphyton, zooplankton, benthic macroinvertebrates, aquatic macrophytes, and fish populations. Results of these historical studies indicated that assemblages of phytoplankton, zooplankton, and benthic macroinvertebrates were diverse and relatively abundant. Phytoplankton communities were dominated by diatoms and green algae, while Cyanobacteria were never present at nuisance levels. Fish species occurrence,

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[27] The type, quality, and abundance of aquatic habitats dictate the diversity and abundance of organisms present in aquatic systems (TVA 2021e). Habitat formers are mentioned in USEPA and TVA documents (USEPA and USNRC 1977; TVA 2021e) as an element of investigation in Section 316(a) demonstrations. In freshwater systems, aquatic macrophytes, submerged and emergent, are the most obvious habitat formers and can be critical to the structure and function of ecological systems (TVA 2021e).

distribution, and abundance were similar pre- and post-operation of KIF, indicating no impacts. Thermal discharges did not appear to cause discernable impacts in fish health related to parasitism, growth characteristics, or reproduction.

TVA's multi-metric Reservoir Fish Assemblage Index (RFAI)[28] of long-term monitoring. TVA's multi-metric Reservoir Fish Assemblage Index (RFAI)[29] scores are consistently in the scoring ranges classified as "Good" for the thermally unaffected reach of the Emory River upstream of the Kingston Reservation (TVA 2021e). In 2020, electrofishing and gillnetting surveys of the Clinch River and Watts Bar Reservoir in the vicinity of the KIF thermal discharge (Clinch RM 4.4 and 1.5 located approximately 0.4 to 2.7 RM downstream of KIF) identified 42 fish species and 2 hybrids The (TVA 2021e; Appendix M). The most abundant species collected were bluegill, gizzard shad, logperch, redear sunfish, Mississippi silverside, spotfin shiner, largemouth bass, bluntnose minnow, spotted sucker, and yellow bass (Table 3.8-18). Long-term macroinvertebrate sampling in the vicinity of Kingston Reservation thermal discharge indicate Reservoir Benthic Index (RBI) scores continue to reflect "Good" or "Excellent" ecological health ratings at all locations except for a "Fair" rating upstream of the discharge at Clinch RM 3.75 in autumn 2020 (Table 3.8-19; TVA 2021e). Overall, the USEPA concluded that the fish community contains a balanced fish community with representation from all major trophic levels and guilds (TDEC 2021d). Similarly, the macroinvertebrate community contained all functional feeding groups upstream and downstream of KIF, with increasing trends in species richness and densities. Detailed information from the historical and recent aquatic life surveys is provided in the Balanced and Indigenous Population report attached as Appendix K (TVA 2021e).

[28] TVA's multi-metric Reservoir Fish Assemblage Index (RFAI) attempts to address characteristics of a balanced and indigenous population in a holistic manner by measuring 12 population "metrics," scoring the metrics based on expectations of healthy populations in the region and summing the scores to arrive at an overall RFAI score and subsequent rating (TVA 2021e and Appendix M). The maximum RFAI score attainable is 60. Ecological health ratings are then applied to the scoring ranges: 12-21 ("Very Poor"), 22-31 ("Poor"), 32-40 ("Fair"), 41-50 ("Good"), or 51-60 ("Excellent"). It has generally been accepted that an RFAI rating of "Fair" or better in the thermally affected area can be considered demonstration of a balanced and indigenous population, particularly where RFAI scores for unaffected upstream areas are similar. A difference of six points or less between the thermally affected area and unaffected upstream area indicates statistical similarity of the fish communities between the two sites.

Table 3.8-18. Species and Relative Abundance of Fish Collected During Electrofishing and Gill Netting Surveys in the Vicinity of Kingston Reservation

Common Name	Clinch RM[1] 1.5 Summer 2020		Clinch RM 4.4 Summer 2020		Clinch RM 1.5 Autumn 2020		Clinch RM 4.4 Autumn 2020	
	Total Fish Collected	Percent Composition	Total Fish Collected	Percent Composition	Total Fish Collected	Percent Composition	Total Fish Collected	Percent Composition
Black buffalo	3	0.5	6	0.7	--	--	--	--
Black crappie	1	0.2	4	0.5	--	--	--	--
Black redhorse	1	0.2	2	0.2	5	0.6	1	0.1
Blue catfish	8	1.5	16	2.0	8	0.9	10	0.9
Bluegill	93	16.9	198	24.3	256	30.0	398	36.8
Bluntnose minnow	40	7.3	99	12.2	14	1.6	4	0.4
Brook silverside	2	0.4	1	0.1	5	0.6	3	0.3
Bullhead minnow	--	--	--	--	2	0.2	--	--
Channel catfish	21	3.8	11	1.4	7	0.8	12	1.1
Common carp	11	2.0	4	0.5	7	0.8	5	0.5
Flathead catfish	--	--	1	0.1	--	--	2	0.2
Freshwater drum	11	2.0	10	1.2	13	1.5	5	0.5
Gizzard shad	49	8.9	155	19.0	62	7.3	26	2.4
Golden redhorse	2	0.4	5	0.6	4	0.5	3	0.3
Green sunfish	5	0.9	--	--	13	1.5	17	1.6
Hybrid bass	1	0.2	--	--	--	--	--	--
Hybrid sunfish	--	--	1	0.1	1	0.1	--	--
Lake sturgeon	1	0.2	2	0.2	5	0.6	4	0.4
Largemouth bass	22	4.0	22	2.7	75	8.8	77	7.1
Logperch	94	17.1	38	4.7	67	7.9	23	2.1
Longear sunfish	9	1.6	3	0.4	15	1.8	15	1.4
Longnose gar	10	1.8	2	0.2			1	0.1
Mississippi silverside	13	2.4	37	4.5	49	5.8	155	14.3

Common Name	Clinch RM[1] 1.5 Summer 2020		Clinch RM 4.4 Summer 2020		Clinch RM 1.5 Autumn 2020		Clinch RM 4.4 Autumn 2020	
	Total Fish Collected	**Percent Composition**	**Total Fish Collected**	**Percent Composition**	**Total Fish Collected**	**Percent Composition**	**Total Fish Collected**	**Percent Composition**
Quillback	--	--	1	0.1	1	0.1	--	--
Redbreast sunfish	11	2.0	1	0.1	14	1.6	1	0.1
Redear sunfish	46	8.4	67	8.2	62	7.3	67	6.2
River carpsucker	1	0.2	--	--	--	--	--	--
Rock bass	--	--	4	0.5	--	--	1	0.1
Sauger	--	--	1	0.1	--	--	--	--
Silver redhorse	--	--	1	0.1	--	--	--	--
Skipjack herring	6	1.1	1	0.1	1	0.1	19	1.8
Smallmouth bass	4	0.7	2	0.2	12	1.4	10	0.9
Smallmouth buffalo	4	0.7	21	2.6	9	1.1	9	0.8
Spotfin shiner	14	2.6	19	2.3	88	10.3	100	9.3
Spotted bass	--	--	1	0.1	5	0.6	9	0.8
Spotted gar	--	--	9	1.1	--	--	--	--
Spotted sucker	9	1.6	19	2.3	25	2.9	61	5.6
Striped bass	1	0.2	2	0.2	3	0.4	3	0.3
Threadfin shad	--	--	8	1.0	1	0.1	1	0.1
Walleye	1	0.2	8	1.0	3	0.4	16	1.5
Warmouth	2	0.4	--	--	6	0.7	7	0.6
White bass	18	3.3	8	1.0	6	0.7	5	0.5
Yellow bass	35	6.4	23	2.8	7	0.8	6	0.6
Yellow perch	--	--	1	0.1	1	0.1	5	0.5
Total	**549**	**100**	**814**	**100**	**852**	**100**	**1,081**	**100**

[1] RM: River Mile

Table 3.8-19. Benthic Macroinvertebrate Index Observed Values and Ratings for Individual Metrics in the Vicinity of Kingston Reservation

Metric	Upstream (Clinch RM[1] 3.75)				Within Thermal Plume (Clinch RM[1] 2.2)				Downstream (Clinch RM[1] 1.5)			
	Summer 2020		Autumn 2020		Summer 2020		Autumn 2020		Summer 2020		Autumn 2020	
	Obs.	Rating	Obs.	Rating	Obs.	Rating	Obs.	Rating	Obs.	Rating	Obs.	Rating
1. Average number of taxa	13.4	5	15.1	5	16.6	5	14.5	5	13.4	5	13.2	5
2. Proportion of samples with long-lived organisms	0.9	3	0.8	3	1.0	5	0.9	3	0.9	3	1.0	5
3. Average number of EPT taxa	2.0	5	0.8	3	1.8	5	1.7	5	1.4	3	1.5	5
4. Average proportion of oligochaete individuals	17.9	3	43.4	1	21.5	3	19.4	3	27.5	1	45.2	1
5. Average proportion of total abundance comprised by the two most abundant taxa	72.5	5	79.7	3	66.1	5	73.5	5	72.9	5	80.1	3
6. Average density excluding chironomids and oligochaetes	768.3	5	510.0	3	603.3	3	718.3	5	720.0	5	348.3	3
7. Zero-samples – proportion of samples containing no organisms	0	5	0	5	0	5	0	5	0	5	0	5
Benthic Index Score[2]		**31**		**23**		**31**		**31**		**27**		**27**
Ecological Health Rating		**Excellent**		**Fair**		**Excellent**		**Excellent**		**Good**		**Good**

Source: TVA 2021e
[1] RM: River Mile
[2] Reservoir Benthic Index Score Range: 7-12 (“Very Poor”), 13-18 (“Poor”), 19-23 (“Fair”), 24-29 (“Good”), 30-35 (“Excellent”)

During a 2005 mussel survey on the Clinch River near the Kingston Reservation shoreline (Yokley 2005), divers searched for mussels and characterized the substrate along forty, 100-meter-long transects. The substrate predominantly consisted of soft mud of varying thickness over hard clay. In areas of low current, hard clay was the surface substrate layer and not a suitable habitat for freshwater mussels. No sensitive freshwater mussel species were observed as they are typically not present in impoundments with little or no flow and an abundance of silt. The survey indicated that few freshwater mussels occur in the impoundment. Four live species of mussel were identified, including giant floater, pimpleback, wartyback, and threehorn wartyback. Various sizes of pimpleback and threehorn wartyback were found in significant abundance along one transect in the actual current of the Clinch River, indicating these species are actively recruiting. Both of these species are considered commonly present in similar sized streams throughout Tennessee and adjacent states (Yokley 2005). A single live wartyback was found in one transect and thought to be a new record for this species in the Clinch River. Relics of two other species, fragile papershell and pistolgrip, were found, but no live individuals were observed.

3.8.3.1.1.3 CWA Section 316(b) Characterizations of Impingement and Entrainment

2007 Impingement Study

Section 316(b) of the CWA requires the location, design, construction, and capacity of cooling water intake structures to reflect the best technology available for minimizing adverse environmental impact. Impingement mortality is a component of 316(b) and is defined as an impact in which fish and/or shellfish are trapped or impinged against an intake screen and often killed in the process. In response to the USEPA issuance of a 2004 rule for implementing Section 316(b) (a rule subsequently suspended in 2007) and in accordance with the Proposal for Information Collection submitted to the TDEC in 2005, TVA conducted impingement monitoring at KIF from November 2004 through November 2006 to assess the effects of impingement on the aquatic community of the Clinch River and Watts Bar Reservoir near the Kingston Reservation. The two-year study estimated annual impingement of 185,577 fish in Year 1 and 225,197 fish in Year 2. Up to 33 species were collected during the study; however, 95 percent of the estimated impingement was comprised of threadfin shad, followed by gizzard shad, freshwater drum, and channel catfish at 1 percent each. The 2007 Fish Impingement Study Report is provided as Appendix M (TVA 2007).

The most recent NPDES permit for KIF was issued on December 1, 2021 and will expire on February 28, 2023. As part of the next permit renewal cycle, TVA is fulfilling Section 316(b) requirements by developing a compliance package to be submitted and reviewed by the NPDES director. A decision will be made by the director on the best technology available for the KIF cooling water intake structure to meet the goal of minimizing impacts to aquatic organisms due to impingement and entrainment, assuming TVA selects the No Action alternative. Once the renewal permit is finalized, continued operation of the existing KIF units would require TVA to comply with any new permit requirements to install impingement reduction technologies.

2017 Entrainment Study

The USEPA issued an amended final Section 316(b) rule effective October 2014 for existing power generating and industrial facilities (USEPA 2014). Under the rule, KIF is required, as an existing facility that withdraws more than 125 million gallons of cooling water per day (actual intake flow), to provide an Entrainment Characterization Study (§122.21(r)(9)) that includes a minimum of two years of entrainment data collection that also includes biological entrainment characterization (TVA 2017b).

To fulfill these requirements, ichthyoplankton sampling was conducted for two years from March 4, 2013, through February 27, 2015. During both years, samples were collected weekly during March through August (expected period of fish spawning) then monthly from September through February. Samples were collected during day and night at all sampling locations. Samples were collected from two stations on either side of the skimmer wall for collection of intake samples: (1) immediately upstream of the intake to account for high rainfall events, and (2) immediately downstream of the intake to account for diverted flow from the Clinch River. Intake samples were collected to determine the numbers and taxonomic identity of fish eggs and larvae entrained by the KIF intake. Reservoir samples were collected at four stations along two transects (two stations each), upstream and downstream from the cooling water intake structure and perpendicular to the river flow, to determine the number of fish eggs and larvae available for entrainment and provide data for spatial and temporal ichthyoplankton occurrence and abundance. Fish eggs and larvae were identified to the lowest possible taxon, counted, and measured (only larvae were measured).

A total of 1,324 and 1,652 fish eggs were collected from the intake and reservoir transects combined during Years 1 and 2, respectively. Fish eggs comprised two families (Sciaenidae and Clupeidae) during Year 1, and 5 families in Year 2, including Sciaenidae, Clupeidae, Moronidae, Catostomidae, and Atherinopsidae. Densities of fish eggs peaked during May at both the intake and at reservoir sampling locations during both years. Other trends observed during both years included higher average intake densities than those at reservoir locations, and nighttime densities higher than daytime.

During Year 1 of the study, 6,439 larvae representing 18 distinct taxa were collected across all sampling locations, while 61,626 larvae representing 21 distinct taxa were collected in Year 2.

Average larval densities were considerably lower during Year 1 than Year 2, likely attributable to differences in flows and water temperatures between years. Two high flow events of approximately 13,000 cubic feet per second occurred during the peak spawning season (April–August) of Year 1, each resulting in sharp decreases in water temperature and preventing water temperatures from reaching those utilized by spawning fish.

Fish larvae comprised the same nine families during both years including Clupeidae, Cyprinidae, Catostomidae, Atherinopsidae, Ictaluridae, Moronidae, Centrarchidae, Percidae, and Sciaenidae. Clupeid larvae comprised the most abundant taxon collected during both years, making up 94.2 percent of the combined sample, followed by Moronidae at 3.2 percent and Centrarchidae at 1.4 percent. All other families were represented by less than one percent of the total combined sample.

Estimated annual numbers of eggs and larvae entrained at KIF during both years were lower than those transported by river/reservoir and had similar family compositions. Species with high fecundity and broadcast spawning behavior, such as clupeids, dominated entrainment and reservoir sampling.

3.8.3.1.2 Alternative A

3.8.3.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

As stated in Section 3.6.2.1.2.1, the only surface waters identified within the bounds of the proposed CC/Aero CT Plant are two WWCs and three wetlands, although an AJD has not yet been received from the USACE for verification of waters classifications (Figure 3.6-2). No surface waters were observed in the switchyard area. Based on field observations, none of these features are likely to contain aquatic life that requires persistent and permanent water flow, such as fish or mussels. However, semi-aquatic wildlife, such as some species of reptiles and amphibians or crustaceans (e.g., box turtles, frogs, salamanders, crayfish), could potentially be present in resources that maintain a sufficient level and/or periodicity of surface water (such as the seasonally flooded wetlands).

3.8.3.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

No surface waters or drainages are found within the proposed 3- to 4-MW Solar Facility and therefore this area does not support aquatic life.

3.8.3.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Only ephemeral channels or WWCs exist within the vicinity of Battery Sites 1, 2, and 3, which do not support aquatic life. Battery Site 3, however, does contain a stormwater detention pond (0.12 acre), which could support aquatic life able to survive in seasonally flooded conditions, such as some species of reptiles and amphibians or crustaceans.

3.8.3.1.2.4 On-site Transmission Upgrades

The site for the proposed battery transmission line connections crosses five WWCs (607 LF), which do not contain aquatic life. The transmission line corridor proposed for upgrades on the Kingston Reservation crosses 7 WWCs (3,659 LF), none of which are capable of supporting aquatic life. The transmission line corridor also crosses one intermittent stream (23 LF), which flows through a wetland and discharges to the Clinch River. The wetland is classified as seasonally flooded or inundated with a similar hydrologic regime as the intermittent stream. As mentioned previously, semi-aquatic life could potentially be found in the stream or wetland during periods of sufficient water levels.

3.8.3.1.2.5 Off-site Transmission Line Upgrades

The Eastern Transmission and Western Transmission Corridors cross 56 perennial streams and rivers (totaling 16,373 LF) and 14 open waters (lakes/ponds totaling 14.13 acres) (Section 3.6.2.1.2.5), which likely contain common fish taxa such as black bass, crappie, sunfishes, pike, perch, trout, catfish, gar, buffalo, redhorses, carpsuckers, shad, bowfin, freshwater drum, sculpins, minnows, suckers, chubs, logperches, and hog suckers as well as native aquatic invertebrates (TWRA 2018; Appendix E). One or more aquatic nuisance species may also be present, such as alewife, blueback herring, Asian swamp eel, brook stickleback, Asian carps, grass carp, common carp, inland silverside, round goby, rudd, ruffe, snakehead, mosquitofish, Kentucky River crayfish, marbled crayfish, rusty crayfish, virile crayfish, Asian clam, channeled apple snail, Chinese mystery snail, New Zealand mud snail, or zebra mussel, which are all species that have been identified in the State of Tennessee. The transmission line corridors also cross 48 intermittent streams (totaling 11,403 LF), which could contain semi-aquatic life such as reptiles, amphibians, or crustaceans depending on the time of year, recent climatic events, and/or longer-term climate conditions (e.g., drought).

3.8.3.1.2.6 Construction and Operation of a Natural Gas Pipeline

ETNG's proposed natural gas pipeline would cross perennial streams, ponds and major waterbodies (defined in FERC's Plan and Procedures [FERC 2013a, 2013b] as waterbodies greater than 100 feet wide at the water's edge at the time of crossing), and intermittent streams that may contain aquatic and semi-aquatic life (streams and waterbodies crossed via HDD are excluded) (see Section 3.6.2.1.2.4). Water resources identified during desktop review of the ETNG Construction ROW are classified as freshwater. The ETNG Construction ROW does not cross Essential Fish Habitat or fish hatcheries. ETNG surveyed each potential waterbody crossing to determine classification, aquatic habitat including fisheries, and presence/absence of state- or federally-listed threatened, endangered, or special concern aquatic species or their designated critical habitat. Typical fish species known or likely to occur within the freshwater streams at aboveground facility sites and/or along access to these sites are summarized in Table 3.8-20. Further, ETNG would coordinate with the USFWS, TWRA, and NPS (NEPA cooperating agency) to identify and address concerns related to aquatic life in potential crossing locations. Waterbodies in the ETNG Construction ROW are discussed further in Section 3.6.2.1.2.4.

Table 3.8-20. Typical Fish Species in Waterbodies Crossed by the ETNG Construction ROW

Common Name	Scientific Name
Blue Catfish	*Ictalurus furcatus*
Channel Catfish	*Ictalurus punctatus*
Flathead Catfish	*Pylodictis olivaris*
Crappie	*Pomoxis* spp.
Largemouth Bass	*Micropterus salmoides*
Spotted Bass	*Micropterus punctulatus*
Smallmouth Bass	*Micropterus dolomieu*
Redeye Bass	*Micropterus coosae*
Walleye	*Stizostedion vitreum*
Sauger	*Stizostedion canadense*
Bluegill	*Lepomis macrochirus*
White Bass	*Morone chrysops*
Striped Bass	*Morone saxatilis*

Source: ETNG 2022d

3.8.3.1.3 Alternative B

As discussed in Section 3.6.2.1.3, the East Tennessee region includes the Cumberland, Upper Tennessee, and Middle Tennessee-Hiwassee/Lower Tennessee river basins and numerous associated major watersheds (TDEC 2022d; State of Tennessee, n.d.). The southeastern United States, including Tennessee, is considered a hot spot of freshwater biodiversity (Elkins et al. 2016). For example, the Clinch River basin, including Kyles Ford Preserve, is known to contain at least 35 mussel species, which is more than any other place on earth (State of Tennessee, n.d.). East Tennessee contains high fish species richness and high numbers of endemic fish species; moderate crayfish species richness and low-moderate crayfish endemics; and very high mussel species richness and high mussel endemics (Elkins et al. 2016).

3.8.3.2 Environmental Consequences

3.8.3.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue current plant operations. TVA would implement all planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be reviewed in subsequent NEPA analyses. Continued short-term, direct, and minor effects on fish eggs, fish larvae, and fish are expected from entrainment and impingement; however, the degree of these effects would be dependent upon the frequency of operations. The No Action Alternative would result in no change to current aquatic ecology conditions; as a result, no beneficial effects from elimination of facility operations with respect to aquatic ecosystems would occur under this alternative.

3.8.3.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

The Clinch River, one man-made perennial stream, and three man-made, non-jurisdictional riprap ponds occur within the demolition boundary and would potentially be impacted by fill to support D4 activities. Aquatic life in these surface water features include snails, leeches, and some fish species, organism that typically tolerate poor water quality conditions. Although watercourses occur on and around the Kingston Reservation, ground-disturbance associated with retirement, decommissioning, decontamination, and deconstruction activities would be minimized, and all work would be done in accordance with state and local BMPs. With proper implementation of BMPs, no direct effects to the aquatic communities outside of these areas are anticipated. All necessary CWA Section 404 and Tennessee ARAP permits would be obtained for in-water work, such as the demolition of intake structures and barge unloading area upgrades; mitigation measures such as appropriate BMPs would be implemented to reduce potential effects. If necessary, compensatory mitigation would be provided for the loss of wetlands or streams on the Kingston Reservation for this activity, if deemed necessary by the agencies.

With the implementation of appropriate BMPs, minor effects to surrounding surface waters are expected from demolition activities. Cumulative effects to surface water may occur with the proximity of CCR management activities as RFFAs in the Kingston Reservation. With the use of proper BMPs and compliance with all federal, state, and local regulations and guidelines, cumulative surface water effects are expected to be temporary and minor.

There is a possibility that aquatic ecology could be indirectly affected due to modification of the riparian zone by stormwater runoff resulting from construction activities associated with selective demolition. Potential effects due to removal of vegetation within the riparian zone include increased erosion and siltation, loss of habitat, and increased temperatures. Construction activities associated with the removal of buildings, as well as backfilling facilities, could lead to increased siltation and runoff in the Clinch River. With appropriate BMPs implemented during construction, operation, and maintenance of the proposed construction activities, any effects to aquatic ecology resulting from the proposed action would be minor, if at all.

The retirement of KIF would result in elimination of entrainment and impingement mortality of fish and shellfish in the vicinity of the KIF cooling water intake structure. Thermal discharges would also cease, generally improving water quality. Based on annual biomonitoring of the fish community as a condition of CWA Section 316(a), effects from KIF on fish populations in the vicinity of the plant are negligible, as the Clinch River (Watts Bar Reservoir) maintains a balanced and indigenous fish community as demonstrated through analysis of fish community diversity, trophic levels, limited presence of pollution-tolerant species, and representation of indigenous species. Some species, such as introduced subtropical species like threadfin shad, may depend on thermal refugia created during winter months by the heated effluent, and the absence of thermal discharges during winter could result in fish kills of this or similar sensitive neotropical species (Reutter and Herdendorf 1976). Overall, the retirement of KIF would have a minor long-term beneficial effect on the aquatic community in the vicinity of the plant due to the elimination of entrainment and impingement and thermal discharges.

3.8.3.2.2.1 Environmental Justice Considerations

Effects to aquatic life that would occur as a result of the KIF coal facility retirement and D4 activities would be minor to minimized or mitigated especially if offshore fishing locations remain open even upon the closure of Kingston. Those utilizing aquatic life that depends on the heated effluent may experience slight negative effects. These minor to minimal adverse effects on EJ populations are unlikely to be amplified due to the absence of EJ populations on the Kingston Reservation and in the nearby area.

3.8.3.2.3 Alternative A

3.8.3.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

No direct effects to aquatic life are anticipated by the construction or operation of the proposed CC/Aero CT Plant. No surface water with permanent flow exists within the CC/Aero CT Plant area and therefore no aquatic life requiring constant flow is expected to be present. There is potential for semi-aquatic life to be present in wetlands located within the proposed CC/Aero CT Plant boundary; however, this would depend on recent climate conditions (i.e., rainfall, drought). The proposed CC/Aero CT Plant would use air-cooled condensers, eliminating the need for water withdrawals from the nearby Clinch River and minimizing effects to aquatic life. Some water treatment may be required to support the CC/Aero CT Plant, which may result in upgrades to the water treatment plant. The facility would require potable water, which would be obtained from the existing public supply at the Kingston Reservation (Harriman Utility Board).

3.8.3.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on the Kingston Reservation

The footprint for the proposed 3- to 4-MW Solar Facility does not contain any water bodies that support aquatic life; therefore, the construction and installation of the solar facility would have no impacts on aquatic communities.

3.8.3.2.3.3 Construction and Operation of a 100-MW BESS on the Kingston Reservation

Construction of a 100-MW BESS at Battery Site 3 would result in permanent loss of 0.12 acre of the detention pond and any aquatic life contained therein. As a detention pond, it is unlikely that the environment supports a wide array of aquatic organisms, as it lacks habitat complexity, consistency in water levels, and food resources. Therefore, the loss of this pond would have a negligible effect on aquatic life.

3.8.3.2.3.4 On-site Transmission Upgrades

No direct effects to aquatic life from the construction of the battery transmission line connections is expected, as this corridor crosses only WWCs which do not support aquatic organisms. Indirect effects to aquatic life resulting from the construction of the proposed batter transmission line connections are expected to be minor and temporary.

The transmission lines proposed for upgrades cross only WWCs and one intermittent stream. If the intermittent stream flows for sufficient periods of time, it could potentially provide habitat for semi-aquatic reptiles, amphibians, or crustaceans. As an existing transmission line corridor, the lines currently span the intermittent stream and therefore no direct impacts to this resource, or potential aquatic life contained therein, is expected. As with other activities, BMPs, such as silt fencing to protect surface water quality from erosion or sedimentation, would be implemented during the construction process.

3.8.3.2.3.5 Off-site Transmission Line Upgrades

As described in Section 3.6.2.1.2.5, sixty-seven perennial streams (totaling 16,373 LF) and 14.13 acres of open water are crossed by the existing transmission line corridors and/or associated access roads proposed for upgrades as part of as part of Alternative A. The transmission line corridors also cross 48 intermittent streams (11,403 LF), which may or may not support semi-aquatic life; field surveys of the additional off-site transmission corridors would be necessary to determine presence/absence of aquatic resources. Any potential impacts to these areas would be required to adhere to appropriate state and federal permitting requirements.

The L5116 corridor crosses Aquatic Species at Risk polygons in the mainstem Tennessee River, indicating potential presence of listed aquatic species. Although it is unlikely that any of the tributary streams present along this corridor would contain listed aquatic species, field surveys would be necessary to determine whether suitable habitat is present for sensitive species. No federally designated critical habitat for aquatic species is present within this corridor.

The L5280 and L5381 corridors are located within 1 mile of Aquatic Species at Risk polygons in the mainstem Tennessee River, indicating potential presence of listed aquatic species in the vicinity. Although it is unlikely that any of the tributary streams present along this corridor would contain listed aquatic species, field surveys would be necessary to determine whether suitable habitat is present for sensitive species. No federally designated critical habitat for aquatic species is present within these corridors. A detailed discussion of aquatic threatened and endangered species is presented in Section 3.8.4.

Effects to organisms within these habitats would be limited since areas proposed for upgrades are within existing ROWs. Replacement of structures, if necessary, would not be placed in aquatic resources; therefore, these replacements would not have the potential to directly impact aquatic life. Although site access would be through existing and new access roads, effects to aquatic life would be avoided or minimized through careful planning of new access roads and would be further minimized through the use of use of BMPs (TVA 2022a) during the construction phase. Effects and minimization measures for upgrade activities are summarized in Section 3.6.2.2.3.6.

3.8.3.2.3.6 Construction and Operation of a Natural Gas Pipeline

The permanent ROW will cross 149 perennial streams, 11 ponds and major waterbodies, and 96 intermittent streams that may contain aquatic and semi-aquatic life (streams and waterbodies crossed via HDD are excluded). Temporary workspaces may directly affect an additional 43 perennial streams, 19 ponds and major waterbodies, and 54 intermittent streams. Waterbodies that are within the construction workspace but not crossed by the pipeline would either be avoided or temporarily crossed using wooden construction mats or equipment bridges. Overall, impacts to this aquatic life in waters directly impacted from pipeline construction or temporary workspaces would be minor and temporary.

For most waterbodies crossed by the permanent ROW, there would be minor or no effects to fisheries (ETNG 2022d). There is no essential fish habitat (EFH) within the ETNG Construction ROW; therefore, there would be no Project-related impacts to EFH. ETNG would be conducting field surveys on aquatic communities through 2023 to verify the presence of sensitive fish species within waterbodies crossed by the permanent ROW. ETNG would follow the Project E&SCP to control erosion and sedimentation and to minimize impacts on waterbodies. Additionally, ETNG would coordinate with federal and state resource agencies to identify potential Project-related impacts to aquatic resources and to develop and implement avoidance and minimization measures.

ETNG’s proposed construction activities have the potential to affect surface waters, including clearing activities, crossings of waterbodies for pipeline installation, HDD, hydrostatic test discharges, potential spills or leaks of hazardous liquids from the refueling of construction vehicles or storage of fuel, oil, and other fluids, and temporary access road crossings. ETNG’s

Resource Report 3 (ETNG 2022d), which TVA has independently reviewed, provides the following:

> [ETNG] is not proposing to cross waterbodies via the [wet] open cut method at this time… Impacts on fishery resources associated with dry [open cut] crossings may include direct contact with relatively immobile prey that may be food resources for fish, increased sedimentation and water turbidity immediately downstream of the construction workspace, alteration or removal of aquatic habitat cover, introduction of pollutants, impingement or entrainment of fish and other biota associated with the use of water pumps at dam and pump crossings, and downstream scour associated with use of those pumps. Fish passage during dam and pump crossings will be temporarily restricted during the installation of the new pipeline. Fish passage will only be temporarily interrupted and will be restored immediately after the restoration of the stream bed and banks. The short-term and localized interruption of fish passage is not anticipated to dramatically affect the migration of fish within the stream systems. Pipeline construction across waterbodies may also result in temporary increases in turbidity and sedimentation downstream of the crossing site. Dry crossing construction activities will be performed in a manner that will minimize the potential for erosion and sedimentation within the stream channel. Specifically, dry crossing methods will be implemented, where site conditions permit, to confine in-stream effects to the construction workspace and eliminate effects to downstream reaches. Additionally, [ETNG] will strive to complete in-stream pipeline removal and installation activities within a 24-hour period for minor crossings and 48 hours for intermediate crossings per each operation. [ETNG] will implement the detailed erosion and sedimentation control measures provided in the Project Erosion & Sediment Control Plan (E&SCP), provided in Appendix 1C of Resource Report 1, to contain materials in the workspace and minimize effects to fisheries from changes in water quality.
>
> Use of the HDD crossing method allows the pipeline to be installed beneath the waterbody without surface disruption between the drill entry and exit points. This allows the installation to occur in a manner that minimizes potential effects to fisheries and aquatic habits.
>
> Potential effects associated with construction of HDDs include erosion or sedimentation associated with the onshore operation of the HDD equipment, which could result in localized turbidity if it enters an adjacent waterbody. [ETNG] will implement the detailed erosion and sedimentation control measures provided in the Project E&SCP to contain materials in the workspace. HDD workspaces will be located away from aquatic resources associated with the crossings wherever possible.
>
> As part of the HDD process, a bentonite drilling fluid will be used to lubricate the cutting tools, maintain the integrity of the hole and transport cutting material from the hole. There are certain effects that could occur as a result of the drilling, such as inadvertent return of drilling fluid. An inadvertent drilling fluid return could occur in the area of the drilling fluid pits or tanks, or along the path of the drill due to unfavorable ground conditions, potentially releasing drilling fluid onto the bottom of the waterbody. Drilling fluid is composed of naturally occurring materials, such as bentonite, which in small quantities would not be detrimental to aquatic species, as the [USPEA] has classified it as not toxic. Detail on potential fluid releases is provided in Section 2.3.9.4 of Resource Report 2. In larger quantities, the return of drilling fluid to a waterbody

could affect fisheries if the accidentally released fluid sufficiently buries benthic resources of the waterbody.

The drilling fluid consists of bentonite clay slurry that is denser than water, causing the slurry to settle along the waterbody bottom. Finfish in the juvenile and adult life stages typically have enough mobility to avoid a bentonite discharge. However, should any species with demersal eggs be present, they may suffer mortality in the case of an inadvertent return. The discharged material would be localized to the inadvertent return area, is non-toxic, and can often be cleaned up. The drilled spoil would settle in the immediate vicinity of the inadvertent return location. Drilling fluids released at the inadvertent return location would tend to disperse near the bottom of the water column, but because of their fine particle size, a small quantity would remain in suspension for an extended period. [ETNG] will prepare a Project-specific Horizontal Directional Drill Monitoring, Inadvertent Return Response, and Contingency Plan which will be included in Appendix 1C of the final Resource Report 1. The Plan will provide details that address the inadvertent return of drilling fluid. To minimize effects to fisheries resources, fisheries of special concern, and/or protected fish species, [ETNG] would comply with the measures outlined in this plan in the case of an inadvertent return of drilling fluid.

Removal of trees and other streamside vegetation from the edges of waterbodies at the crossing may reduce shading of the waterbody, diminish escape cover, and can result in locally elevated water temperatures. Elevated water temperatures can, in turn, lead to reductions in levels of dissolved oxygen. This can negatively influence habitat quality and reduce availability of habitat for certain fish species. Effects resulting from tree clearing will be minimized due to the use of existing cleared ROWs for the majority of the Project facilities. To further minimize potential effects associated with loss of riparian shade and vegetation cover, clearing of trees and other vegetation will be restricted to only what is necessary to safely construct and operate the pipeline.

Once construction is complete, streambeds and banks will be quickly restored to preconstruction conditions to the fullest extent possible. Restoration, bank stabilization, and revegetation efforts, which are defined in the Project E&SCP, will minimize the potential for erosion from the surrounding landscape. Adherence to the Project’s E&SCP will also maximize the potential for re-growth of riparian vegetation, thereby minimizing the potential for any long-term effects associated with lack of shade and cover. Implementation of the Project’s construction, restoration, and mitigation procedures will result in only limited, short-term effects to fishery resources, and the aquatic habitats upon which these fishery resources depend. Invertebrate populations will recolonize the crossing area and temporary workspaces will revert to their original condition, including re-establishment of riparian cover. Furthermore, operation and routine maintenance of the pipeline ROW and aboveground facilities, which will be restricted to clearing and mowing vegetation on the permanent ROW, are not expected to have any noticeable effect on fishery resources in the Project area.

Increased sedimentation and turbidity from in-stream construction across waterbodies or from runoff from adjacent construction areas have the greatest potential to adversely affect fishery resources. However, these types of effects will be short term and would only occur during the construction phase. Total suspended solid concentrations may increase during construction, but soon after construction is complete these concentrations will decrease as the in-stream sediments disturbed during construction are allowed to settle. Adherence to the Project's E&SCP will minimize the potential for impacts due to runoff from adjacent construction areas.

Hydrostatic test water appropriations and discharges will not result in a significant entrainment of fish, loss of habitat, or an adverse effect to water quality. Proposed sources of water to be used by [ETNG]for hydrostatic testing of the Project pipeline facilities are listed in Tables 2.3-7 in Resource Report 2. The withdrawal locations will occur at or near the construction corridor. The discharge locations have not been identified, but all discharge locations will be sited within a well vegetated upland area within the same watershed, where practicable. If local sources of water are used, withdrawal intake hoses will be fitted with intake screen devices to prevent the entrainment of fingerlings and small fish during water withdrawal. Discharge will comply with regulatory permit conditions and will be controlled to prevent scour and sedimentation, flooding, or the introduction of foreign or toxic substances into the aquatic system. Sampling of discharge water will be conducted in accordance with the Project E&SCP to document water quality at the time of discharge. A detailed description of the hydrostatic test process and mitigation measures is provided in Section 2.3.8 of Resource Report 2.

Accidental spills of construction-related fluids (e.g., oil, gasoline, or hydraulic fluids) on the landscape or directly into waterbodies could result in water quality effects affecting fish and other organisms. Effects to fisheries would depend on the type and quantity of the spill, and the dispersal and attenuation characteristics of the waterbody. To reduce the potential for surface water contamination, [ETNG] will have a Spill Prevention Control and Countermeasure Plan (SPCC Plan) in place prior to construction that contractor(s) will be required to implement. The SPCC Plan is provided in Appendix 1C of Resource Report 1. To minimize spill risk, refueling or other handling of hazardous materials within 100 feet of wetland and waterbody resources will be restricted. If the 100-foot setback cannot be met, these activities will be performed under the supervision of an environmental inspector (EI) in accordance with the SPCC Plan. The SPCC Plan also specifies that [ETNG] will conduct routine inspections of tank and storage areas to help reduce the potential for spills or leaks of hazardous materials.

Construction crossing methods for each waterbody were identified in the environmental resource reports submitted by ETNG to FERC in September 2022.

TVA has independently reviewed and concurs with the aquatic-related findings in ETNG's Resource Report 3 (ETNG 2022d) that effects to aquatic life in waters directly impacted from construction or temporary workspaces would be minor and temporary.

3.8.3.2.3.7 Summary of Alternative A

TVA Actions

No permanent impacts would occur to perennial or intermittent streams under the Alternative A proposed actions (see Table 3.6-13); therefore, no permanent impacts would occur to aquatic life. Streams within the on-site transmission line corridors proposed for upgrades have potential to experience short-term temporary disturbance, such as surface water runoff and increased siltation; however, appropriate BMPs, including sediment and erosion control devices, such as silt fencing, would be installed to prevent and minimize risk to surface waters from construction activities.

Waters within the demolition boundary have the potential to be directly impacted by stormwater runoff during D4 activities, including the Clinch River. Waters on Kingston Reservation within this boundary support low quality habitat and corresponding low aquatic diversity. While the removal of intake structure equipment (i.e., fish screens and pumps) and construction of a barge unloading area could have a minor direct impact aquatic life in the Clinch River, the aquatic community in the vicinity of KIF would experience a minor, permanent beneficial effect with the elimination of facility operations.

There would be no long-term impacts to surface waters, and therefore aquatic life, associated with the proposed CC/Aero CT Plant, 3- to 4-MW Solar Facility, 100-MW BESS, natural gas pipeline, or on-site or off-site transmission line corridors.

Cumulative effects to surface waters (and by proxy, aquatic life) may occur given proximity of past/present and RFFAs near the transmission line corridors. Cumulative effects to surface waters would be minimized and mitigated through proper siting of these facilities (i.e., avoidance), the use of BMPs, and adherence to mitigation requirements in applicable CWA Section 404 and 401 permits.

ETNG Actions - Natural Gas Pipeline and Associated Structures

There would be no permanent impacts to surface waters, and therefore no permanent impacts to aquatic life associated with the ETNG Construction ROW. Short-term, temporary impacts from stream diversion during open cut natural gas pipeline installation would occur. Streams would be returned to original grade, streambanks stabilized, and flow restored following pipeline installation; therefore, impacts to aquatic life would be minor.

3.8.3.2.3.8 Environmental Justice Considerations

TVA Actions

Direct effects to aquatic life that would occur as a result of the proposed CC/Aero CT Plant and transmission line activities would be minimized or mitigated and generally limited to the immediate TVA-owned Kingston Reservation, where no residential populations are settled. Short-term effects near the transmission line corridors could result in amplified negative effects for nearby EJ populations that currently fish the affected waters and may rely on aquatic resources as additional sustenance. Fishing is permitted in nearby wildlife management areas (see Section 3.9 for more details on these areas).

ETNG Actions - Natural Gas Pipeline and Associated Structures

Direct effects to aquatic life resulting from the proposed pipeline project would be minor and temporary as most potential direct effects would be minimized or mitigated. Any negative effects to aquatic life could be amplified within EJ populations near the ETNG EJ Study Area during and immediately after construction; however, such effects to aquatic resources would likely elevate from negligible to minor as those potentially affected waters currently fished for additional sustenance by these populations are typically major waterbodies such as rivers, large creeks, ponds, and lakes that are anticipated to be crossed using HDD methods. Fishing is also permitted in nearby wildlife management areas (see Section 3.9 for more details on these areas).

Although TVA has assessed these impacts to be minor and temporary, and potentially amplified to identified EJ populations, ETNG is still evaluating effects of its proposed project and TVA may update its conclusions in TVA's final EIS based on ETNG's findings.

3.8.3.2.4 Alternative B

3.8.3.2.4.1 Construction and Operations of Solar and Storage Facilities

Alternative B would result in construction activities that have the potential to permanently affect streams and/or temporarily affect aquatic life via stormwater runoff. As noted in Table 3.2-1, TVA has evaluated typical effects associated with the development of solar facilities. Estimates of an average 8.7 LF of stream effect per MW average would result in approximately 13,050 LF of stream effects for the 1,500 MW of solar facilities, and 14,790 LF of stream for BESS facilities. Cumulative effects to aquatic life would occur; combined with future expansion of solar additions by 2030s forecasted in TVA's 2019 IRP, there is potential for an additional 87,000 LF of stream impacts.

On-site surveys of aquatic resources and appropriate permitting (and mitigation) prior to land disturbance activities would be completed. TVA and solar developers would minimize effects to aquatic life by siting facilities on lands with few surface water resources, configuring the solar arrays, access roads, and other infrastructure to avoid surface waters to the maximum extent practicable, while maintaining vegetated/wooded buffers along surface waters. BESS sites are typically small enough to be sited to avoid surface water and aquatic life effects.

Appropriate BMPs would be installed, and all proposed project activities would be conducted in a manner to ensure that waste materials are contained, and the introduction of pollution materials to the receiving waters would be avoided.

3.8.3.2.4.2 Transmission and Other Components

As noted in Table 3.2-1, transmission lines typically result in an average of 2.9 stream crossings per mile of new line. Based on TVA's evaluation, an average of 1.7 miles of new transmission line are needed for solar facilities, equating to approximately 74 surface water crossings that may occur for the 15 solar facilities, and/or 84 stream crossings associated with the 17 BESS facilities. To minimize effects to aquatic life, TVA would avoid placing structures within surface waters, and effects would be minimized by crossing surface waters at a perpendicular angle where practicable. Erosion and sediment control BMPs would be deployed and USACE and TDEC permits would be obtained. Minor cumulative effects to aquatic life may occur under Alternative B with the addition of 10,000 MW of solar identified in the 2019 IRP throughout the TVA PSA, but effects would be minimized through proper siting of transmission lines and the use of BMPs.

3.8.3.2.4.3 Environmental Justice Considerations

Effects to aquatic life that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to have disproportionate environmental and human health effects on EJ populations. Potential effects to aquatic life on the solar facility sites would be minimized or mitigated through BMPs such as avoiding surface water resources and maintaining vegetated avoidance buffers around surface waters. Transmission activities would take a similar approach. Erosion and sediment control measures would also be taken in association with both solar facility and transmission line activities. Effects to aquatic life would therefore be limited to the immediate project sites and transmission line corridors and would not disproportionately affect EJ populations utilizing aquatic life resources nearby. Effects would be more fully evaluated for individual solar and storage facilities.

3.8.4 Threatened and Endangered Species

Some species of fish and wildlife are protected under the ESA of 1973 and related state laws. The ESA was implemented to provide a framework to conserve and protect threatened and endangered species and their habitats. This act authorizes the determination and listing of species as endangered and threatened; prohibits unauthorized taking, possession, sale, and transport of endangered species, provides authority to acquire land for the conservation of listed species; authorizes civil and criminal penalties for violating the ESA; and other authorizations. An endangered species is defined by the ESA as any species in danger of extinction throughout all or a significant portion of its range. Likewise, a threatened species is likely to become endangered within the foreseeable future throughout all or a significant part of its range. Critical habitats, essential to the conservation of listed species, also can be designated under the ESA. The ESA establishes programs to conserve and recover endangered and threatened species and makes their conservation a priority for Federal agencies. Under Section 7 of the ESA, federal agencies are required to consider the potential effects of their proposed actions on endangered and threatened species and critical habitats. If a proposed action has the potential to affect these resources, the federal agency is required to consult with the USFWS.

Fish and game species are also protected by hunting, fish, and trapping regulations enforced by the USFWS and TWRA. In addition to these laws, the Migratory Bird Treaty Act (MBTA) of 1918, the Bald and Golden Eagle Protection Act (BGEPA) of 1940, and EO 13186 – Responsibilities of Federal Agencies to Protect Migratory Birds also provide protection to birds. The MBTA and EO 13186 address most native birds occurring in the U.S. The MBTA makes the purposeful taking, killing, or possession of migratory birds, their eggs, or nests unlawful, except as authorized under a valid permit. EO 13186 focuses on federal agencies taking actions with the potential to have negative effects on populations of migratory birds. It provides broad guidelines on avian conservation responsibilities and requires agencies whose actions affect or could affect migratory bird populations to evaluate those impacts and implement practices to minimize, to the extent practicable, adverse effects on migratory bird resources. Aside from federal and state laws regulating the hunting, trapping or other capture, and possession of some species, most wildlife other than birds generally receives no legal protection.

In addition to the ESA and EOs 13563, 13112, and 13751, established for the protection of native, threatened, and endangered plant species and communities, the Rare Plant Protection and Conservation Act of 1985 authorized the state of Tennessee to legally list plants as threatened, endangered, and of special concern (TDEC, n.d.). The Act allows TDEC to enter into a cooperative agreement with the USFWS “with respect to programs designed to conserve rare plants,” that establishes the Division of Natural Areas as the lead state agency in the process of listing and recovery efforts for federally endangered or threatened species of plants.

A desktop review of state and federal resources was performed, which included the USFWS Information for Planning and Consultation (IPaC) tool, the TDEC rare species list, and the TVA Regional Natural Heritage Database, to identify species of conservation concern potentially present within each alternative project area. Field surveys were conducted by TVA within the Kingston Reservation in summer 2019 (TVA 2020c) to assess the potential for the presence of threatened and endangered species or their habitats. The Kingston Reservation boundary and off-site transmission line corridor boundaries were used for the USFWS IPaC tool. TDEC rare species lists are reported on a county-wide basis, and therefore species listed for each county were included for those areas that the Alternative A proposed CC/Aero CT Plant site or transmission line corridors cross. Similarly, the USFW IPaC tool was reviewed to identify federally listed species known or expected to occur within the ETNG Construction ROW, and a review of all state-listed species that may occur within counties traversed by the ETNG

Construction ROW were reviewed in the absence of an official response by the TWRA (ETNG 2022d). Information derived from the TVA Regional Natural Heritage Database was reported from within five miles of the site for plant species, at the county level for aquatic species, and within three miles for terrestrial species. Species contained on the USFWS IPaC, TDEC, and TVA Regional Natural Heritage Database protected species lists are discussed in the following sections.

3.8.4.1 Affected Environment

3.8.4.1.1 Kingston Reservation (No Action and D4 Activities)

Fish, wildlife, and plant species under state or federal protection that may be found on or in the vicinity of the Kingston Reservation, as determined by the state and federal resources, are summarized in Table 3.8-21. No federally designated critical habitat is located on the Reservation. Only species with potential habitat on the Reservation and those that have been directly observed on-site are discussed below.

Table 3.8-21. Threatened, Endangered, and Other Protected Species Evaluated for Potential Impacts under the Individual Components of Alternative A Proposed on the Kingston Reservation

Common Name *Scientific Name*	State Rank and Listing Status[1]	Federal Listing Status[1]	Habitat Requirement	D4 Process Site[3]	CC/Aero CT Plant Site and Switchyard[2]	3- to 4-MW Solar Facility[2]	100-MW Battery Storage Site 1[2]	100-MW Battery Storage Site 2[2]	100-MW Battery Storage Site 3[2]	On-Site Transmission Line[2]
Birds										
Bachman's Sparrow *Peucaea aestivalis*	S1, SE		Dry open pine or oak woods; nests on the ground in dense cover.	Yes	Yes	No	Yes	Yes	Yes	Yes
Bald Eagle[3] *Haliaeetus leucocephalus*	SD		Nests in tall, mature trees near large bodies of water such as large rivers, lakes, reservoirs, and coastal areas.	Yes (foraging)	Yes (foraging)	No	Yes (foraging)	Yes (foraging)	Yes (foraging)	Yes (foraging)
Osprey *Pandion haliaetus*	SR		Found on rivers, lakes, reservoirs, lagoons, swamps, and marshes where fish are abundant.	Yes[4] (nesting, foraging)	Yes[4] (foraging)	No	Yes[4] (foraging)	Yes[4] (foraging)	Yes[4] (foraging)	Yes (foraging)
Swainson's Warbler *Limnothlypis swainsonii*	S3, SD		Mature, rich, damp, deciduous floodplain and swamp forests with thick understory.	Yes	Yes	No	Yes	Yes	Yes	Yes
Mammals										
Gray Bat *Myotis grisescens*	S2, SE	FE	Roosts in caves or karst features year-round. Various foraging habitats including wet meadows, damp woods, and uplands.	Yes (foraging)	Yes (foraging)	No	Yes (foraging)	Yes (foraging)	Yes (foraging)	Yes (foraging)
Indiana Bat *Myotis sodalis*	S1, SE	FE	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures and sinkhole fissures/karst features; statewide.	Yes (roosting and foraging)	Yes (roosting and foraging)	No	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)
Little Brown Bat *Myotis lucifugus*	S3, ST	UR	Variety of habitats including human-made structures, caves, and hollow trees for resting and maternity sites; typically feed over water.	Yes (roosting and foraging)	Yes (roosting and foraging)	No	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)
Long-tailed Shrew *Sorex dispar*	S2, SD		Mountainous, forested areas with loose talus.	No	No	No	No	No	No	No
Northern Long-eared Bat *Myotis septentrionalis*	S1S2, ST	FE	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures, sinkhole/karst features; statewide.	Yes (roosting and foraging)	Yes (roosting and foraging)	No	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)
Southern Bog Lemming *Synaptomys cooperi*	S4, SD		Marshy meadows, wet balds, and rich upland forests with a thick humus layer.	No	No	No	No	No	No	No
Tricolored Bat *Perimyotis subflavus*	S2S3, ST		Generally associated with forested landscapes but may roost near openings.	Yes (roosting and foraging)	Yes (roosting and foraging)	No	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)	Yes (roosting and foraging)
Reptiles										
Eastern Slender Glass Lizard *Ophisaurus attenuates longicaudus*	S3, SD		Dry upland areas including brush, cut-over woodlands and grassy fields.	Yes	No	No	No	Yes	Yes	Yes
Northern Pinesnake *Pituophis melanoleucus melanoleucus*	S3, ST		Well-drained sandy soils in pine/pine-oak woods; dry mountain ridges.	No	No	No	No	No	No	No
Amphibians										
Berry Cave Salamander *Gyrinohilus gulolineatus*	S1, ST	FE	Aquatic cave obligate.	No	No	No	No	No	No	No

Common Name *Scientific Name*	State Rank and Listing Status[1]	Federal Listing Status[1]	Habitat Requirement	D4 Process Site[3]	CC/Aero CT Plant Site and Switchyard[2]	3- to 4-MW Solar Facility[2]	100-MW Battery Storage Site 1[2]	100-MW Battery Storage Site 2[2]	100-MW Battery Storage Site 3[2]	On-Site Transmission Line[2]
Four-toed Salamander *Hemidactylium scutatum*	S3, SD		Woodland swamps, shallow depressions, and sphagnum mats on acidic soils in middle and east Tennessee	No	No	No	No	No	No	No
Hellbender *Cryptobranchus alleganiensis*	S3, SE		Clean and flowing water with plenty of oxygen in large streams and creeks. Areas with gravel bottoms and an abundance of rocks and submerged logs are necessary.	No	No	No	No	No	No	No
Fish										
Blue Sucker *Cycleptus elongatus*	S2, ST		Swift waters over firm substrates in big rivers.	Yes	No	No	No	No	No	No
Flame Chub *Hemitremia flammea*	S3, SD		Springs and spring-fed streams with lush aquatic vegetation; Tennessee and middle Cumberland watersheds.	No	No	No	No	No	No	No
Lake Sturgeon *Acipenser fulvescens*	S1, SE		Bottoms of large, clean rivers and lakes.	Yes	No	No	No	No	No	No
Slender Chub *Erimystax cahni*		FT	Restricted to bars and shoals of fine to medium gravel in runs and riffles of medium to large, clear, warm rivers.	Yes	No	No	No	No	No	No
Spotfin Chub *Erimonax monachus*	S2, ST	FT, EXPN	Clear upland rivers with swift currents and boulder substrates; portions of the Tennessee River watershed.	Yes	No	No	No	No	No	No
Tangerine Darter *Percina aurantiaca*	S3, SD		Large-moderate size headwater tributaries to Tennessee River, in clear, fairly deep, rocky pools, usually below riffles.	No	No	No	No	No	No	No
Tennessee Dace *Chrosomus tennesseensis*	S3, SD		First order spring-fed streams of woodlands in Ridge and Valley limestone region; Tennessee River watershed.	No	No	No	No	No	No	No
Yellowfin Madtom *Noturus flavipinnis*		FT	Shallow pools and backwaters of streams with cover of roots, sunken leaves, brush piles, and bedrock ledges.	No	No	No	No	No	No	No
Crustaceans										
Valley Flame Crayfish *Cambarus deweesae*	S1, SE		Primary burrower; open areas with high water tables.	Yes	No	No	Yes	Yes	Yes	Yes
Mollusks										
Alabama Lampmussel *Lampsilis virescens*	S1, SE	FE	Sand and gravel substrates in shoal areas of small-medium size rivers.	No	No	No	No	No	No	No
Anthony's Riversnail *Athearnia anthonyi*	S1, SE	FE	Large-medium rivers with moderate-high gradient, or riffles of larger creeks with cobble/boulder substrate.	No	No	No	No	No	No	No
Birdwing Pearlymussel *Lemiox rimosus*	S1, SE	FE, EXPN	Riffles with stable, sand and gravel substrates in moderate to fast currents in small to medium sized rivers.	No	No	No	No	No	No	No
Cracking Pearlymussel *Hemistena lata*	S1, SE	FE, EXPN	Sand, gravel, and cobble substrates in swift currents or mud and sand in slower currents.	No	No	No	No	No	No	No
Cumberland Bean (pearlymussel) *Villosa trabalis*		FE	Sand, gravel, and cobble substrates in waters with moderate to swift currents, and depths less than 1 meter.	No	No	No	No	No	No	No

Common Name *Scientific Name*	State Rank and Listing Status[1]	Federal Listing Status[1]	Habitat Requirement	D4 Process Site[3]	CC/Aero CT Plant Site and Switchyard[2]	3- to 4-MW Solar Facility[2]	100-MW Battery Storage Site 1[2]	100-MW Battery Storage Site 2[2]	100-MW Battery Storage Site 3[2]	On-Site Transmission Line[2]
Dromedary Pearlymussel *Dromus dromas*	S1, SE	FE, EXPN	Riffles and shoals with sand and gravel and moderate current velocities; may also be found in deeper, slower moving water in Tennessee.	No	No	No	No	No	No	No
Fanshell *Cyprogenia stegaria*	S1, SE	FE, EXPN	Medium to large streams and rivers with coarse sand and gravel substrates.	No	No	No	No	No	No	No
Finerayed Pigtoe *Fusconaia cuneolus*	S1, SE	FE, EXPN	Riffles of fords and shoals of mod gradient streams in firm cobble and gravel substrates.	No	No	No	No	No	No	No
Orangefoot Pimpleback (pearlymussel) *Plethobasus cooperianus*	S1, SE	FE, EXPN	Perennial streams with rocky areas and swift to slow moving currents.	No	No	No	No	No	No	No
Pink Mucket *Lampsilis abrupta*	S2, SE	FE	Large rivers with sand-gravel or rocky substrates with moderate to strong currents.	No	No	No	No	No	No	No
Purple Bean *Villosa perpurpurea*		FE	Creeks to medium-sized rivers and occasionally headwaters; generally associated with riffles but may be in direct current, pools.	No	No	No	No	No	No	No
Ring Pink *Obovaria retusa*	S1, SE	FE, EXPN	Large rivers in sand and gravel.	No	No	No	No	No	No	No
Rough Pigtoe *Pleurobema plenum*	S1, SE	FE, EXPN	Medium to large sized rivers, in substrates ranging from mud and sand to gravel, cobble, and boulders	No	No	No	No	No	No	No
Rough Rabbitsfoot *Quadrula cylindrica strigillata*	S2, SE	FE	Small-medium sized rivers in clear, shallow riffles with sand-gravel substrates	No	No	No	No	No	No	No
Sheepnose Mussel *Plethobasus cyphyus*	S2S3, SE	FE	Large to medium-sized rivers, in riffles and coarse sand/gravel substrate.	No	No	No	No	No	No	No
Shiny Pigtoe *Fusconaia cor*	S1, SE	FE, EXPN	Shoals and riffles of small-medium sized rivers with moderate-fast current over sand-cobble substrates.	No	No	No	No	No	No	No
Spectaclecase *Cumberlandia monodonta*	S2S3, SE	FE	Medium to large rivers; in substrates ranging from mud and sand to gravel, cobble, and boulders.	No	No	No	No	No	No	No
Tennessee Bean *Venustaconcha trabalis*	S1, SE	FE, EXPN	Riffle areas of small rivers and streams in sand, gravel, and cobble substrates with swift current	No	No	No	No	No	No	No
Turgid Blossom (pearlymussel) *Epioblasma turgidula*		FE, EXPN	Clear, unpolluted water over sand and gravel substrates of shallow, fast-moving streams.	No	No	No	No	No	No	No
American Ginseng *Panax quinquefolius*	S-CE		Shaded forests with deep, moist and rich soils	No	No	No	No	No	No	No
Barrens Silky Aster *Symphyotrichum pratense*	S1, SE		Barrens.	No	No	No	No	No	No	No
Branching Whitlow-grass *Draba ramosissima*	S2, SSC		Calcareous bluffs.	No	No	No	No	No	No	No
Butternut *Juglans cinerea*	S3, ST		Shaded forests with deep, moist and rich soils	No	No	No	No	No	No	No
Earleaved False-foxglove *Agalinis auriculata*	S2, SE		Barrens.	No	No	No	No	No	No	No

Common Name *Scientific Name*	State Rank and Listing Status[1]	Federal Listing Status[1]	Habitat Requirement	D4 Process Site[3]	CC/Aero CT Plant Site and Switchyard[2]	3- to 4-MW Solar Facility[2]	100-MW Battery Storage Site 1[2]	100-MW Battery Storage Site 2[2]	100-MW Battery Storage Site 3[2]	On-Site Transmission Line[2]
Fen Orchis *Liparis loeselii*	S1, ST		Calcareous seeps.	No	No	No	No	No	No	No
Fetter-bush *Leucothoe racemosa*	S2, ST		Acidic wetlands and swamps.	Yes [+]	Yes [+]	No	No	No	No	Yes [+]
Hart's-tongue Fern *Aspelnium scolopendrium var. americanum*	S1, SE	FT	Sinks.	No	No	No	No	No	No	No
Heller's Catfoot *Pseudognaphalium helleri*	S2, SSC		Dry sandy woods.	No	No	No	No	No	No	No
Large-flowered Barbara's-buttons *Marshallia grandiflora*	S2, SE		Rocky river bars.	No	No	No	No	No	No	No
Liverwort *Preissia quadrata*	S1, ST		Seepy limestone cliffs and bluffs.	No	No	No	No	No	No	No
Missouri Gooseberry *Ribes missouriense*	S2, SSC		Rocky woods.	No	No	No	No	No	No	No
Mountain Bush-honeysuckle *Diervilla sessilifolia var. rivularis*	S2, ST		Dry cliffs and bluffs.	No	No	No	No	No	No	No
Mountain Honeysuckle *Lonicera diocia*	S2, SSC		Mountain woods and thickets.	No	No	No	No	No	No	No
Myurella Moss *Myurella julacea*	SH, SSC-PE		Shale bluffs.	No	No	No	No	No	No	No
Naked-stem Sunflower *Helianthus occidentalis*	S2, SSC		Limestone glades and barrens.	No	No	No	No	No	No	No
Northern Bush-honeysuckle *Diervilla lonicera*	S2, ST		Rooky woodlands and bluffs.	No	No	No	No	No	No	No
Nuttall's Waterweed *Elodea nuttallii*	S2, SSC		Streams and ponds.	No	No	No	No	No	No	No
Prairie Goldenrod *Oligoneuron album*	S1S2, SE		Barrens.	No	No	No	No	No	No	No
River Bulrush *Bolboschoenus fluviatilis*	S1, SSC		Marshes, openings in swamps, edges of ponds and streams, fresh tidal marshes, and inland salt marshes and ponds.	No	No	No	No	No	No	No
Schreber's Aster *Eurybia schreberi*	S1, SSC		Mesic woods and seepage slopes.	No	Yes	No	No	No	No	No
Shining Ladies'-tresses *Sprianthes lucida*	S1S2, ST		Alluvial woods and moist slopes.	No	No	No	No	No	No	No
Slender Blazing-Star *Liatris cylindracea*	S2, ST		Barrens.	No	No	No	No	No	No	No
Small-headed Rush *Juncus brachycephalus*	S2, SSC		Seeps and wet bluffs.	No	No	No	No	No	No	No
Spreading False-foxglove *Aureolaria patula*	S3, SSC		Oak woods and edges.	No	No	No	No	No	No	No

Common Name *Scientific Name*	State Rank and Listing Status[1]	Federal Listing Status[1]	Habitat Requirement	D4 Process Site[3]	CC/Aero CT Plant Site and Switchyard[2]	3- to 4-MW Solar Facility[2]	100-MW Battery Storage Site 1[2]	100-MW Battery Storage Site 2[2]	100-MW Battery Storage Site 3[2]	On-Site Transmission Line[2]
Swamp Lousewort *Pedicularis lanceolata*	S1S2, SSC		Wet acidic barrens and seeps.	No	No	No	No	No	No	No
Tall Larkspur *Delphinium exaltatum*	S2, SE		Glades and barrens.	No	No	No	No	No	No	No
Tubercled Rein-orchid *Platanthera flava var. herbioloa*	S2, ST		Swamps and floodplains.	No	No	No	No	No	No	No
Virginia Spiraea *Spiraea virginiana*	S2, SE	FT	Flood-scoured banks of high-gradient mountain streams, point bars, natural levees, and braided features of lower stream reaches.	No	No	No	No	No	No	No
Western Wallflower *Erysimum capitatum*	S1S2, SE		Rocky bluffs.	No	No	No	No	No	No	No
White Fringeless Orchid *Platanthera integrilabia*	S2S3, SE	FT	Acidic seeps and stream heads.	No	No	No	No	No	No	No
Insects										
Monarch Butterfly *Danaus plexippus*		FC	Milkweed and flowering plants.	Yes	Yes	No	No	Yes	Yes	Yes

Source: USFWS Information, Planning, and Consultation (IPaC) dated April 20, 2023, Tennessee Department of Environment and Conservation's (TDEC) Rare Species by County for Roane County, TVA Regional Natural Heritage Database
^Critical habitat designated; critical habitat does not occur within Project limits
[1] FE = Federally Endangered; FT = Federally Threatened; FPT = Federally Proposed as Threatened; FC = Federal Candidate for Listing; EXPN = non-essential experimental populations; UR = under review for federal listing; SE = State-Listed as Endangered; ST = State-Listed as Threatened; SSC = State-Listed as Special Concern; SD = State-Listed as Deemed in Need of Management; S1 = Extremely rare and critically imperiled in the state with five or fewer occurrences, or very few individuals, or because of some special condition where the species is particularly vulnerable to extinction; S2 = Very rare and imperiled in the state, 6 to 20 occurrences, or few remaining individuals, or because of some factor(s) making it vulnerable to extinction; S3 = Rare and uncommon in the state, from 21-100 occurrences; S4 = Widespread, abundant, and apparently secure within the state but cause for long-term concern; SH = of historical occurrence in Tennessee, e.g. formally part of the established biota, with the expectation that it may be rediscovered; PE = Possibly Extirpated;
[2] Yes = suitable habitat present in project area; No = no potential presence of suitable habitat in project area
[3] Protected under the Bald and Golden Eagle Protection Act
[4] Record of observation on-site

3.8.4.1.1.1 Birds

Bachman's sparrow is listed as endangered in the State of Tennessee. This species requires habitat consisting of open pine or oak woods, palmetto scrub, or bushy pastures, although the classic historical habitat is mature pine forests where individuals nest in the open, grassy understory. As mature forest has become scarce, Bachman's sparrows have been found utilizing clearcuts, powerline ROWs, old pastures, and open areas (National Audubon Society 2022). The early successional habitat and fragmented forests found on the Kingston Reservation may provide habitat to support the Bachman's sparrow; however, there have been no historical or recent observations of Bachman's sparrow at the Reservation.

Swainson's warbler is classified by the State as Deemed in Need of Management. This species inhabits swamps and river floodplain forests, preferably with a large tract of dense understory and sparse ground cover. Breeding occurs in both swamps and bottomlands in moist forests, preferably with rhododendron-laurel-hemlock associations, or yellow polar, oak, and maple with moderate undergrowth (National Audubon Society 2022). While the forested habitats adjacent to the Clinch and Emory rivers may provide suitable habitat for Swainson's warbler, no individuals were documented on the Kingston Reservation during recent or historical field surveys.

Suitable nesting habitat exists for osprey on the Kingston Reservation. However, currently across Tennessee, osprey are locally common in summer, uncommon during migration, and rare in winter. The numbers of nesting osprey in Tennessee continues to slowly increase. Osprey build large nests near water, on top of dead trees or artificial structures, such as nesting poles, utility poles, cells, or TV towers. Nests are made of branches, sticks, twigs, and lined with smaller material (TWRA 2023a). The TVA Regional Natural Heritage database documents 12 records of osprey nests in or around the Reservation, typically on telephone poles, light poles, or platforms and navigation markers in both the Clinch and Emory rivers. Five active osprey nests were observed on the Kingston Reservation in May 2019. Two were on transmission line structures, one on a lighting structure near the coal pile, one on a nesting platform in the Emory River, and one on an island adjacent to Reservation in the Emory River (Figure 3.8-5).

Bald eagles are protected under the BGEPA. They inhabit a variety of environments, including mountains and open country, but are typically found close to water, including rivers, lakes, and coasts. Nests are typically constructed in tall trees and cliffsides near water. Tree nests are typically very tall, often above the surrounding forest (National Audubon Society 2022). In past decades, bald eagles have been observed perched in shoreline trees and flying over the Clinch River by TVA Terrestrial Zoologists and KIF staff. The closest bald eagle nest on record to the KIF is approximately two miles away; however, this nest was inactive at the time of observation in 2021. The closest active bald eagle nest to the KIF is located approximately four miles away on the Tennessee River, observed in February 2023 (E.B Hamrick, personal communication, March 7, 2023). There is no suitable nesting habitat on KIF, but the Clinch River provides suitable foraging habitat.

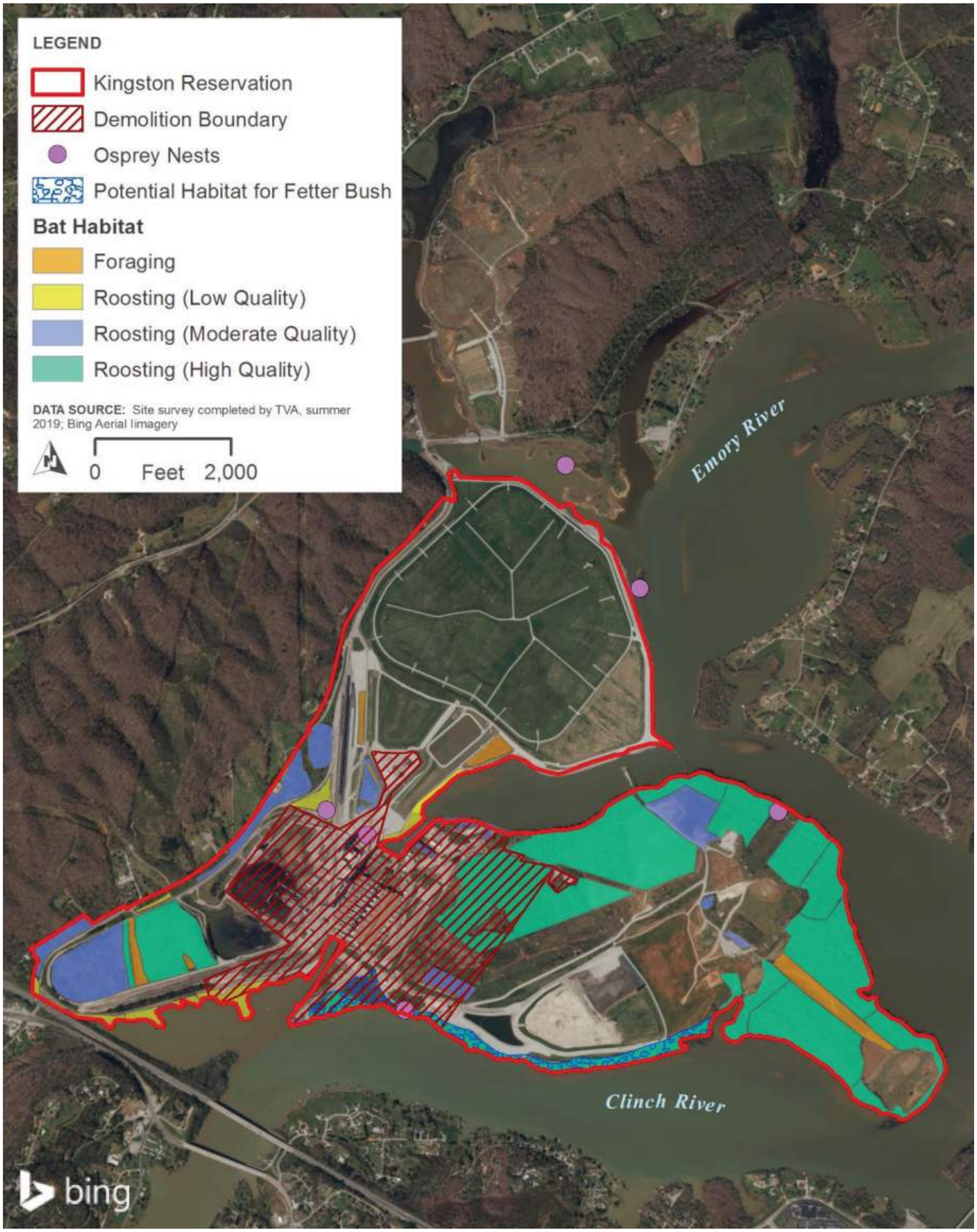

Figure 3.8-5. Federally and State-Listed Species and Habitats on the Kingston Reservation

Migratory Birds

Approximately 276 species of migratory birds have been identified in Roane County (eBird 2022), and additional species likely occur regularly. The USFWS maintains a list of migratory birds of conservation concern (USFWS 2021a). These species are not listed under the ESA but are a high conservation priority for the USFWS. Additionally, without additional conservation action, these species are likely to become candidates for listing under the ESA. Twenty species of birds of conservation concern are listed for Bird Conservation Region 28, Appalachian Mountains, which encompasses the area of the Kingston Reservation (USFWS 2021a). Species from this list with a “common” occurrence (during all seasons, breeding, wintering, or migration) as shown on range maps by the National Audubon Society (2022) are listed in Table 3.8-22. Additionally, species from the Migratory Birds list obtained from the USFWS IPaC report and summer 2019 TVA field survey (TVA 2020c) were also included.

Table 3.8-22. Migratory Bird Species of Conservation Concern Potentially Occurring or Confirmed Present on the Kingston Reservation

Common Name	Scientific Name	General Habitat Description	Potential Habitat Documented on Project Site
Migrant Species (present as spring and fall migrant and/or during winter)			
Bobolink	*Dolichonyx oryzivorus*	Grasslands, meadows, and hayfields.	Yes
Canada Goose	*Branta canadensis*	Lakes, ponds, bays, marshes, fields.	Yes*
Canada Warbler	*Cardellina canadensis*	Forest undergrowth, shady thickets. Breeds in mature mixed hardwoods of extensive forests and streamside thickets.	Yes
Golden-winged Warbler	*Vermivora chrysoptera*	Open woodlands, brushy clearings, undergrowth. Breeds in brushy areas with patches of weeds, shrubs, and scattered trees (such as alder or pine). This habitat type is found in places where a cleared field is growing up to woods again, as well as in marshes and tamarack bogs.	Yes
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Winter habitat includes woodlands, aspen groves, orchards, deciduous trees.	Yes
Lesser Yellowlegs	*Tringa flavipes*	Mudflats, sandy beaches, shores of lakes and ponds, and wet meadows.	No
Breeding Season Migrants (may occur only during the breeding season)			
Chimney Swift	*Chaetura pelagica*	Forages over variety of habitats, requires chimneys or large hollow tree snags with open tops for nesting.	No
Common Nighthawk (lesser)	*Chordeiles minor*	Inhabits any kind of open or semi-open terrain, including clearings in forest, open pine woods, prairie country, farmland, suburbs, and city centers.	Yes
Chuck-will’s Widow	*Antrostomus carolinensis*	Oak and pine woodlands. Breeds in shady southern woodlands of various types, including open pine forest, oak woodlands, edges of swamps.	Yes
Eastern Whip-poor-will	*Antrostomus vociferus*	Woodlands with open understory.	Yes
Kentucky Warbler	*Geothlypis formosa*	Large moist forest tracts with mature trees and thick understory.	Yes
Prairie Warbler	*Dendroica discolor*	Various shrubby habitats, including regenerating forests, open brushy fields, and Christmas tree farms.	Yes

Common Name	Scientific Name	General Habitat Description	Potential Habitat Documented on Project Site
Wood Thrush	*Hylocichla mustelina*	Breeds in mature deciduous and mixed forests, forests with dense understory, and forest edges.	Yes
Yellow-billed Cuckoo (Eastern)	*Coccyzus americanus*	Woodlands, thickets, orchards, streamside groves. Breeds mostly in dense deciduous stands, including forest edges, tall thickets, dense second growth, overgrown orchards, scrubby oak woods.	Yes
Resident Species (may occur year-round)			
Eastern Meadowlark	*Sturnella magna*	Open fields and pastures, meadows, prairies. Breeds in natural grasslands, meadows, weedy pastures, also in hayfields and sometimes in fields of other crops. Winters in many kinds of natural and cultivated fields.	Yes*
Killdeer	*Charadrius vociferus*	Fields, airports, lawns, riverbanks, mudflats, shores. Often found on open ground, such as pastures, plowed fields, large lawns, even at a great distance from water. Most successful nesting areas, however, have some shallow water or other good feeding area for the chicks. Also commonly found around water, on mudflats, lake shores, coastal estuaries.	Yes*
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Deciduous woodlands with oak or beech, groves of dead or dying trees, forested river bottoms, recent clearings, farmland, grasslands, forest edges and roadsides.	Yes

Source: USFWS 2021a
*Migratory birds of conservation concern identified on or near the Kingston Reservation (TVA 2020c)

Most of the species listed in the table above have suitable habitat on the Kingston Reservation, comprising forested areas, early successional habitat, or herbaceous habitat. Three of the species identified from the USFWS IPaC and Birds of Conservation Concern lists, Canada goose, Eastern meadowlark, and killdeer, were identified during site surveys in 2019 (TVA 2020c). None of these species were observed within the demolition boundary or other Alternative A component boundaries.

3.8.4.1.1.2 Mammals

Three species of bat with federal protection status and two more being considered for federal protection may have potential habitat on Kingston Reservation: gray bat, Indiana bat, northern long-eared bat, tricolored bat, and little brown bat (Table 3.8-21). Bat habitat on the Kingston Reservation was identified during field surveys in 2019 (TVA 2020c) utilizing USFWS guidelines for Indiana and northern long-eared bat habitat assessments (Figure 3.8-5). Habitat was categorized according to the quality of foraging or summer roosting habitat. Approximately 329.4 acres, or 26.2 percent of the Kingston Reservation, was identified as containing medium- to high-quality summer roosting habitat. This type of habitat generally consists of mature, deciduous forests with a variety of species including oaks, sycamores, hickories, and other species with loose and/or exfoliating bark. An additional 19.8 acres provide low-quality roosting habitat, which contains lower roosting tree diversity, size, and abundance. Kingston Reservation also provides 18.7 acres of foraging habitat. No winter roosting habitat was identified.

Gray bats almost exclusively roost in large caves throughout the year but travel up to 50 miles per night to forage (TVA 2020c). They are sometimes found roosting in mines or buildings (NatureServe 2022). Foraging habitat for this species may occur over open fields, forested areas, and open water areas such as streams, wetlands, and the Clinch and Emory rivers. There are no known caves on Kingston Reservation, but there is a known maternity cave for gray bats in Roane County approximately 9 miles away. Gray bats have also been documented on the Oak Ridge Reservation located approximately 5.8 miles from the Kingston Reservation. Gray bats have been observed nearby foraging over the Clinch River (TVA 2020c).

Indiana bats overwinter in large numbers in caves and form small colonies under loose bark of trees and snags during summer months, when they favor mature forests interspersed with openings and roosts in trees with snags, cavities, or exfoliating bark (Barbour and Davis 1974). Use of living trees, especially species such as shagbark hickory, mature white oaks, and other trees with suitable roost characteristics near suitable snags, has also been documented. The availability of trees of a certain size and sun exposure are other important limiting factors contributing to roost site suitability (Tuttle and Kennedy 2002; Harvey and Britzke 2002; Kurta et al. 2002). Multiple roost sites are often selected, and roosting habitat changes as the suitability of forested areas change. No records were found in the TVA Regional Natural Heritage Database found no records of Indiana bat observations or hibernacula within three miles of Kingston Reservation. There are no known hibernacula for this species within 10 miles of the Kingston Reservation or within Roane County. Forested areas may provide some roosting opportunity and the Clinch and Emory rivers may provide suitable foraging habitat.

Effective March 31, 2023, the status of northern long-eared bat under the ESA was upgraded from threatened to endangered. In general, habitat use by northern long-eared bats and Indiana bats are similar and both species exhibit annual life cycles of hibernation, spring staging and migration, pregnancy and lactation, pup volancy, and fall migration and mating (USFWS 2018). Suitable hibernacula for northern long-eared bat includes caves and cave-like structures such as mines and railroad tunnels (USFWS 2014). These hibernacula typically have large passages with cracks and crevices for roosting; relatively constant, cool temperatures (32 to 48°F) and high humidity; and minimal air currents. During summer, this species roosts singly or in colonies in cavities, underneath bark, crevices, or hollows of both live and dead trees (typical diameter greater than or equal to 3 inches). Males and non-reproductive females may also roost in cooler places, like caves and mines. Northern long-eared bat forage in upland and lowland woodlots, treelined corridors, and water surfaces, feeding on insects. Like Indiana bat, most mature forested areas provide some value as potential summer roosting habitat for northern long-eared bat. Also similar to Indiana bats, the forested areas and open areas over the Clinch and Emory rivers may provide suitable foraging habitat for the northern long-eared bats. No records of individuals or hibernacula were identified from a search of the TVA Regional Natural Heritage Database within three miles of the Kingston Reservation, although two observations have been documented in Roane County in the last 10 years according to the Regional Natural Heritage Database. The closest known hibernacula for this species is approximately 9 miles away in Roane County.

The tricolored bat is state-listed as threatened and is proposed endangered under the ESA. This species hibernates in caves, rock crevices, and mines, and locates summer roosts in trees, cliffs, and sometimes buildings (TWRA 2023b). Although the open areas on the Kingston Reservation and over the Clinch and Emory rivers may provide suitable foraging habitat, no tricolored bat individuals or hibernacula have been documented on the Kingston Reservation. There is a known hibernacula for tricolored bats in Roane County approximately 9 miles from the site.

Little brown bat has become a species of concern in Tennessee and is also proposed being considered for federal listing candidacy under the ESA. Males of this species can be solitary or living in small colonies that inhabit in rocky crevices, hollow trees, loose bark, or under shingles or sidings of building during the summer (TWRA 2023c). Females lives in nursery colonies in the spring and summer, which could be cliff crevices, hollow trees, under loose bark, or in undisturbed buildings. During the winter, this species hibernates in limestone caves. Mating typically occurs in the fall before hibernation but can also occur in winter and spring. Open areas on the Kingston Reservation and over the Clinch and Emory rivers provides suitable foraging habitat, and forested areas provide suitable summer roosting habitat. No little brown bat individuals or hibernacula have been documented on the Kingston Reservation or in Roane County according to the TVA Regional Natural Heritage Database.

3.8.4.1.1.3 Reptiles

One state-listed reptile identified in Table 3.8-21 could occur on the Kingston Reservation based on habitat requirements and the existing site conditions. The Eastern slender glass lizard is Deemed in Need of Management in Tennessee and is found in early successional habitats, such as prairies and grasslands, and tend to inhabit places with less canopy cover and abundant woody debris (TWRA 2023d). Nest locations include wooded areas close to trails and clearings, and the species tends to occur in dry, upland, and brushy areas. This species is secretive, and no Eastern slender glass lizards have been observed on Kingston Reservation or within 10 miles of the site based on a review of the TVA Regional Natural Heritage Database; however, targeted surveys have not been conducted.

3.8.4.1.1.4 Amphibians

None of the threatened or endangered amphibians identified in Table 3.8-21 are expected to occur on the Kingston Reservation based on their habitat requirements and the existing site conditions.

3.8.4.1.1.5 Plants

Several species of flowering plants and one fern species with state and federal ESA listing status were identified from a review of state and federal resources (e.g., TDEC, IPaC, etc.) as having the potential to occur on the Kingston Reservation or within Roane County (Table 3.8-21). However, field surveys conducted in the summer of 2019 determined that most vegetated habitats on Kingston Reservation have no potential to support state or federally listed plant species or unique plant species (TVA 2020c).

Fetter bush, also known as the swamp doghobble, is a state-threatened plant. This plant is a tall deciduous shrub that prefers moist, cool, acidic soil in partially shaded areas (NCSU 2022). Despite finding several patches of intact, higher quality deciduous forest along the shore of the Clinch River that could support this species (TVA 2020c), and being documented at Kingston in 1984, no fetter bush plants were identified in the 2019 surveys (Figure 3.8-5).

3.8.4.1.1.6 Aquatic Species

Five aquatic species listed as threatened or endangered were identified as potentially occurring on the Kingston Reservation or the Watts Bar Reservoir based on a review of state and federal resources (Table 3.8-21), including four species of fish and one crayfish.

The blue sucker is state-listed as threatened. This species inhabits the mainstem of major rivers and lower sections of main tributaries throughout their range (ADW 2022). They are typically found in moderate currents, within riffles or rapidly flowing chutes, over a combination of substrates including hard clay, sand, and gravel (USFS 2002). Based on benthic surveys performed in the Clinch River in the vicinity of KIF in 2005 (see Section 3.8.3.1.1.2; Yokley

2005), the substrate near KIF consists of soft mud over hard clay. Although substrate may be suboptimal for this species with soft and silty sediments, this species was documented within 10 miles of the Kingston Reservation in 1975 according to the TVA Regional Natural Heritage Database. It has not been documented during recent surveys by TVA (TVA 2021e).

The federally threatened slender chub is a fish that is restricted to bars and shoals in runs and riffles of medium to large rivers with clear, warm water (NatureServe 2022). Potential habitat could exist for this species in the Emory or Clinch rivers bordering the Kingston Reservation, but this species is not expected to occur in the streams located on the Kingston Reservation.

Spotfin chub inhabits clear, large creeks or medium-sized rivers of moderate gradient, in upland and montane areas, generally in or near moderate and swift currents over gravel to bedrock and rarely over sand or silt (NatureServe 2022). Although this is a schooling species frequently associated with white-tailed shiners and other mid-water species, the spotfin chub generally remains close to the substrate. Sub-adults appear more commonly on smaller substrates such as sand and small gravel compared to adults. Critical habitat has been designated for this species that encompasses almost all of the currently occupied range. This includes approximately 12 river miles of the Clinch River upstream of the Kingston Reservation. Due to habitat preferences, the presence of this species would be in the Clinch or Emory rivers adjacent to the site. This species is unlikely to be found in the small perennial streams on the Reservation.

The lake sturgeon, state listed as endangered, typically inhabits large rivers and lakes. TVA participates in the Tennessee Sturgeon Working Group, which includes researchers and conservation agencies including the Tennessee Aquarium, University of Tennessee, and the USFWS. This group has stocked over 250,000 young Lake Sturgeon into the Holston, French Broad, and upper Tennessee rivers over the past 10 years including Watts Bar Reservoir (Knoxville News Sentinel 2021). There have been four documented observations of lake sturgeon within 10 miles of the Kingston Reservation since 2010. The two most recent observations occurred in 2015 based on the TVA Regional Natural Heritage Database.

The valley flame crayfish, state listed as endangered, burrows in areas with high water tables and often with vegetation for concealment of burrow openings (NatureServe 2022). Given the proximity of the Kingston Reservation to the Emory and Clinch rivers, the water table may be high in areas of the adjacent to the surrounding rivers; therefore, the valley flame crayfish was considered to have potential for occurrence in the vicinity of the Kingston Reservation.

Of those mollusks listed in Table 3.8-21, nineteen federally or state-listed threatened or endangered species of freshwater mollusks were identified as potentially occurring in the vicinity of the Kingston Reservation or in Roane County; however, none of these species are considered to have suitable habitat on the Kingston Reservation. Nine of these mollusk species are known to occur or believed to exist within a 10-mile radius of the Kingston Reservation: Alabama lampmussel, fine-rayed pigtoe, orangefoot pimpleback, pink mucket, purple bean, shiny pigtoe pearlymussel, spectaclecase, and turgid blossom pearlymussel (TVA 2021e). The Tennessee bean and shiny pigtoe pearlymussel were historically documented as occurring within a 10-mile radius of the Reservation but are currently thought to be extirpated from the area. No federally or state-listed mollusks were found during the 2005 survey of the Clinch River/Watts Bar Reservoir in the vicinity of the Kingston Reservation (Yokley 2005). River substrates were noted as degraded (“sub-optimal”) and clay as the dominant substrates, overlain by varying thicknesses of mud.

3.8.4.1.1.7 Insects

Monarch butterflies are currently classified as a federal candidate species for listing. They are milkweed specialists meaning that the larval phase of the species exclusively feeds on one of various milkweed species. Monarchs prefer habitats that provide milkweed and other flowering plants for nectarine during the adult phase. These areas include roadsides, open areas such as fields, wet areas with flowering species, or urban gardens (NatureServe 2022). Milkweed and other flowering herbaceous plants have been observed in transmission line ROWs on the Kingston Reservation (TVA 2020c); therefore, there is potential periodically for the adult monarch butterfly to be present and if milkweed is present, also for the larva.

3.8.4.1.2 Alternative A

3.8.4.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The proposed CC/Aero CT Plant site is located within the Kingston Reservation boundary in an area consisting primarily of herbaceous or ruderal vegetation with small portions of deciduous and mesic forest along the Clinch River. Aquatic resources consist of WWCs and small areas of wetlands. Of the threatened and endangered species identified for the Kingston Reservation listed in Table 3.8-21, Swainson's warbler may have potential to occur on the proposed CC/Aero CT Plant site due to the presence of two forested wetlands (totaling 0.13 acre) and Bachman's sparrow may have potential to occur in the small deciduous forest (6.3 acres within the proposed CC/Aero CT Plant site and 0.3 acre within the switchyard). The areas of herbaceous, early successional, or forested habitat (totaling 58.8 acres) would provide habitat for many migratory bird species listed in Table 3.8-22.

The Bald Eagle may also be visible foraging or perching in the vicinity of the proposed CC/Aero CT Plant and switchyard given a nearby nesting location; this species uses the Clinch River for foraging. Similarly, Osprey similarly likely use the forested area for perching while foraging along the Clinch River. Osprey nests exist on existing transmission line structures, lighting structures, platforms, and trees within and adjacent to Kingston Reservation. No nesting habitat is present for either of these species, although an osprey nest is nearby on Kingston Reservation (Figure 3.8-6).

Summer roosting and foraging habitat for protected bat species also occurs within the proposed CC/Aero CT Plant site area (Figure 3.8-6). Approximately 7.4 acres of forested area is considered medium to high-quality bat summer roosting bat habitat, with an additional 0.1 acre for suitable foraging habitat. While categorized as roosting habitat, forested areas also function as foraging habitat. No open-space foraging habitat was identified in the switchyard area; however, 0.27 acre of high-quality roosting habitat falls within the southeastern boundary of the switchyard area.

Although the proposed CC/Aero CT Plant site contains 7.7 acres of bat roosting habitat, the roosting habitat is fragmented (Figure 3.8-6). The largest discrete roosting habitat within the Alternative A proposed CT/Aero CT Plant site consists of 2.3 acres on the southern-central boundary comprising a mature forested area and wetlands adjacent to the Clinch River. These areas could provide habitat for roosting for the Indiana bat, northern long-eared bat, little brown bat, and tricolored bat, and foraging habitat for the gray bat (as well as the other species), with ample foraging and roosting opportunities outside of Kingston Reservation and along the Clinch River.

The Eastern slender glass lizard prefers dry, upland areas including brush and grassy fields. Herbaceous habitats (totaling 52.0 acres) within the proposed CC/Aero CT Plant site and switchyard may provide this type of habitat for this species.

During field surveys in 2019 (TVA 2020c, see Section 3.8.4.1.1.5), one state protected plant species, fetter-bush, was considered to have potential habitat on the Kingston Reservation. Although individual plant species were not documented during recent field surveys, potential habitat for the fetter bush (consisting of 1.9 acres) falls within the proposed CC/Aero CT Plant boundary in a forested area along the Clinch River (Figure 3.8-6).

No suitable habitat for protected aquatic species or amphibians are found on the proposed CC/Aero CT Plant site or switchyard.

The herbaceous and early successional habitat within the proposed CC/Aero CT Plant site and switchyard could contain pollinator species that could be used by monarch butterflies for foraging. Milkweed, which is required for egg laying, was not identified during the 2019 field surveys (TVA 2020c).

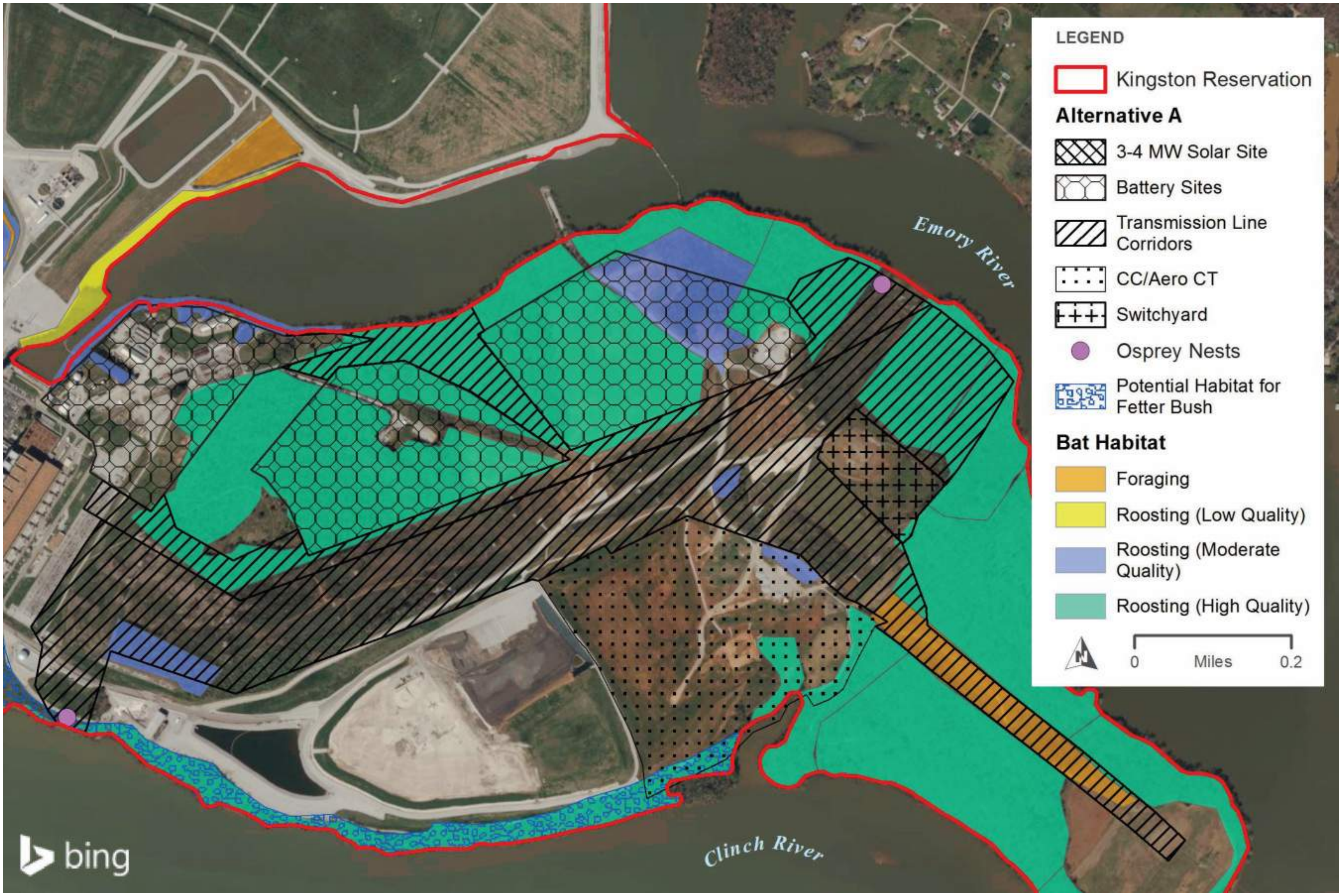

Figure 3.8-6. Protected Species' Habitat near the proposed CC/Aero CT Plant Footprint on the Kingston Reservation

3.8.4.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

No suitable habitat to support state or federally listed species was identified within the footprint for the proposed 3- to 4-MW Solar Facility.

3.8.4.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The Battery Site 3 site contains the greatest amount of suitable habitat (i.e., forested habitat) for the four protected bird species listed in Table 3.8-21 at 36.2 acres, followed by Battery Site 2 (30.5 acres), and the least amount of suitable habitat on Battery Site 1 (3.5 acres). Therefore, all four protected bird species listed in Table 3.8-21 could be found on each of the battery storage option sites due to presence of forested areas and proximity to the Emory River. These sites would also provide habitat for migratory birds by providing forested areas as well as herbaceous and early successional habitats. As previously described, Battery Site 3 contains the greatest amount of habitat (totaling 40.0 acres), followed by Battery Site 2 (33.3 acres), and Battery Site 3 (9.5 acres including manicured lawn, which could be used for foraging).

The mature trees within the Battery Site 1 footprint contains 3.5 acres of high-quality bat roosting habitat and 2.9 acres of medium-quality roosting habitat (Figure 3.8-5). The footprint for Battery Site 2 contains approximately 30.5 acres of high-quality bat roosting habitat. Battery Site 3 contains 27.1 acres of suitable high-quality roosting habitat as well as additional 9.1 acres of deciduous forest that provide medium-quality bat roosting habitat. All roosting habitat also functions as foraging habitat. Protected bat species that may use these areas (i.e., Indiana bat, northern long-eared bat, little brown bat, and tricolored bat) are discussed in Section 3.8.4.1.1.2.

functions as foraging habitat. Protected bat species that may use these areas (i.e., Indiana bat, northern long-eared bat, little brown bat, and tricolored bat) are discussed in Section 3.8.4.1.1.2.

3.8.4.1.2.4 On-site Transmission Upgrades

Approximately 24.3 acres of high-quality bat roosting habitat and 0.1 acre of medium-quality bat roosting habitat occurs within the battery transmission line connections corridor. Within the existing transmission line corridor proposed for upgrades, approximately 21.8 acres is suitable as medium- or high-quality bat roosting habitat, with an additional 9.5 acres suitable as bat foraging habitat, which potentially provides habitat for the Indiana bat, northern long-eared bat, tricolored bat, and little brown bat.

Approximately 41.4 acres of vegetated habitat of all types (from manicured lawn to forest) provides habitat to migratory bird species throughout the battery transmission line connections corridor.

The battery transmission line connections corridor contains approximately 0.3 acre of habitat suitable for the migratory bird species listed in Table 3.8-22 (Figure 3.8-6). Migratory bird habitat is also found throughout the transmission line corridor proposed for upgrades on Kingston Reservation, totaling 147.1 acres.

The transmission lines proposed for upgrades also cross potential habitat for the fetter bush (totaling 1.4 acres, Figure 3.8-6). Information on this species is included in Section 3.8.4.1.1.5.

As an existing transmission line corridor, habitat in this area includes 86.5 acres of early successional and herbaceous habitat. Milkweed has been observed within transmission line ROWs on Kingston Reservation; therefore, this area may support monarch butterflies if appropriate resources are present. For additional information on the monarch butterfly, see Section 3.8.4.1.1.7.

3.8.4.1.2.5 Off-site Transmission Line Upgrades

Federally and state-listed terrestrial and aquatic species that may be found along the proposed off-site transmission corridors which cross Cumberland (Western Transmission Corridor) and Roane and Anderson (Eastern Transmission Corridor) counties are summarized in Table 3.8-23. Species with potential habitat in the off-site transmission corridor are discussed below.

Table 3.8-23. Threatened, Endangered, and Other Protected Species for the Off-Site Transmission Corridors[1]

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Birds							
Bachman's Sparrow *Peucaea aestivalis*	X	X	X	S1, SE		Dry open pine or oak woods; nests on the ground in dense cover.	Yes
Bald Eagle[5] *Haliaeetus leucocephalus*		X	X	SD		Nests in tall, mature trees near large bodies of water such as large rivers, lakes, reservoirs, and coastal areas.	Yes (foraging)
Bewick's Wren *Thryomanes bewickii*				S1, SD		Prefer brushy areas, thickets and scrub in open country.	Yes
Cerulean Warbler *Setophaga cerulea*		X		S3, S		Mature, deciduous forest, particularly in floodplains or mesic conditions.	Yes
Golden-winged Warbler *Vermivora chrysoptera*	X	X		S3, ST		Early successional habitats in foothills regions of Appalachians.	Yes
Swainson's Warbler *Limnothlypis swainsonii*		X	X	S3, SD		Mature, rich, damp, deciduous floodplain and swamp forests with thick understory.	Yes
Whooping Crane *Grus americana*					FE, EXPN	Breeds in freshwater marshes and prairies; uses grain fields, shallow lakes, and lagoons on migration in winter.	Yes
Mammals							
Allegheny Woodrat *Neotoma magister*	X	X		S3, SD		Rock outcrops, cliffs, talus slopes, crevices.	No
Eastern Small-footed Bat *Myotis leibii*	X			S2S3, SD		Hibernates in caves and mines; also uses abandoned buildings, bridges, barns, and rocky outcrops/talus slopes seasonally.	Yes (foraging)
Gray Bat *Myotis grisescens*	X	X	X	S2, SE	FE	Roosts in caves or karst features year-round. Various foraging habitats including wet meadows, damp woods, and uplands.	Yes (foraging)

Common Name ***Scientific Name***	**Record of Occurrence by County[1,2]**			**State Rank and Listing Status[3]**	**Federal Listing Status[3]**	**Habitat Requirement**	**Potential Habitat in Eastern and Western Transmission Corridors[4]**
	Cumberland	Anderson	Roane				
Indiana Bat *Myotis sodalis*	X	X		S1, SE	FE	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures and sinkhole fissures/karst features; statewide.	Yes (roosting and foraging)
Little Brown Bat *Myotis lucifugus*		X	X	S3, ST		Roost in caves, hollow trees, and human-made structures.	Yes (roosting and foraging)
Long-tailed Shrew *Sorex dispar*			X	S2, SD		Mountainous, forested areas with loose talus.	Yes
Northern Long-eared Bat *Myotis septentrionalis*	X	X	X	S1S2, ST	FE	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures, sinkhole/karst features; statewide.	Yes (roosting and foraging)
Rafinesque's Big-eared Bat *Corynorhinus rafinesquii*	X			S3, SD		Caves, hollow trees, abandoned buildings; often associated with forested areas	Yes (roosting and foraging)
Southern bog lemming *Synaptomys cooperi*		X	X	S4, SD		Marshy meadows, wet balds, and rich upland forests.	Yes
Tricolored Bat *Perimyotis subflavus*	X	X	X	S2S3, ST	FPE	Generally associated with forested landscapes but may roost near openings.	Yes (roosting and foraging)
Reptiles							
Eastern Slender Glass Lizard *Ophisaurus attenuates longicaudus*	X	X	X	S3, SD		Dry upland areas including brush, cut-over woodlands and grassy fields.	Yes
Northern Pinesnake *Pituophis melanoleucus melanoleucus*	X	X	X	S3, ST		Well-drained sandy soils in pine/pine-oak woods; dry mountain ridges.	No

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Amphibians							
Berry Cave Salamander *Gyrinohilus gulolineatus*			X	S1, ST	FC	Aquatic cave obligate.	No
Black Mountain Salamander *Desmognathus welteri*	X	X		S3, SD		Spring runs and permanent streams in wooded mountainous terrain.	Yes
Cumberland Dusky Salamander *Desmognathus abditus*	X			S2S3, SD		Associated with streams of Cumberland Plateau; under rocks along small streams or adjacent cover.	Yes
Four-toed Salamander *Hemidactylium scutatum*	X	X	X	S3, SD		Woodland swamps, shallow depressions, and sphagnum mats on acidic soils in middle and east Tennessee	No
Hellbender *Cryptobranchus alleganiensis*	X	X	X	S3, SE		Clean and flowing water with plenty of oxygen in large streams and creeks. Areas with gravel bottoms and an abundance of rocks and submerged logs are necessary.	Yes
Fish							
Blue Sucker *Cycleptus elongatus*		X	X	S2, ST		Swift waters over firm substrates in big rivers.	No
Emerald Darter *Etheostoma baileyi*				S2, SD		Creeks and small rivers with riffles containing gravel or rubble; upper Cumberland drainage.	Yes
Flame Chub *Hemitremia flammea*			X	S3, SD		Springs and spring-fed streams with lush aquatic vegetation; Tennessee and middle Cumberland watersheds.	Yes
Lake Sturgeon *Acipenser fulvescens*			X	S1, SE		Bottoms of large, clean rivers and lakes.	No

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Laurel Dace *Chrosomus saylori*	X			S1, SE	FE	Cool 1st-2nd order streams with slab rock and rubble substrate; Tennessee River watershed.	Yes
Olive Darter *Percina squamata*	X			S2, SD		Small to medium rivers; in strong flowing chutes with rubble/boulders in high-gradient streams.	No
Redlips Darter *Etheostoma maydeni*		X		S2, SE		Slow-moving large creeks and rivers in pools along the banks strewn with boulders and woody debris.	No
Sickle Darter *Percina williamsi*				S2, ST	FT	Flowing pools over rock, sandy, or silty substrates in clear creeks or small rivers	Yes
Slender Chub *Erimystax cahni*		X		S1, ST	FT	Restricted to bars and shoals of fine to medium gravel in runs and riffles of medium to large, clear, warm rivers.	Yes
Spotfin Chub *Erimonax monachus*	X	X	X	S1, ST	FT, EXPN	Clear upland rivers with swift currents and boulder substrates; portions of the Tennessee River watershed.	Yes
Tangerine Darter *Percina aurantiaca*	X	X	X	S3, SD		Large-moderate size headwater tributaries to Tennessee River, in clear, fairly deep, rocky pools, usually below riffles.	No
Tennessee Dace *Chrosomus tennesseensis*	X	X	X	S3, SD		First order spring-fed streams of woodlands in Ridge and Valley limestone region; Tennessee River watershed.	Yes
Yellowfin Madtom *Noturus flavipinnis*		X		S1, ST	FT	Shallow pools and backwaters of streams with cover of roots, sunken leaves, brush piles, and bedrock ledges.	No (extirpated)
Obey Crayfish *Cambarus obeyensis*	X			S1, SE		Under cover in small-medium sized streams; headwaters of East Fork Obey River; northern Cumberland.	No

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Prickly Cave Crayfish *Cambarus hamulatus*	X			S3, SD		Aquatic caves; Sequatchie Valley and southern Cumberland.	No
Pristine Crayfish *Cambarus pristinus*	X			S2, SE		Under cover in small-large streams; headwaters of Caney Fork River and abutting Sequatchie River tributaries.	No
Valley Flame Crayfish *Cambarus deweesae*		X	X	S1, SE		Primary burrower; open areas with high water tables.	Yes
Mollusks							
Alabama Lampmussel *Lampsilis virescens*		X	X	S1, SE	FE	Sand and gravel substrates in shoal areas of small-medium size rivers.	Yes
Anthony's Riversnail *Athearnia anthonyi*		X		S1, SE	FE, EXPN	Large-medium rivers with moderate-high gradient, or riffles of larger creeks with cobble/boulder substrate.	Yes
Birdwing Pearlymussel *Lemiox rimosus*		X		S1, SE	FE, EXPN	Riffles with stable, sand and gravel substrates in moderate to fast currents in small to medium sized rivers.	Yes
Cracking Pearlymussel *Hemistena lata*		X		S1, SE	FE, EXPN	Sand, gravel, and cobble substrates in swift currents or mud and sand in slower currents.	Yes
Cumberland Bean (pearlymussel) *Villosa trabalis*				S1, SE	FE	Sand, gravel, and cobble substrates in waters with moderate to swift currents, and depths less than 1 meter.	Yes
Dromedary Pearlymussel *Dromus dromas*		X		S1, SE	FE, EXPN	Riffles and shoals with sand and gravel and moderate current velocities; may also be found in deeper, slower moving water in Tennessee.	Yes
Fanshell *Cyprogenia stegaria*		X	X	S1, SE	FE, EXPN	Medium to large streams and rivers with coarse sand and gravel substrates.	Yes

Common Name ***Scientific Name***	**Record of Occurrence by County[1,2]**			**State Rank and Listing Status[3]**	**Federal Listing Status[3]**	**Habitat Requirement**	**Potential Habitat in Eastern and Western Transmission Corridors[4]**
	Cumberland	Anderson	Roane				
Finerayed Pigtoe *Fusconaia cuneolus*		X	X	S1, SE	FE, EXPN	Riffles of fords and shoals of mod gradient streams in firm cobble and gravel substrates.	Yes
Green Blossom Pearlymussel *Epioblasma torulosa gubernaculum*		X		SX, SE	FE	Riffle or shoal areas with fast flowing water that contains firm rubble, gravel, and sand substrates.	Yes
Orangefoot Pimpleback (pearlymussel) *Plethobasus cooperianus*		X	X	S1, SE	FE, EXPN	Perennial streams with rocky areas and swift to slow moving currents.	Yes
Pink Mucket *Lampsilis abrupta*		X	X	S2, SE	FE	Large rivers with sand-gravel or rocky substrates with moderate to strong currents.	Yes
Purple Bean *Villosa perpurpurea*					FE	Creeks to medium-sized rivers and occasionally headwaters; generally associated with riffles but may be in direct current, pools.	Yes
Ring pink *Obovaria retusa*			X	S1, SE	FE, EXPN	Large rivers in sand and gravel.	Yes
Rough Pigtoe *Pleurobema plenum*		X		S1, SE	FE, EXPN	Medium to large sized rivers, in substrates ranging from mud and sand to gravel, cobble, and boulders	Yes
Rough Rabbitsfoot *Quadrula cylindrica strigillata*			X	S1, SE	FE	Small-medium sized rivers in clear, shallow riffles with sand-gravel substrates	Yes
Sheepnose Mussel *Plethobasus cyphyus*			X	S2S3, SE	FE	Large to medium-sized rivers, in riffles and coarse sand/gravel substrate.	Yes
Shiny Pigtoe *Fusconaia cor*		X	X	S1, SE	FE, EXPN	Shoals and riffles of small-medium sized rivers with moderate-fast current over sand-cobble substrates.	Yes

Common Name ***Scientific Name***	**Record of Occurrence by County[1,2]**			**State Rank and Listing Status[3]**	**Federal Listing Status[3]**	**Habitat Requirement**	**Potential Habitat in Eastern and Western Transmission Corridors[4]**
	Cumberland	Anderson	Roane				
Slabside Pearlymussel *Pleuronaia dolabelloides*		X		S2, SE	FE	Large creeks to moderate-sized rivers, in riffles and shoals of sand, fine gravel, and cobble substrates with moderate current	Yes
Spectaclecase *Cumberlandia monodonta*		X	X	S2S3, SE	FE	Medium to large rivers; in substrates ranging from mud and sand to gravel, cobble, and boulders.	Yes
Tan Riffleshell *Epuoblasma walkeri*		X		S1, SE	FE	Found in river headwaters, in riffles and shoals in sand and gravel substrates	Yes
Tennessee Bean *Venustaconcha trabalis*	X		X	S1, SE	FE, EXPN	Riffle areas of small rivers and streams in sand, gravel, and cobble substrates with swift current	Yes
Turgid Blossom (pearlymussel) *Epioblasma turgidula*			X		FE, EXPN	Clear, unpolluted water over sand and gravel substrates of shallow, fast-moving streams.	No
White Wartyback *Plethobasus cicatricosus*		X		S1, SE	FE, EXPN	Shoals and riffles in large rivers; Tennessee and Cumberland River systems; possibly extirpated in TN	Yes
Plants[5]							
American Barberry *Berberis canadensis*	X	X		S2, SSC		Rocky woods and river bars.	No
American Ginseng *Panax quinquefolius*		X	X	SSC		Shaded forests with deep, moist and rich soils	No
Barrens Silky Aster *Symphyotrichum pratense*	X		X	S1, SE		Barrens.	No
Bog Oat-grass *Danthonia epilis*	X			S1S2, SSC		Acidic seeps	No
Branching Whitlow-grass *Draba ramosissima*		X	X	S2, SSC		Calcareous bluffs.	No

Common Name ***Scientific Name***	**Record of Occurrence by County[1,2]**			**State Rank and Listing Status[3]**	**Federal Listing Status[3]**	**Habitat Requirement**	**Potential Habitat in Eastern and Western Transmission Corridors[4]**
	Cumberland	Anderson	Roane				
Brown Bog Sedge *Carex buxbaumii*	X			S1, SE		Swamps.	No
Butternut *Juglans cinerea*		X	X	S3, ST		Shaded forests with deep, moist and rich soils	No
Buxbaum's Sedge *Carex buxbaumii*	X			S1, SE		Swamps.	No
Copper Iris *Iris fulva*		X		S2, ST		Bottomlands.	No
Cumberland Rosemary *Conradina verticillata*	X			S3, ST	FT	Sandy, rocky riverbanks and bars.	No
Cumberland Sand-grass *Sporobolus arcuatus*	X			S2, ST		Rocky and sandy river bars.	No
Drooping Bluegrass *Poa saltuensis*	X			S1, ST		Rich oak woods.	No
Earleaved False-foxglove *Agalinis auriculata*			X	S2, SE		Barrens.	No
Early St. Johnswort *Hypericum nudiflorum*	X			S2, SSC		Acidic wet and/or open areas.	No
Fen Orchis *Liparis loeselii*			X	S2, ST		Calcareous seeps.	No
Fetter-bush *Leucothoe racemosa*			X	S2, ST		Acidic wetlands and swamps.	No
Foxtail Clubmoss *Lycopodiella alopecuroides*	X			S2, ST		Wet acidic barren.	No
Godfrey's Thoroughwort *Eupatorium godfreyanum*	X		X	S1, SSC		Dry woods.	Yes

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Granite Gooseberry *Ribes curvatum*	X			S1, ST		Rocky woods.	No
Hairy Willow-herb *Epilobium ciliatum*		X		S1, ST		Mountain balds.	No
Hart's-tongue Fern *Aspelnium scolopendrium var. americanum*			X	S1, SE	FT	Sinks.	No
Heartleaf Meehania *Meehania cordata*		X		S2, ST		Wooded mountain slopes.	No
Heller's Catfoot *Pseudognaphalium helleri*			X	S2, SSC		Dry sandy woods.	No
Large-flowered Barbara's-buttons *Marshallia grandiflora*	X		X	S2, SE		Rocky river bars.	No
Large-leaf Pondweed *Potamogeton amplifolius*	X			S1, ST		Lakes and streams.	No
Large-leaved Grass-of-Parnassus *Parnassia grandifolia*		X		S3, SSC		Calcareous seeps.	No
Least Trillium *Trillium pusillum*	X			S2, SE		Alluvial/moist ravines in dry ridges.	No
Marsh Bellflower *Campanula aparinoides*	X			S2, SSC		Bogs.	No
Missouri Gooseberry *Ribes missouriense*			X	S2, SSC		Rocky woods.	No
Mountain Bush-honeysuckle *Diervilla sessilifolia var. rivularis*			X	S2, ST		Dry cliffs and bluffs.	No

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Mountain Honeysuckle *Lonicera diocia*			X	S2, SSC		Mountain woods and thickets.	No
Mountain Witch-alder *Fothergilla major*		X		S2, ST		Rocky slopes and riverbanks.	No
Muhlenberg's Nutrush *Scleria muehlenbergii*	X			S2, ST		Wet meadows.	No
Naked-stem Sunflower *Helianthus occidentalis*	X	X	X	S2, SSC		Limestone glades and barrens.	Yes
Narrow Mushroom-headed Liverwort *Preissia quadrata*			X	S1, ST		Seepy limestone cliffs and bluffs.	No
Northern Bush-honeysuckle *Diervilla lonicera*		X	X	S2, ST		Rooky woodlands and bluffs.	No
Northern Evening-primrose *Oenothera parviflora*	X			S1, SSC		Disturbed open areas.	Yes
Nuttall's Pondweed *Potamogeton epihydrus*	X			S1S2, SSC		Lakes and streams.	No
Nuttall's Waterweed *Elodea nuttallii*		X	X	S2, SSC		Streams and ponds.	No
Ovate-leaved Arrowhead *Sagittaria platyphylla*	X			S2S3, SSC		Swamps, emergent.	No
Ozark Bunchflower *Veratum woodii*			X	S2, SSC		Rich wooded slopes.	No

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Palamocladium Moss *Palamocladium leskeoides*		X	X	S1, ST		Seepy limestone cliffs and bluffs.	No
Prairie Goldenrod *Oligoneuron album*		X	X	S1S2, SE		Barrens.	No
River Bulrush *Bolboschoenus fluviatilis*			X	S1, SSC		Marshes, openings in swamps, edges of ponds and streams, fresh tidal marshes, and inland salt marshes and ponds.	No
Rose Pogonia *Pogonia ophioglossoides*	X			S2, SE		Wet acidic barrens.	No
Roundleaf Shadbush *Amelanchier sanguinea*	X			S2, ST		Rocky slopes and riverbanks.	No
Schreber's Aster *Eurybia schreberi*			X	S1, SSC		Mesic woods and seepage slopes.	No
Sharp's Homaliadelphus *Homaliadelphus sharpii*		X		S1, SE		Calcareous or dolomite bluffs.	No
Sharp's Lejeunea *Lejeunea sharpii*		X		S1S2, SE		Calcareous bluffs, rocks and logs of wet sinks.	No
Shining Ladies'-tresses *Sprianthes lucida*			X	S1S2, ST		Alluvial woods and moist slopes.	No
Shortleaf Sneezeweed *Helenium brevifolium*	X			S1, SE		Rocky, sandy streamsides.	No
Silverling *Paronychia aegyrocoma*	X			S1, ST		Dry sandstone, granite outcrops.	No

Common Name ***Scientific Name***	**Record of Occurrence by County[1,2]**			**State Rank and Listing Status[3]**	**Federal Listing Status[3]**	**Habitat Requirement**	**Potential Habitat in Eastern and Western Transmission Corridors[4]**
	Cumberland	Anderson	Roane				
Slender Blazing-Star *Liatris cylindracea*			X	S2, ST		Barrens.	No
Small's Stonecrop *Diamorpha smallii*	X			S1S2, SE		Sandstone outcrops.	No
Small-headed Rush *Juncus brachycephalus*			X	S2, SSC		Seeps and wet bluffs.	No
Small Mousetail Moss *Myurella julacea*			X	SH, SSC-PE		Shale bluffs.	No
Spoonleaf Sundew *Drosera intermedia*	X			S2, SSC		Acidic wetlands.	No
Spreading False-foxglove *Aureolaria patula*		X	X	S3, SSC		Oak woods and edges.	No
Sticky Hedge-hyssop *Gratiola brevifolia*	X			S1, SSC		Wet barrens and marshes.	No
Sullivantia *Sullivantia sullivantii*		X		S1, SE		Moist shaded cliffs.	No
Sundew *Drosera capillaris*	X			S2, ST		Acidic wetlands.	No
Swamp Lousewort *Pedicularis lanceolata*	X		X	S1S2, SSC		Wet acidic barrens and seeps.	No
Tall Larkspur *Delphinium exaltatum*		X	X	S2, SE		Glades and barrens.	Yes
Tawny Cotton-grass *Eriophorum virginicum*	X			S1S2, SE		Bogs.	No
Tennessee Pondweed *Potamogeton tennesseensis*	X			S2, ST		Slow acidic streams.	No

Common Name *Scientific Name*	Record of Occurrence by County[1,2]			State Rank and Listing Status[3]	Federal Listing Status[3]	Habitat Requirement	Potential Habitat in Eastern and Western Transmission Corridors[4]
	Cumberland	Anderson	Roane				
Torrey's Mountain-mint *Pycanthemum torrei*		X		S1, SE		Barrens.	No
Tubercled Rein-orchid *Platanthera flava var. herbioloa*		X	X	S2, ST		Swamps and floodplains.	Yes
Virginia Spiraea *Spiraea virginiana*	X		X	S2, SE	FT	Stream bars and ledges.	No
Water Bulrush *Schoenoplectus subterminalis*	X			S1, SE		Ponds and stream margins.	No
Western Wallflower *Erysimum capitatum*			X	S1S2, SE		Rocky bluffs.	No
White Fringeless Orchid *Platanthera integrilabia*	X		X	S2S3, SE	FT	Acidic seeps and stream heads.	No
Wood Lily *Lilium philadelphicum*	X			S1, SE		Dry openings, powerlines.	No
Yellow Crested Orchid *Platanthera cristata*	X			S2S3, SSC		Acidic seeps and stream heads.	No
Yellow Nodding Ladies'-tresses *Spiranthes ochroleuca*	X			S1, SE		Moist mountain woods.	No
Zigzag Bladderwort *Utricularia subulata*	X			S1, ST		Wet barrens, ecotones.	No
Insects							
Monarch Butterfly *Danaus plexippus*					FC	Milkweed and flowering plants.	Yes

Source: USFWS Information, Planning, and Consultation (IPaC) dated April 20, 2023, Tennessee Department of Environment and Conservation's (TDEC) Rare Species by County, TVA Regional Natural Heritage Database
[1] Alternative A existing off-site transmission corridors cross Cumberland (Western Transmission Corridor) and Roane and Anderson (Eastern Transmission Corridor) counties.
*Protected under the Bald and Golden Eagle Protection Act
[+]Record of observation on-site
[2] FE = Federal-Endangered; FT = Federal-Threatened; FPE = Federal Proposed-Endangered; FPT = Federal Proposed-Threatened; FC: Federal Candidate for Listing; EXPN = non-essential experimental populations; SE = State-Listed as Endangered; ST = State-Listed as Threatened; SSC = State-Listed as Special Concern; SD = State-Listed as Deemed in Need of Management; S1 = Extremely rare and critically imperiled in the state with five or fewer occurrences, or very few individuals, or because of some special condition where the species is particularly vulnerable to extinction; S2 = Very rare and imperiled in the state, 6 to 20 occurrences, or few remaining individuals, or because of some factor(s) making it vulnerable to extinction; S3 = Rare and uncommon in the state, from 21-100 occurrences; S4 = Widespread, abundant, and apparently secure within the state but cause for long-term concern; SH = of historical occurrence in Tennessee, e.g. formally part of the established biota, with the expectation that it may be rediscovered; PE = Possibly Extirpated; SX = presumed extirpated
[3] Yes = suitable habitat present in project area; No = no potential presence of suitable habitat in project area
[4] Protected under the Bald and Golden Eagle Protection Act
[5] Field surveys for federally and state-listed plant species were completed in June and August, 2022. For plants listed in this table, the last column lists whether the species was directly observed during field surveys, which were conducted during the appropriate times of year for identification.

3.8.4.1.2.5.1 Birds

Seven federally or state-listed bird species have potentially suitable habitat within or alongside the existing off-site transmission corridors. These species include Bachman's sparrow, bald eagle (foraging over water), Bewick's wren, cerulean warbler, golden-winged warbler, Swainson's warbler, and whooping crane (Table 3.8-23). Habitat requirements for Bachman's sparrow, bald eagle, and Swainson's warbler are discussed in Section 3.8.4.1.1.1. The golden-winged warbler, state-listed as threatened, is known from Anderson and Cumberland counties, which encompasses the entirety of the Western Transmission Corridor and the eastern half of the Eastern Transmission Corridor. Golden-winged warblers are found in open woodlands, brushy clearings, and undergrowth, and breed in early successional habitat with brushy areas with patches of weeds, shrubs, and scattered trees (National Audubon Society 2022). Bewick's wren and cerulean warbler are both listed as Deemed in Need of Management In Tennessee, which includes the eastern half of the Eastern Transmission Corridor. Habitat requirements for Bewick's wren includes brushy areas, thickets, and scrub in open country and around the edges of woods (National Audubon Society 2022). Habitat requirements for cerulean warbler includes mature, deciduous forest in floodplains. Whooping crane is a federally endangered population that does not have state-listed status in Tennessee, but the species is considered very rare (TDEC 2023b). Habitat requirements for whooping crane includes open prairies and marsh habitat for breeding and grain fields and shallow lakes during winter migration. Potential habitat for whooping crane occurs along the off-site transmission line corridors and several small population have been observed along the Cumberland River during their winter migrations since 2008. Potential habitat for golden-winged warbler, Bewick's wren, cerulean warbler, and whooping crane exists within and alongside the transmission line corridors; however, no individuals were observed during the 2022 field surveys. The golden-winged warbler and cerulean warbler have been documented within three miles of the transmission line corridors based on a review of the TVA Regional Natural Heritage Database.

Migratory Birds

The migratory bird species of conservation concern for the proposed upgrades to transmission line ROWs are the same as those listed and discussed for the Kingston Reservation in Section 3.8.4.1.1.1, as both areas are in Bird Conservation Region 28. Table 3.8-24 summarizes the migratory birds that may occur along the existing transmission line ROWs proposed for upgrades based on field surveys completed in June 2022.

Table 3.8-24. Migratory Bird Species of Conservation Concern Potentially Occurring in or Identified on the Alternative A Transmission Line Corridors

Common Name	Scientific Name	General Habitat Description	Potential Habitat Present
Migrant Species (present as spring and fall migrant and/or during winter)			
Bobolink	*Dolichonyx oryzivorus*	Open country with a preference for large hayfields, moist meadows and weedy fields dominated by a mixture of tall grasses	Yes
Golden-winged Warbler	*Vermivora chrysoptera*	Inhabits upland sites on abandoned farmland in early successional habitats, powerline ROWs, dry and shrubby fields.	Yes

Common Name	Scientific Name	General Habitat Description	Potential Habitat Present
Lesser Yellowlegs	*Tringa flavipes*	Winters and migrates along mudflats, sandy beaches, shores of lakes and ponds, and wet meadows.	No
Black-capped Chickadee	*Poecile atricapillus*	Occurs in deciduous and mixed forests, open woods, parks, willow thickets, cottonwood groves, and disturbed areas	Yes
Rusty Blackbird	*Euphagus carolinus*	Forested wetlands	Yes
Prothonotary Warbler	*Protonotaria citrea*	Forested wetlands with areas of standing water	Yes
Cerulean Warbler	*Dendroica cerulea*	Mature deciduous forest with scattered canopy gaps	Yes
Breeding Season Migrants (may occur only during the breeding season)			
Chimney Swift	*Chaetura pelagica*	Forages over variety of habitats, requires chimneys or large hollow tree snags with open tops for nesting.	Yes
Common Nighthawk (lesser)	*Chordeiles minor*	Inhabits any kind of open or semi-open terrain, including clearings in forest, open pine woods, prairie country, farmland, suburbs and city centers.	Yes
Chuck-will's Widow	*Antrostomus carolinensis*	Oak and pine woodlands. Breeds in shady southern woodlands of various types, including open pine forest, oak woodlands, edges of swamps.	Yes
Eastern Whip-poor-will	*Antrostomus vociferus*	Woodlands with open understory.	Yes
Kentucky Warbler	*Geothlypis formosa*	Large moist forest tracts with mature trees and thick understory.	Yes
Prairie Warbler	*Dendroica discolor*	Various shrubby habitats, including regenerating forests, open brushy fields, and Christmas tree farms.	Yes
Wood Thrush	*Hylocichla mustelina*	Breeds in mature deciduous and mixed forests, forests with dense understory, and forest edges.	Yes
Yellow-billed Cuckoo (Eastern)	*Coccyzus americanus*	Woodlands, thickets, orchards, streamside groves. Breeds mostly in dense deciduous stands, including forest edges, tall thickets, dense second growth, overgrown orchards, scrubby oak woods.	Yes

Common Name	Scientific Name	General Habitat Description	Potential Habitat Present
Black-billed Cuckoo	*Coccyzus erythrophthalmus*	Occurs along wood edges, groves, thickets. Breeds mostly in deciduous thickets and shrubby places, often on the edges of woodland or around marshes	Yes
Resident Species (may occur year-round)			
Eastern Meadowlark	*Sturnella magna*	Open fields and pastures, meadows, prairies. Breeds in natural grasslands, meadows, weedy pastures, also in hayfields and sometimes in fields of other crops. Winters in many kinds of natural and cultivated fields	Yes
Killdeer	*Charadrius vociferus*	Fields, airports, lawns, riverbanks, mudflats, shores. Often found on open ground, such as pastures, plowed fields, large lawns, even at a great distance from water. Most successful nesting areas, however, have some shallow water or other good feeding area for the chicks. Also commonly found around water, on mudflats, lake shores, coastal estuaries	No
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Deciduous woodlands with oak or beech, groves of dead or dying trees, forested river bottoms, recent clearings, farmland, grasslands, forest edges and roadsides	Yes
Northern Saw-whet Owl	*Aegolius acadicus*	Occurs in forest with an open understory for foraging, deciduous trees for nesting, dense conifers for roosting, and riverside habitat nearby. But they nest in a wide range of wooded habitats, including coniferous swamps, disturbed deciduous woods, savannahs, riverside forest, and shrub-steppe habitat	Yes

Sources: USFWS 2021b, HDR 2022c

In addition to protection under the MBTA, eagles are also protected under the BGEPA. Bald eagles typically utilize forested areas adjacent to large bodies of water for nesting habitat. Tall, mature coniferous or deciduous trees that afford a wide view of the surroundings are used as nest trees and roost trees. Bald eagles typically avoid heavily developed areas. Suitable summer nesting habitat for bald eagles generally consists of prominent trees along riparian corridors on large bodies of water. Winter habitat in Tennessee includes reservoirs and large rivers. Bald eagles are known to nest in Tennessee, with 175 nesting pairs as of 2012 (TWRA 2023e). Neither bald eagles nor their nests were sighted during field surveys of the off-site transmission line corridors. There are 9 bald eagle records for Roane County, 6 of which are extant. The closest known nesting record for these transmission line corridors is approximately 0.48 miles away; however, this nest was abandoned in 2004 (E.B. Hamrick, personal communication, March 7, 2023). In 2021, an eagle nest was also observed 2.03 miles from the KIF plant on the bank of the Clinch River but this nest was not active at the time of the observation. In February 2023, an active nest was document approximately 3.96 miles from the KIF plant on the Tennessee River.

More detailed information regarding potential habitat for protected and migratory birds along the transmission line corridors is provided in HDR (2022d), attached as Appendix L.

3.8.4.1.2.5.2 Mammals

Seven federally or state-listed bat species were identified as potentially occurring in the vicinity of the Alternative A transmission corridors (Table 3.8-23). Bats identified for Cumberland County, which includes the Western Transmission Corridor, are the gray bat, eastern small-footed bat, Indiana bat, northern long-eared bat, Rafinesque's big-eared bat, and the tricolored bat. Bats identified in Roane or Anderson counties, which are crossed by the Eastern Transmission Corridor, include gray bat, Indiana bat, little brown bat, northern long-eared bat, and tricolored bat. The gray bat, Indiana bat, northern long-eared bat, little brown bat, and tricolored bat are state-listed in Tennessee; the gray bat, Indiana bat, and northern long-eared bat, are also federally protected species under the ESA. The tricolored bat is expected to be proposed for listed as endangered under the ESA in October 2023. The little brown bat is expected to be proposed for listing sometime in 2024. Suitable summer roost habitat for these species consists of trees of varying ages, including dead snags, is present alongside the transmission line corridors and access roads, including a total of 218.8 acres of moderately to highly suitable summer roost habitat (HDR 2022c). Foraging habitats for all listed bat species is present within the transmission line corridors over ponds, wetlands, streams, and open agricultural fields. Additional foraging habitat occurs within forested habitat, forest edges, and/or alongside tree lines. The TVA Regional Natural Heritage Database reported four caves in Anderson County and six caves in Roane County that are within three miles of the Eastern Transmission Corridor, indicating that winter roosting may also occur nearby.

Two other state-listed mammals may have potential habitat within the transmission line corridors: the long-tailed shrew and the southern bog lemming. The long-tailed shrew prefers mountainous, forested areas with loose talus (TWRA 2022c). More detailed information regarding potential habitat for mammals along the transmission line corridors is provided in HDR 2022c and attached as Appendix L.

3.8.4.1.2.5.3 Reptiles

The eastern slender glass lizard was the only federally or state-listed species of reptile identified with potential habitat along both the Western and Eastern Transmission Corridors for Alternative A (Table 3.8-23). Information for this species is provided in Section 3.8.4.1.1.3.

3.8.4.1.2.5.4 Amphibians

The black mountain salamander, Cumberland dusky salamander, and the eastern hellbender may have suitable habitat within the transmission line ROWs. The black mountain salamander and Cumberland dusky salamander are state listed as Deemed in Need of Management in Tennessee, which includes the Western Transmission Corridor. The black mountain salamander is found in spring runs and permanent streams in wooded, mountainous terrain. This species has been reported on the TVA Regional Natural Heritage Database as being identified within three miles of the Western Transmission Corridor. The Cumberland dusky salamander species occupies spaces under rocks along small streams, or adjacent cover, and are associated with streams of the Cumberland Plateau, which is crossed by the Western Transmission Corridor. As such, there is potential for this species or its habitat to occur within streams crossed by the existing transmission line.

The eastern hellbender is state-listed as endangered. It is a large salamander found in clear, rocky creeks and rivers with water temperatures that are ideally less than or equal to 20°C, and where there are large shelter rocks. Eggs are laid in nests in late summer or fall beneath these large, flat shelter rocks or submerged logs. Presence of the eastern hellbender has been documented for Anderson, Cumberland, and Roane counties, which are crossed by the Western (Cumberland) and Eastern (Anderson and Roane) transmission corridors. There is potential for the hellbender or its habitat to occur within streams crossed by the existing transmission lines.

3.8.4.1.2.5.5 Plants

Seventy-three federally and state-listed plant species were identified on the resource lists, including the USFWS IPaC, TDEC species by county, and TVA's Regional Natural Heritage Database (Table 3.8-23). Of the 73 state-listed species, 17 have been identified within 5 miles of the off-site transmission line corridor since the early 2000s, and 5 species since 2010, including tall larkspur, spreading false-foxglove, waterweed, northern bush-honeysuckle, and copper iris. Field surveys conducted in June and August 2022 determined that none of these species are present within the existing off-site transmission corridors at the time of survey, however surveys may not have been completed during a species' specific blooming period. Additional information is provided in Appendix L. Field surveys to be completed in June 2023 will further evaluate potential presence of listed plant species in areas not previously surveyed.

3.8.4.1.2.5.6 Aquatic Species

Based on the habitat requirements and identified within surface waters during field surveys, 8 species of fish, 1 crayfish, and 22 mollusks may have potential habitat within the off-site transmission line corridors. Fish species include the emerald darter, flame chub, laurel dace, sickle darter, slender chub, spotfin chub, Tennessee dace, and yellowfin madtom. Emerald darters are found in a variety of clear freshwater habitats with moderately low siltation and mixed substrates (ADW 2022) in the upper Cumberland drainage, which encompasses the Western Transmission Corridor. They are typically found in shallow water ranging from 8 to 45 centimeters, but may seek deeper, rock-lined pools during winter months or when flooding alters current velocity and depth at riffles (ADW 2022). The emerald darter has been observed within 10 miles of the Eastern Transmission Corridor in Anderson County according to records under the TVA Regional Natural Heritage Database.

The flame chub inhabits springs, shallow seepage waters, and spring-fed streams usually over gravel in areas where aquatic vegetation is abundant (NatureServe 2022). A historical (circa 1941) observation of the flame chub within 10 miles of the Eastern Transmission Corridor was listed on the TVA Regional Natural Heritage Database for Roane County.

The Laurel dace prefers undercut banks or beneath slab boulders in pools and slow runs of first and second order streams (headwaters and creeks) with cobble-rubble-boulder substrate and cool water (NatureServe 2022). There is one record of a laurel dace observation in Cumberland County provided in the TVA Regional Natural Heritage Database in 1954.

The sickle darter inhabits flowing pools over rocky, sandy, or silty substrates in clear creeks or small rivers, and often occurs near woody debris, vegetation such as water willow, or large boulders (NatureServe 2022). No records of the sickle darter were found in the TVA Regional Natural Heritage Database.

The Tennessee dace are found in spring-fed streams with gravel, sand, and silt-bottom pools; streams are usually well shaded by riparian growth and woodlands and remain cool year-round (NatureServe 2022). The TVA Regional Natural Heritage Database provides 7 observations of this species within 10 miles of the Eastern Transmission Corridor in Roane County, and six observations in Anderson County. Observations date as far back as 1950 and most recently as 2011.

The yellowfin madtom are found in medium and large creeks and small rivers with clean, warm or warm-to-cool water free of silt with moderate or gentle gradient (NatureServe 2022). They are usually found in slow pools and small backwaters under cover. The TVA Regional Natural Heritage Database reports one observation of this species from 1959; however, it is currently considered extirpated. The slender chub and Spotfin chub habitat requirements are described in Section 3.8.4.1.1.6. The valley flame crayfish is the only crayfish considered to have potential habitat within the off-site transmission line corridors. Habitat requirements for this species are provided in Section 3.8.4.1.1.6. No records of the valley flame crayfish are listed in the TVA Regional Natural Heritage Database.

Twenty-one mussel species and one snail were identified with potential to occur within waterbodies crossed by the off-site transmission line corridors. The federally listed shiny pigtoe, Tennessee bean (formerly the purple bean), Cumberland bean, green blossom pearlymussel, tan riffleshell, and the Alabama lampmussel require relatively silt free substrates of sand, gravel, and cobble in good flows of smaller streams (NatureServe 2022). The federally listed rough rabbitsfoot, dromedary pearlymussel, and birdwing pearlymussel inhabit small to medium sized streams with sand and gravel substrates (NatureServe 2022). The federally listed rough pigtoe, fine-rayed pigtoe, fanshell, cracking pearlymussel, slabslide pearlymussel, and Anthony’s riversnail inhabit medium to large rivers in sand, gravel, and cobble substrates. The federally listed spectaclecase, sheepnose mussel, ring pink, pink mucket, and the orangefoot pimpleback inhabit large rivers with sand and gravel substrates (NatureServe 2022). The spectaclecase, dromedary pearlymussel, shiny pigtoe, fine-rayed pigtoe, cracking pearlymussel, birdwing pearlymussel, and orange-foot pimpleback all have observations listed in the TVA Regional Natural Heritage Database for within 10 miles of the Eastern Transmission Corridor in Anderson County. The Tennessee bean has observations listed for Cumberland County, and the spectaclecase, shiny pigtoe pearlymussel, fine-rayed pigtoe, pink mucket, Alabama lampmussel, orange-foot pimpleback, and Tennessee bean also has observations listed in the TVA Regional Natural Heritage Database within 10 miles of the off-site transmission corridors in Roane County.

3.8.4.1.2.5.7 Insects
Monarch butterflies are the only protected or candidate insect species with the potential to occur within the existing transmission line ROWs. Additional details on the monarch butterfly and its preferred larval habitat, milkweed, are presented in Section 3.8.4.1.1.7. Milkweed and other flowering plants were observed in multiple areas throughout the Western and Eastern transmission corridors; therefore, monarch butterflies may also be present within the transmission line corridors (HDR 2022c).

3.8.4.1.2.6 Construction and Operation of a Natural Gas Pipeline
Terrestrial and aquatic wildlife and plant species with state or federal ESA protected status that may be found in the proposed ETNG Construction ROW are summarized in Table 3.8-25. The

species list includes species listed on the USFWS IPaC, TVA's Regional Natural Heritage Database, and TDEC state listings. TVA's Regional Natural Heritage Database includes several records (including historical records) that are not reported by USFWS due to state (but not federal) listing or may not result in potential ESA concerns as identified by IPaC. However, these records are still addressed under NEPA per TVA procedure. The ETNG Construction ROW crosses eight counties (Trousdale, Smith, Jackson, Putnam, Overton, Fentress, Morgan, and Roane). ETNG is conducting habitat assessments and field surveys for federal and state-listed species with the potential to occur within the ETNG Construction ROW in late 2022 and 2023. Detailed habitat information and information on any species observations made during the surveys were reported as part of FERC's Environmental Resource Reports submitted by ETNG with their certificate application.

As stated in ETNG's Resource Report 3 (ETNG 2022d):

> Consultation with resource agencies is ongoing as well as surveys for endangered, threatened, and special concern species. Impacts on protected species from the Project would primarily result from vegetation clearing. [ETNG] is currently in the process of consulting with USFWS and TWRA regarding mitigation measures for work in protected species habitat. Impacts are expected to be temporary in nature, however, they will be addressed as consultation and surveys continue. Assessment of impacts and species presence or probable absence is expected to be ongoing through 2023. A Habitat Assessment Report and Species Survey Reports will be provided in the final Resource Report 3 included in the Project Application.

A preliminary assessment of potential habitat presence for protected species was made based on habitat information contained in ETNG's RR2 and RR3 (ETNG 2022c, 2022d) and best professional judgment. Based on the evaluation of information provided in ETNG's Resource Reports 2 and 3 (as of submittal of this DEIS) and understanding of similar projects completed within the region, ETNG will implement its assessments findings to maximizes avoidance of cave and karst features within the proposed ROW to the extent practicable. In all work areas of potential and known karst features, including sinkholes, caves, sinking or losing streams, swallow holes, and springs, standard safe-work practices would be implemented. Buffer zones of 300 feet will be established. During all construction earthwork activities, these zones will be clearly marked in the field with signs and safety fencing or similar barriers depending on the feature. Therefore, it is unlikely that these habitats and their associated obligate species will be affected. Should effects be determined likely, TVA assumes that the effects determination would be "may affect, but not likely to adversely affect," and that post-construction compensatory mitigation will be implemented.

As an initial desktop analysis, suitable mussel habitat is assumed to be present in the ETNG Construction ROW if the mussel was identified within the same county as a "TN Exceptional Waters" designated waterbody in RR2 (ETNG 2022c) and described in Section 3.6.1.2.3.6 (ETNG 2022c). Mussels can be indicator species for identifying the presence of good water quality due to their sensitivity to degradation and pollution, therefore waters categorized as "TN Exceptional Waters" may be more likely to contain these species. Consultation with the agencies is ongoing; determinations made for state and federally protected species will be provided in the FEIS, if available at that time.

Table 3.8-25. Threatened, Endangered, and Other Protected Species Reported for the ETNG Construction ROW[1]

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW[2,3]**
Birds				
Bachman's Sparrow *Peucaea aestivalis*	S1, SE		Dry open pine or oak woods; nests on the ground in dense cover.	Yes
Mammals				
Gray Bat *Myotis grisescens*	S2, SE	FE	Roosts in caves or karst features year-round. Various foraging habitats including wet meadows, damp woods, and uplands.	Yes (foraging)
Indiana Bat *Myotis sodalis*	S1, SE	FE	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures and sinkhole fissures/karst features; statewide.	Yes (roosting and foraging)[4]
Little Brown Bat *Myotis lucifugus*	S3, ST		Roost in caves, hollow trees, and human-made structures.	Yes (roosting and foraging
Northern Long-eared Bat *Myotis septentrionalis*	S1S2, ST	FE	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures, sinkhole/karst features; statewide.	Yes (roosting and foraging)
Tricolored Bat *Perimyotis subflavus*	S2S3, ST		Generally associated with forested landscapes but may roost near openings.	Yes (roosting and foraging)
Reptiles				
Northern Pinesnake *Pituophis melanoleucus melanoleucus*	S3, ST		Well-drained sandy soils in pine/pine-oak woods; dry mountain ridges.	Yes
Amphibians				
Berry Cave Salamander *Gyrinohilus gulolineatus*	S3, ST	FC	Aquatic cave obligate.	No
Hellbender *Cryptobranchus alleganiensis*	S3, SE		Clean and flowing water with plenty of oxygen in large streams and creeks. Areas with gravel bottoms and an abundance of rocks and submerged logs are necessary.	Yes
Streamside Salamander *Ambystoma barbouri*	S2, SE		Seasonally flowing karst streams.	No

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW**[2,3]
Fish				
Blotchside Logperch *Percina burtoni*	S2, ST		Swift riffles and flowing pools over gravel and small cobble substrates in clear, moderately large streams and small rivers with exceptionally good water quality.	Yes
Blue Sucker *Cycleptus elongatus*	S2, ST		Swift waters over firm substrates in big rivers.	Yes
Lake Sturgeon *Acipenser fulvescens*	S1, SE		Bottoms of large, clean rivers and lakes.	Yes
Redlips Darter *Etheostoma maydeni*	S2, SE		Slow-moving large creeks and rivers in pools along the banks strewn with boulders and woody debris.	Yes
Sickle Darter *Percina williamsi*	S2, ST		Flowing pools over rocky, sandy, or silty substrates in clear creeks or small rivers; often occurs near woody debris or vegetations.	Yes
Slender Chub *Erimystax cahni*	S1, ST	FT	Restricted to bars and shoals of fine to medium gravel in runs and riffles of medium to large, clear, warm rivers.	Yes
Spotfin Chub *Erimonax monachus*	S2, ST	FT	Clear upland rivers with swift currents and boulder substrates; portions of the Tennessee River watershed.	Yes
Yellowfin Madtom *Noturus flavipinnis*	S1, ST	FT	Shallow pools and backwaters of streams with cover of roots, sunken leaves, brush piles, and bedrock ledges.	Yes
Crayfish				
Obey Crayfish *Cambarus obeyensis*	S1, SE		Under cover in small-medium sized streams; headwaters of East Fork Obey River; northern Cumberland.	Yes
Tennessee Cave Crayfish *Orconectes incomptus*	S1, SE		Shallow pool areas in caves and subterranean streams.	Yes
Valley Flame Crayfish *Cambarus deweesae*	S1, SE		Primary burrower; open areas with high water tables.	Yes
Mollusks				
Alabama Lampmussel *Lampsilis virescens*	S1, SE	FE	Sand and gravel substrates in shoal areas of small-medium size rivers.	Yes

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW[2,3]**
Anthony's Riversnail *Athearnia anthonyi*	S1, SE	FE	Large-medium rivers with moderate-high gradient, or riffles of larger creeks with cobble/boulder substrate.	Yes
Appalachian Monkeyface *Quadrula sparsa*	S1, SE	FE	Riffles and runs in fast-flowing medium rivers or creeks with moderate gradient.	Yes
Birdwing Pearlymussel *Lemiox rimosus*	S1, SE	FE, EXPN	Riffles with stable, sand and gravel substrates in moderate to fast currents in small to medium sized rivers.	Yes
Catspaw *Epioblasma obliquata*	S1, SE	FE	Riffles and runs of large river systems with sand and gravel substrate.	Yes
Clubshell *Pleurobema clava*	SH, SE	FE	Small to medium sized rivers and streams with sand and fine gravel substrates or in clean, coarse sand and gravel runs.	Yes
Cracking Pearlymussel *Hemistena lata*	S1, SE	FE, EXPN	Sand, gravel, and cobble substrates in swift currents or mud and sand in slower currents.	Yes
Cumberland Bean (pearlymussel) *Villosa trabalis*	S1, SE	FE	Sand, gravel, and cobble substrates in waters with moderate to swift currents, and depths less than 1 meter.	Yes
Cumberland Elktoe *Alasmindonta atropurpurea*	S1S2, SE	FE	Shallow flats or pools of small creeks to medium-sized rivers, with slow current, sand substrate, and scattered cobble/boulder material.	Yes
Cumberlandian Combshell *Epioblasma brevidens*	S1, SE	FE	Large creeks to large rivers with substrate ranging from coarse sand to mixtures of gravel, cobble, and boulder-sized particles; typically occurs at depths of less than one meter.	Yes
Dromedary Pearlymussel *Dromus dromas*	S1, SE	FE, EXPN	Riffles and shoals with sand and gravel and moderate current velocities; may also be found in deeper, slower moving water in Tennessee.	Yes
Fanshell *Cyprogenia stegaria*	S1, SE	FE, EXPN	Medium to large streams and rivers with coarse sand and gravel substrates.	Yes
Finerayed Pigtoe *Fusconaia cuneolus*	S1, SE	FE, EXPN	Riffles of fords and shoals of mod gradient streams in firm cobble and gravel substrates.	Yes
Fluted Kidneyshell *Ptychobranchus subtentus*	S2, SE	FE	Small-medium rivers in swift currents or riffles, in sand, gravel, or cobble substrates.	Yes

Common Name *Scientific Name*	State Rank and Listing Status	Federal Listing Status	Habitat Requirement	Potential Habitat within the ETNG Construction ROW[2,3]
Orangefoot Pimpleback (pearlymussel) *Plethobasus cooperianus*	S1, SE	FE, EXPN	Perennial streams with rocky areas and swift to slow moving currents.	Yes
Oyster Mussel *Epioblasma capsaeformis*	S1, SE	FE	Moderate to swift currents in large creeks and rivers in substrates composed of coarse sand and gravel to boulder-sized particles. Sometimes associated with water-willow beds and in pockets of gravel between bedrock ledges in areas of swift current.	Yes
Pink Mucket *Lampsilis abrupta*	S2, SE	FE	Large rivers with sand-gravel or rocky substrates with moderate to strong currents.	Yes
Purple Bean *Villosa perpurpurea*		FE	Creeks to medium-sized rivers and occasionally headwaters; generally associated with riffles but may be in direct current, pools.	Yes
Rabbitsfoot *Theliderma cylindrica cylindrica*	S3, ST	FT	Large rivers with sand and gravel.	Yes
Ring Pink *Obovaria retusa*	S1, SE	FE, EXPN	Large rivers in sand and gravel.	Yes
Rough Pigtoe *Pleurobema plenum*	S1, SE	FE, EXPN	Medium to large sized rivers, in substrates ranging from mud and sand to gravel, cobble, and boulders	Yes
Rough Rabbitsfoot *Quadrula cylindrica strigillata*	S2, SE	FE	Small-medium sized rivers in clear, shallow riffles with sand-gravel substrates	Yes
Sheepnose Mussel *Plethobasus cyphyus*	S2S3, SE	FE	Large to medium-sized rivers, in riffles and coarse sand/gravel substrate.	Yes
Shiny Pigtoe *Fusconaia cor*	S1, SE	FE, EXPN	Shoals and riffles of small-medium sized rivers with moderate-fast current over sand-cobble substrates.	Yes
Slabside pearlymussel *Pleuronaia dolabelloides*	S2, SE	FE	Large creek to moderately sized rivers. Generally observed in gravel substrates within interstitial sand, with moderate current.	Yes
Spectaclecase *Cumberlandia monodonta*	S2S3, SE	FE	Medium to large rivers; in substrates ranging from mud and sand to gravel, cobble, and boulders.	Yes

Common Name *Scientific Name*	State Rank and Listing Status	Federal Listing Status	Habitat Requirement	Potential Habitat within the ETNG Construction ROW[2,3]
Snuffbox *Epioblasma triquetra*	S3, SE	FE	Riffles of small-medium creeks and large rivers, and in shoals and wave-washed lake shores. Found in sand, gravel, or cobble substrates.	Yes
Tennessee Bean *Venustaconcha trabalis*	S1, SE	FE, EXPN	Riffle areas of small rivers and streams in sand, gravel, and cobble substrates with swift current	Yes
Tubercled Blossom (pearlymussel) *Epioblasma torulosa torulosa*		FE	Riffles or shoals in shallow waters of medium rivers or creeks -with sandy gravel substrate and rapid currents.	Yes
Turgid Blossom (pearlymussel) *Epioblasma turgidula*		FE, EXPN	Clear, unpolluted water over sand and gravel substrates of shallow, fast-moving streams.	Yes
White Wartyback *Plethobasus cicatricosus*	S1, SE	FE, EXPN	Shoals and riffles in large rivers; Tennessee and Cumberland River systems; possibly extirpated in TN	Yes
Plants				
American Hart's-tongue Fern *Asplenium scolopendrium var. americanum*	S1, SE	FT	Moist crevices of mossy rock outcrops, or in sinkholes of limestone caves.	No
Barrens Silky Aster *Symphyotrichum pratense*	S1, SE		Barrens.	No
Blue Mud-plantain *Heteranthera limosa*	S1S2, ST		Mud flats.	No
Blue-flower Coyote-thistle *Eryngium integrifolium*	S1, ST		Pine flatwoods, savannas, seepages, and other moist and nutrient-poor areas.	Yes
Braun's Rockcress *Boechera perstellata*	S1, SE	FE	Mesic, shady, steep, north-facing wooded slopes.	Yes
Bristle-fern *Trichomanes boschianum*	S1S2, ST		Found in deep shade on damp, acidic rocks, usually sandstone, in sheltered canyons, grottos, and rock shelters within mesic upland forests at altitudes of 150 to 800 meters.	No

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW**[2,3]
Butternut *Juglans cinerea*	S3, ST		Shaded forests with deep, moist and rich soils	Yes
Chapman's Redtop *Tridens flavus* var. *chapmanii*	S1, SE		Pine and oak woodlands.	Yes
Climbing Fumitory *Adlumia fungosa*	S2, ST		Disturbed habitats, cliffs, balds, or ledges.	No
Cumberland Featherbells *Stenanthium diffusum*	S1, SE		Cliffs or rock ledges in woodlands with sandy, moist soil.	No
Cumberland Rosemary *Conradina verticillata*	S3, ST	FT	Well-drained sandy and poorer soil in full sun.	Yes
Cumberland Sand-grass *Sporobolus arcuatus*	S2, ST		Rocky and sandy river bars.	Yes
Cumberland Sandwort *Minuartia cumberlandensis*	S2, SE	FE	Found on sandy floors of cool, humid, cave-like overhangs.	No
Earleaved False-foxglove *Agalinis auriculata*	S2, SE		Barrens.	No
Eastern Yampah *Perideridia americana*	S2, SE		Mesic black soil prairies, openings or edges near woodlands, areas along woodland paths, thickets, limestone glades, and bluffs.	Yes
Fen Orchis *Liparis loeselii*	S1, ST		Calcareous seeps.	No
Fetter-bush *Leucothoe racemosa*	S2, ST		Acidic wetlands and swamps.	Yes
Foxtail Clubmoss *Lycopodiella alopecuroides*	S2, ST		Disturbed areas, bogs, grasslands.	Yes
Fragile Tortula *Tortula fragilis*	S1, SE		Grows on tree bark and calcareous rocks.	Yes
Grassleaf Arrowhead *Sagittaria graminea*	S1, ST		Fresh tidal marshes or flats, lakes, ponds, rivers and river shorelines, wetland margins.	Yes

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW**[2,3]
Harper's Umbrella- plant *Eriogonum harperi*	S1, SE		Sandy to gravelly, often calcareous flats, bluffs, outcrops, and slopes in oak and conifer woodlands.	Yes
Hitchcock's Sedge *Carex hitchcockiana*	S1, ST		Rich moist woods.	Yes
Horse-tail Spike-rush *Eleocharis equisetoides*	S1, SE		In lakes or ponds or along the shorelines of lakes and rivers.	Yes
Large-flowered Barbara's-buttons *Marshallia grandiflora*	S2, SE		Rocky river bars.	Yes
Large-leaf Pondweed *Potamogeton amplifolius*	S1, ST		Lakes and streams.	Yes
Least Trillium *Trillium pusillum*	S2, SE		Alluvial/moist ravines in dry ridges.	No
Liverwort *Preissia quadrata*	S1, ST		Seepy limestone cliffs and bluffs.	No
Lucy Braun's White Snakeroot *Ageratina luciae-brauniae*	S3, ST		Moist, sandy spaces under rock overhangs.	No
Menge's Flame-flower *Phemeranthus mengesii*	S2, ST		Shallow soil over granite or sandstone that is periodically wet by seepage.	Yes
Mountain Bush-honeysuckle *Diervilla sessilifolia var. rivularis*	S2, ST		Dry cliffs and bluffs.	No
Narrow-leaved Meadow-sweet *Spiraea alba*	S1, SE		Medium to wet, well-drained soil such as in wet prairies, low areas along stream, marsh edges, bogs, and ditches.	Yes
Northern Bush-honeysuckle *Diervilla lonicera*	S2, ST		Rocky woodlands and bluffs.	Yes
Northern Starflower *Trientalis borealis*	S1, ST		Bogs, hummocks in sandy swamps, edges of sandy woodlands, and ravines.	Yes
Pinelands Dropseed *Sporobolus junceus*	S1, SE		Flatwoods and sandhills.	Yes

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW[2,3]**
Plains Muhly *Muhlenbergia cuspidata*	S1, SE		Prairies, mountain grasslands, shrublands, and woodlands.	Yes
Prairie Goldenrod *Oligoneuron album*	S1S2, SE		Barrens.	No
Rose Pogonia *Pogonia ophioglossoides*	S2, SE		Wet acidic barrens.	No
Roundleaf Fameflower *Phemeranthus teretifolius*	S2, ST		Grows in thin rocky or sandy soil on sandstone, granitic, or serpentine outcrops.	No
Roundleaf Shadbush *Amelanchier sanguinea*	S2, ST		Rocky slopes and riverbanks.	Yes
Roundleaf Sundew *Drosera rotundifolia*	S1, ST		Bogs and seeps.	No
Shining Ladies'-tresses *Sprianthes lucida*	S1S2, ST		Alluvial woods and moist slopes.	Yes
Short's Bladderpod *Physaria globosa*	S1, SE	FE	Steep, rocky, wooded slopes and talus area; also occurs along tops, bases, and ledges of bluffs.	No
Shortleaf Sneezeweed *Helenium brevifolium*	S1, SE		Rocky, sandy streamsides.	Yes
Short-leaved Panic Grass *Dichanthelium ensifolium* ssp. *curtifolium*	S1, SE		Moist, sandy woodlands, pinelands, savannahs, and bogs, often on Sphagnum mats.	Yes
Small's Stonecrop *Diamorpha smallii*	S1S2, SE		Sandstone outcrops.	No
Softleaf Arrow-wood *Viburnum molle*	S2, SE		Rocky bluff forests over calcareous soil, and in adjacent bottomlands.	No
Southern Jointweed *Polygonella americana*	S1S2, SE		Dry, sandy areas.	Yes
Svenson's Wild-rye *Elymus svensonii*	S2, ST		Dry, rocky, limestone river bluffs.	No
Sweet Pinesap *Monotropsis odorata*	S2, ST		Mature, moist, shaded, rich hardwood forests.	Yes

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW[2,3]**
Sword Moss *Bryoxiphium norvegicum*	S1, ST		Undersides of moist, shaded, sandstone ledges and cliffs, often overhanging streams.	No
Tall Larkspur *Delphinium exaltatum*	S2, SE		Glades and barrens.	No
Tawny Cotton-grass *Eriophorum virginicum*	S1S2, SE		Bogs.	No
Ten-angle pipewort *Eriocaulon decangulare*	S1, SE		Moist peat or sands associated with savannas, bogs, low pinelands, ditches, and the banks of cypress domes.	No
Tennessee Pondweed *Potamogeton tennesseensis*	S2, ST		Slow acidic streams.	Yes
Torrey's Mountain-mint *Pycnathemum torrei*	S1, SE		Barrens.	No
Tubercled Rein-orchid *Platanthera flava var. herbioloa*	S2, ST		Swamps and floodplains.	Yes
Velvety Cerastium *Cerastium velutinum* var. *velutinum*	S1, SE		Limestone rocks, woodlands, and serpentine barrens.	No
Virginia Spiraea *Spiraea virginiana*	S2, SE	FT	Stream bars and ledges.	Yes
Western Wallflower *Erysimum capitatum*	S1S2, SE		Rocky bluffs.	No
White Fringeless Orchid *Platanthera integrilabia*	S2S3, SE	FT	Acidic seeps and stream heads.	Yes
White Prairie-clover *Dalea candida*	S2, ST		Sandy, rocky, or clay soils in prairies and open woods.	Yes
Whorled Mountain-mint *Pycnanthemum verticillatum*	S1, SE		Forests, meadows, and fields.	Yes
.Zigzag Bladderwort *Utricularia subulata*	S1, ST		Wet barrens, ecotones.	Yes

Common Name ***Scientific Name***	**State Rank and Listing Status**	**Federal Listing Status**	**Habitat Requirement**	**Potential Habitat within the ETNG Construction ROW[2,3]**
Insects				
Monarch butterfly *Danaus plexippus*		FC	Milkweed and flowering plants.	Yes

Source: USFWS Information, Planning, and Consultation (IPaC) dated April 20, 2023, Tennessee Department of Environment and Conservation's (TDEC) Rare Species by County, TVA Regional Natural Heritage Database, ETNG 2023d

[+]Record of observation on-site

[1] FE = Federal-Endangered; FT = Federal-Threatened; FPE = Federal Proposed-Endangered; FPT = Federal Proposed-Threatened; FC: Federal Candidate for Listing; EXPN = non-essential experimental populations; SE = State-Listed as Endangered; ST = State-Listed as Threatened; SSC = State-Listed as Special Concern; SD = State-Listed as Deemed in Need of Management; S1 = Extremely rare and critically imperiled in the state with five or fewer occurrences, or very few individuals, or because of some special condition where the species is particularly vulnerable to extinction; S2 = Very rare and imperiled in the state, 6 to 20 occurrences, or few remaining individuals, or because of some factor(s) making it vulnerable to extinction; S3 = Rare and uncommon in the state, from 21-100 occurrences; S4 = Widespread, abundant, and apparently secure within the state but cause for long-term concern; SH = of historical occurrence in Tennessee, e.g. formally part of the established biota, with the expectation that it may be rediscovered; PE = Possibly Extirpated; SX = presumed extirpated

[2] Potential habitat assessment made on review of habitat information contained within the ETNG Construction ROW (vegetation, streams, wetlands) as described in ETNG's RR2 and RR3 (ETNG 2022c, d) and best professional judgement.

[3] Yes = suitable habitat present in project area; No = no potential presence of suitable habitat in project area

[4] Appropriate habitat is potentially present; however, bat surveys performed on behalf of ETNG did not capture any Indiana or northern long ear bats during recent mist net or fall swarming surveys.

3.8.4.1.2.6.1 Birds

Bachman's sparrow was the only bird with state protected status identified as having potential to occur throughout the ETNG Construction ROW based on a review of state and federal resources (Table 3.8-26). Bachman's sparrow has the potential to occur in portions of the ETNG Construction ROW located in Putnam and Roane counties. Habitat for Bachman's sparrow is described in Section 3.8.4.1.1.1. The proposed ETNG Construction ROW crosses a variety of habitats consisting of herbaceous, shrub, and forested vegetation communities, as well as numerous resources such as streams, wetlands, and open water; therefore, it is possible that the corridor is within an area containing Bachman's sparrow or their habitats. Consultation with the agencies is ongoing and potential for presence of protected would be updated as appropriate through 2023.

The migratory bird species of conservation concern for the ETNG Construction ROW are the same as those listed and discussed for the Kingston Reservation in Section 3.8.4.1.1.1 since both fall within the same Bird Conservation Regions (USFWS 2021a; ETNG 2022d). Table 3.8-24 summarizes the migratory birds that may occur along the proposed ETNG Construction ROW based on habitat requirements and field surveys.

Table 3.8-26. Migratory Bird Species of Conservation Concern Potentially Occurring in or identified on the Alternative A ETNG Construction ROW

Common Name	Scientific Name	General Habitat Description	Habitat Present
Migrant Species (present as spring and fall migrant and/or during winter)			
Bobolink	*Dolichonyx oryzivorus*	Grasslands, meadows, and hayfields.	Yes
Canada Warbler	*Cardellina canadensis*	Forest undergrowth, shady thickets. Breeds in mature mixed hardwoods of extensive forests and streamside thickets	Yes
Golden-winged Warbler	*Vermivora chrysoptera*	Open woodlands, brushy clearings, undergrowth. Breeds in brushy areas with patches of weeds, shrubs, and scattered trees (such as alder or pine). This habitat type is found in places where a cleared field is growing up to woods again, as well as in marshes and tamarack bogs.	Yes
Yellow-bellied Sapsucker	*Sphyrapicus varius*	Winter habitat includes woodlands, aspen groves, orchards, deciduous trees.	Yes
Lesser Yellowlegs	*Tringa flavipes*	Mudflats, sandy beaches, shores of lakes and ponds, and wet meadows.	No
Breeding Season Migrants (may occur only during the breeding season)			
Chimney Swift	*Chaetura pelagica*	Forages over variety of habitats, requires chimneys or large hollow tree snags with open tops for nesting.	No
Common Nighthawk (lesser)	*Chordeiles minor*	Inhabits any kind of open or semi-open terrain, including clearings in forest, open pine woods, prairie country, farmland, suburbs and city centers.	Yes

Common Name	Scientific Name	General Habitat Description	Habitat Present
Chuck-will's Widdow	*Antrostomus carolinensis*	Oak and pine woodlands. Breeds in shady southern woodlands of various types, including open pine forest, oak woodlands, edges of swamps.	Yes
Eastern Whip-poor-will	*Antrostomus vociferus*	Woodlands with open understory.	Yes
Kentucky Warbler	*Geothlypis formosa*	Large moist forest tracts with mature trees and thick understory.	Yes
Prairie Warbler	*Dendroica discolor*	Various shrubby habitats, including regenerating forests, open brushy fields, and Christmas tree farms.	Yes
Wood Thrush	*Hylocichla mustelina*	Breeds in mature deciduous and mixed forests, forests with dense understory, and forest edges.	Yes
Yellow-billed Cuckoo (Eastern)	*Coccyzus americanus*	Woodlands, thickets, orchards, streamside groves. Breeds mostly in dense deciduous stands, including forest edges, tall thickets, dense second growth, overgrown orchards, scrubby oak woods.	Yes
Resident Species (may occur year-round)			
Eastern Meadowlark	*Sturnella magna*	Open fields and pastures, meadows, prairies. Breeds in natural grasslands, meadows, weedy pastures, also in hayfields and sometimes in fields of other crops. Winters in many kinds of natural and cultivated fields	Yes
Killdeer	*Charadrius vociferus*	Fields, airports, lawns, riverbanks, mudflats, shores. Often found on open ground, such as pastures, plowed fields, large lawns, even at a great distance from water. Most successful nesting areas, however, have some shallow water or other good feeding area for the chicks. Also commonly found around water, on mudflats, lake shores, coastal estuaries	Yes
Red-headed Woodpecker	*Melanerpes erythrocephalus*	Deciduous woodlands with oak or beech, groves of dead or dying trees, forested river bottoms, recent clearings, farmland, grasslands, forest edges and roadsides	Yes

Source: USFWS 2021a

3.8.4.1.2.6.2 Mammals

Three species of bat with federal protected status and one more with expected federal protection in the near future were identified as having potential to occur along the ETNG Construction ROW based on a review of federal resources, including gray bat, Indiana bat, northern long-eared bat, and tricolored bat (Table 3.8-25). One state-listed species of bat (little brown bat) was also identified as having observations within three miles of the ETNG Construction ROW based on the TVA Regional Natural Heritage Database. Based on the required habitat descriptions provided in Section 3.8.4.1.1.2, these species may use the ETNG Construction ROW for foraging. Some species may also use certain trees for summer roosting. All five bat species and several caves have been documented within a 3-mile radius of the ETNG Construction ROW based on a review of the TVA Regional Natural Heritage Database. No Indiana bats or northern long-eared bats were collected during targeted fall and summer mist net surveys conducted by ETNG (ETNG 2022d). Based on these observations and the preferred habitats of bats for foraging and/or roosting, the ETNG Construction ROW likely crosses potential bat habitats. Consultation with the agencies is ongoing and potential for presence of protected mammals within the ETNG Construction ROW and associated aboveground facilities will be refined through 2023.

3.8.4.1.2.6.3 Reptiles

The northern pine snake is state-listed as threatened and has the potential to occur along the proposed ETNG Construction ROW in Putnam, Morgan, and Roane counties (Table 3.8-25). It is a large, nonvenomous snake typically found in sandy, well-drained upland pine or pine-oak woodlands. Northern pine snakes spend much of their time underground, but they are often encountered aboveground during spring and late summer to early autumn (Tennant 2003; Tuberville and Mason 2008). This species has the potential to be present along portions of the ETNG Construction ROW. Consultation with the agencies is ongoing and potential for presence of protected reptiles within the ETNG Construction ROW and associated aboveground facilities would be refined as appropriate through 2023.

3.8.4.1.2.6.4 Amphibians

The eastern hellbender is the only amphibian that may have potential habitat within the ETNG Construction ROW. A description of the required habitat for hellbenders is included in Section 3.8.4.1.1.4. This species has been observed within a 3-mile radius of the ETNG Construction ROW based on TVA Regional Natural Heritage Database documentation.

The proposed ETNG Construction ROW crosses a variety of habitats including numerous aquatic resources such as streams, wetlands, and open waters. Consultation with the agencies is ongoing and potential for presence of protected amphibians within the ETNG Construction ROW and associated aboveground facilities would be refined as appropriate through 2023.

3.8.4.1.2.6.5 Plants

Of the 63 federal- and state-protected species of plants listed in Table 3.8-25, 35 were identified as potentially occurring within the proposed ETNG Construction ROW based on habitat requirements. The proposed ETNG Construction ROW crosses a variety of habitats including herbaceous, shrub, and forested communities, as well as numerous resources such as streams, wetlands, and open water; therefore, the ETNG Construction ROW has the potential to cross areas containing one or more of these protected plant species or their habitats. Consultation with the agencies is ongoing and potential for presence of protected plant species within the ETNG Construction ROW and associated aboveground facilities will be refined through 2023.

3.8.4.1.2.6.6 Aquatic Species

Eight species of fish, three species of crayfish, and 31 aquatic mollusk species were identified on the state and federal resource lists as having potential for occurrence within the ETNG Construction ROW. The corridor also crosses many aquatic habitats including large and small streams, creeks, major waterbodies, and named rivers that are near the Obed Wild and Scenic River complex. The Obed River was designated as a Wild and Scenic River because it has maintained the same wild and natural conditions and characteristics that it exhibited when first discovered in the late 1700s; therefore, this area provides optimal, pristine habitat conditions without substantial anthropogenic effects. Several waterbodies are classified as a Tennessee Exceptional Water. Given these natural conditions, the protected aquatic species listed in Table 3.8-25 may be present in streams or creeks along the proposed ETNG Construction ROW.

Of the species listed in Table 3.8-25, 2 crayfish, 3 fish, and 18 mussel species were identified as having historical or recent observations within 10 miles of the ETNG Construction ROW based on a review of the TVA Regional Natural Heritage Database. Additionally, federally designated critical habitat for spotfin chub occurs along the ETNG Construction ROW in Fentress, Morgan, Putnam, and Roane counties. As stated in Section 3.8.4.1.1.6, suitable habitats throughout the entire range of the spotfin chub are designated as critical habitat. Consultation with the agencies is ongoing and potential for presence of protected aquatic species within the ETNG Construction ROW and associated aboveground facilities will be refined through 2023.

3.8.4.1.2.6.7 Insects

Monarch butterflies are currently classified as a federal candidate for species listing. They are milkweed specialists and prefer habitats that provide abundant milkweed and other flowering plants, such as roadside areas, open areas, wet areas, or urban gardens (NatureServe 2022). Approximately 393 acres of upland herbaceous/scrub habitat occurs within the ETNG Construction ROW based on NLCD; therefore, there is a reasonable potential for monarch butterflies to occur throughout suitable habitats located within the ETNG Construction ROW. Consultation with the agencies is ongoing and potential for presence of protected insect species within the ETNG Construction ROW and associated aboveground facilities will be refined through 2023.

3.8.4.1.3 Alternative B

There is a wide range of species of conservation concern that may occur in the East Tennessee region due to the variable, and sometimes rare, habitat types and vegetation communities. Protected species, such as vertebrates as small as cave-dwelling bats and salamanders and as large as cougars and black bears, invertebrates such as mussels, and a variety of plants can be found in this region (Martin et al. 1993a). Some of the highest concentrations of federally listed threatened or endangered species are found in the Interior Low Plateau ecoregion (TVA 2019a), which includes the Western Highland Rim, Eastern Highland Rim, Outer Nashville Basin, and Inner Nashville Basin (Griffith et al. 1998). The Blue Ridge Mountains and Ridge and Valley ecoregions in East Tennessee also contain some of the most floristically and aquatically diverse areas of the state. The Tennessee State Wildlife Action Plan (TWRA 2015) states that a total of 1,445,409 acres of medium, high, and very high priority habitat exists throughout the Ridge and Valley, with species of greatest conservation need varying from priority scores of 7.1 up to 47.5, depending on the natural habitat type. The taxonomic groups with the highest proportion of species listed under the ESA are fish and mollusks. Factors contributing to the high proportions of vulnerable species in these groups include the high number of endemic species in the TVA PSA and the alteration of their habitats by reservoir construction, water pollution, habitat destruction or fragmentation, and a variety of other impacts. River systems with the highest numbers of listed aquatic species include the Tennessee, Cumberland, and Coosa rivers.

Conservation efforts have successfully downgraded or removed some species from the ESA list in Tennessee, such as the bald eagle. Conversely, some species have been added to federal and state listings due to declines driven by development/habitat loss, introduced pathogens (e.g., white nose syndrome), insects (e.g., gypsy moth, two-lined chestnut borer), or other causes (Martin et al. 1993a; TVA 2019a).

3.8.4.2 Environmental Consequences

3.8.4.2.1 The No Action Alternative

Under the No Action Alternative, KIF would continue operations. TVA would implement all planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be reviewed in subsequent NEPA analyses. As a result, no new work would be conducted that could potentially alter Project-related environmental conditions within the plant. Therefore, no new effects on threatened or endangered species, or species of conservation concern or any suitable habitat, would occur under this alternative.

3.8.4.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

One osprey nest exists within the proposed demolition boundary, one nest exists just outside of the proposed demolition boundary, and three more are in the vicinity of Kingston (Figure 3.8-5). Actions that rise to disturbance levels above typical, demonstrated tolerance levels would be performed when ospreys are not actively nesting (typically between March 1st and July 31). Should there be a potential for effects to nesting osprey, TVA would coordinate with USDA-Wildlife Services to ensure compliance with federal law. With adherence to seasonal restrictions around osprey nests and/or coordination with USDA-Wildlife Services, proposed actions for the retirement of the KIF plant would not impact populations of common wildlife species.

The Bachman’s sparrow could be found in the forested areas within the demolition boundary. Clearing of forested areas within the demolition boundary would be conducted from November 15 and March 31 to avoid impacts to nesting protected or migratory bird species. While direct impacts to this species are therefore not expected, if present, this species could experience minor habitat loss with the removal of the forested areas within the demolition boundary. Ample comparable or higher quality forested habitat is located elsewhere on or outside of Kingston Reservation and this impact would be minor, if any.

The bald eagle could also be in the vicinity of Kingston Reservation as the Clinch River is used for foraging; however, no nesting habitat is present on Kingston Reservation and minor, if any impacts due to noise disturbance would be expected, if present.

Prior to demolition, internal surveys of the would occur to ensure no colonies of bats or migratory birds are residing within the buildings proposed for demolition. Should bats or birds be observed roosting in buildings, avoidance and minimization measures (such as seasonal restrictions) would be put in place and the appropriate state or federal agencies (USDA, USFWS, TWRA) would be contacted to ensure compliance with these precautionary measures, minor direct effects, if any, would be expected to protected bat species or colonies of migratory birds.

Approximately 46 acres of bat roosting habitat exists within the demolition boundary, the majority of which (78 percent) is considered high quality (Figure 3.8-3). In September 2017, TVA completed a programmatic biological assessment (BA) to address the potential for impacts of specific TVA actions on federally listed bat species whose ranges overlap with the TVA action area. The BA addresses 10 overarching actions and 96 routine activities that TVA authorizes, funds, or carries out, and how these actions and activities may affect the Indiana bat, northern long-eared bat, gray bat, and Virginia big-eared bat. TVA determined that 21 of the 96 routine activities would have no effect on these listed bat species or their critical habitat. On March 8, 2018, the USFWS responded to the BA with concurrence that the remaining 75 routine activities are not likely to adversely affect the gray bat, Virginia big-eared bat, or critical habitat of the Indiana bat. The USFWS also agreed that 72 of the 96 proposed routine actions are not likely to adversely affect the Indiana bat or northern long-eared bat. On April 12, 2018, the USFWS provided a biological opinion (BO) regarding the remaining three activities that could result in adverse effects to Indiana bat and northern long-eared bat (vegetation removal, hazard tree removal, and prescribed burning) that concluded that “the action is not likely to jeopardize the continued existence of the [Indiana bat] or the [northern long-eared bat].” In addition, the BO also included an Incidental Take Statement which defined the “action is reasonably certain to cause incidental take of individual [Indiana bats].” Due to the difficulty of detecting the take of Indiana bats, TVA must quantify the extent of take by using the annual and 20-year cumulative acreages of tree removal and prescribed burning under the programmatic action as a surrogate measure, as defined in the BO.

While the products of TVA’s 2017/2018 formal consultation with the USFWS provided effects determinations for the Northern Long-eared bat, an incidental take statement was not prepared for this species due to its 4d status at the time. Due to the USFWS’ uplisting of the Northern Long-eared bat from threatened to endangered (effective as of March 31, 2023), TVA is currently in the process of reinitiating programmatic consultations with the USFWS for this species.

All activities associated with this alternative that may affect bats were addressed in TVA’s programmatic consultation with the USFWS on routine actions and federally listed bats in accordance with ESA Section 7(a)(2), completed in April 2018 (USFWS 2018). For those activities with potential to affect bats, TVA committed to implement specific conservation measures when direct and indirect effects to federally listed bat species are expected. Relevant conservation measures to this project are listed in the bat strategy form and must be reviewed and implemented as part of the approved project. Given the lack of effects to known roosting habitat and identified conservation measures, proposed project activities would not significantly affect the gray bat, Indiana bat, northern long-eared bat, or tricolored bat, or little brown bat. Proposed actions would not jeopardize the continued existence of tricolored bat, nor would they affect populations of little brown bat.

Conservation measures identified in the bat strategy form include:

- Projects that involve structural modification or demolition of buildings, bridges, and potentially suitable box culverts, would require assessment to determine if the structure has characteristics that make it a potentially suitable unconventional bat roost. If so, a survey to determine if bats may be present would be conducted.
- Additional bat presence/absence surveys (e.g., emergence counts) would be conducted if warranted (i.e., when AR1 indicates that bats may be present).
- Operations involving chemical/fuel storage or resupply and vehicle servicing would be handled outside of riparian zones (streamside management zones) in a manner to prevent these items from reaching a watercourse. Earthen berms or other effective means would be installed to protect stream channel from direct surface runoff. Servicing would be done with care to avoid leakage, spillage, and subsequent stream, wetland, or ground water contamination. Oil waste, filters, other litter would be collected and disposed of properly.

The eastern slender glass lizard could be present based on habitat requirements; however, Kingston Reservation generally contains limited suitable habitat and no records of the eastern slender glass lizard presence within 10 miles of the site; therefore, it is unlikely that this species is present within the demolition boundary.

The blue sucker, lake sturgeon, slender chub, and spotfin chub could be found in the Clinch River, which falls within the demolition boundary for the purposes of cooling water intake structure removal and barge unloading area upgrades. If in vicinity of the activities, these species would move out of the area due to disturbance and are unlikely to experience direct injury or mortality from demolition and construction activities. With proper implementation of BMPs, no direct effects to the aquatic communities outside of the demolition boundary are anticipated. All necessary CWA Section 404 and Tennessee ARAP permits would be obtained for in-water work, such as the demolition of intake structures and barge unloading area upgrades; mitigation measures such as appropriate BMPs would be implemented to reduce potential effects. If necessary, compensatory mitigation would be provided for the loss of wetlands or streams on the Kingston Reservation for this activity, if deemed necessary by the agencies.

The valley flame crayfish could be present along the margin of the Clinch River. Other than the areas of direct work (i.e., intakes and barge unloading area), it is unlikely that the shore of the Clinch River would be impacted. Additionally, the crayfish is a burrowing species and earth moving near the river is not anticipated, therefore no impacts to this species is expected.

The fetter bush is a protected plant species that has potential habitat on the Kingston Reservation; these areas are unlikely to be disturbed during D4 activities. However, the areas would be resurveyed during the appropriate blooming season to confirm the presence or absence of these plants prior to construction or demolition activities.

The monarch butterfly could be found in herbaceous or early successional habitat (totaling 15.3 acres) within the demolition boundary. Potential habitat for the monarch butterfly occurs primarily within the existing on-site transmission line corridor. Following tree clearing and demolition activities, early successional habitat would regenerate in a relatively short time period and potentially provide additional resources such as wildflowers (foraging) and milkweed (breeding).

Cumulative effects to threatened and endangered species are not anticipated as CCR management activities on the Kingston Reservation have completed Section 7 consultation and would adhere to conservation and mitigation measures.

3.8.4.2.2.1 Environmental Justice Considerations

Effects to threatened and endangered species that may occur as a result of KIF D4 activities are not anticipated to have disproportionately high and adverse human health or environmental effects on EJ populations because there are no human settlements within the Kingston Reservation.

3.8.4.2.3 Alternative A

3.8.4.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

A forested wetland (0.12 acre) area within the limits of the proposed CC/Aero CT Plant would be permanently impacted under this action. This wetland area may provide habitat for the Swainson's warbler; however, removal of trees in this area and loss of habitat for this species would be minor due to the prevalence of similar or higher quality habitat in the area. Bald eagle and osprey nearby could be disturbed from construction activities during foraging, but no nests are present within 660 feet of the CC/Aero CT Plant or switchyard boundaries; therefore, minor impacts, if any, would occur to these species.

Bat roosting or foraging habitat removal for this action is limited, comprising only 0.1 acre for foraging, 1.0 acre for moderate-quality roosting, and 6.7 acres for high-quality roosting, and an additional 0.1 acres for foraging only. The largest discrete roosting habitat within the proposed CT/Aero CT Plant site consists of 2.3 acres on the southern-central boundary comprising a mature forested area and wetlands adjacent to the Clinch River (Figure 3.8-3 and Figure 3.8-4). Tree removal at the CC/Aero CT Plant site, if necessary, would occur between November 15 and March 31 to the extent practicable, when listed bat species would be roosting in caves or other hibernacula. Habitat removal activities associated with this action were addressed in TVA's programmatic consultation with the USFWS on routine actions and federally listed bats in accordance with ESA Section 7(a)(2), completed in April 2018 (USFWS 2018). Project-specific consultation with the USFWS would also occur for the northern long-eared bat. For those activities with potential to affect bats, TVA committed to implement specific conservation measures when direct and indirect effects to federally listed bat species are expected. Additional information about the BO and conservation measures are described in Section 3.8.4.2.3.1. Proposed actions would not jeopardize the continued existence of tricolored bat, nor would they affect populations of little brown bat. Winter tree removal would also avoid direct effects to some nesting migratory songbirds of conservation concern and other birds of conservation concern. Through consultation with the USFWS and tree removal during winter to avoid impacts, significant effects to listed bats are not anticipated.

Approximately 1.9 acres of potential habitat for the fetter-bush falls within the boundary of the proposed CC/Aero CT Plant site and have the potential to be impacted (Figure 3.8-6). The area would be resurveyed during the appropriate blooming season to confirm the presence or absence of this species, and further consultation with TDEC would be conducted if needed.

Approximately 43.8 acres of herbaceous and early successional habitat exists within the boundaries of the proposed CC/Aero CT Plant and switchyard, which may contain wildflower species supporting the monarch butterfly foraging and/or breeding. An existing transmission line adjacent to this site may provide an alternative habitat area. A survey for milkweed during the flowering season would be conducted to confirm presence or absence of this resource within the CC/Aero CT Plant and switchyard boundaries.

Cumulative effects to threatened and endangered species are not anticipated as Section 7 consultation would be completed and would adhere to conservation and mitigation measures.

3.8.4.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

No suitable habitat to support state or federally listed species was identified within the footprint for the proposed 3- to 4-MW Solar Facility. Therefore, no impacts to protected species are anticipated from the construction of the 3- to 4-MW Solar Facility.

Following construction of the solar facility, the area would be seeded with native herbaceous vegetation less than 12 inches high. Areas outside of the solar array would be planted with pollinator species as possible. Since this area currently does not provide habitat to any protected species, the environmental conditions following construction of the 3- to 4-MW Solar Facility would provide a minor beneficial effect to the monarch butterfly and any other species which may use herbaceous habitat, such as migratory birds or foraging bats.

Cumulative effects to threatened and endangered species are not anticipated as Section 7 consultation would be completed and would adhere to conservation and mitigation measures.

3.8.4.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Forested habitat within the battery option sites could provide suitable habitat for Bachman's sparrow and, Swainson's warbler, and foraging habitat for osprey and bald eagle. Removal of forested habitat (3.5 acres for Battery Site 1, 30.5 acres for Battery Site 2, and 36.2 acres for Battery Site 3) would result in a minor effect to these species as there is abundant forested habitat in the surrounding area of Kingston Reservation.

Suitable habitat for bats exists on the battery storage sites. Implementation of Alternative A would result in the loss of 6.5 acres of medium- and high-quality roosting habitat for Battery Site 1; 30.5 acres of high-quality roosting habitat for Battery Site 2; and 36.2 acres of medium- and high-quality roosting habitat for Battery Site 3. All roosting habitat also functions as foraging habitat. When feasible, clearing of the site would be conducted during the non-breeding season for most migratory birds, which also encompasses the bat hibernation season, thereby minimizing impacts to protected bat and bird species. Flying species such as birds and bats are able to access alternative habitats outside of Kingston Reservation if needed; forested areas across the Clinch River may also be of higher quality than those found on the Reservation due to its history of disturbance. Therefore, effects to bats and migratory birds would be minor with the construction of one of the battery site options. Habitat removal activities associated with this action were addressed in TVA's programmatic consultation with the USFWS on routine actions and federally listed bats in accordance with ESA Section 7(a)(2), completed in April 2018 (USFWS 2018). For those activities with potential to affect bats, TVA committed to implement specific conservation measures when direct and indirect effects to federally listed bat species are expected. Additional information about the BO and conservation measures are described in Section 3.8.4.2.3.3. Proposed actions would not jeopardize the continued existence of tricolored bat, nor would they affect populations of little brown bat.

The eastern slender glass lizard may have potential habitat on Battery Site sites 2 and 3 where early successional habitat is present (2.8 and 3.9 acres, respectively). The monarch butterfly may also use the same areas for foraging and/or breeding (if milkweed is present). The construction of one of the battery sites would cause minor habitat removal for these species. Due to the relatively small amount of habitat proposed for removal under this alternative, minor impacts to these species are anticipated. If suspected to be present at the time of construction or upgrade activities, TVA would initiate further consultation with the agencies to develop conservation measures, which would minimize or eliminate effects to these species. Overall, there would be no effects or minor impacts to these species, primarily related to a small amount of habitat loss.

The valley flame crayfish could find suitable burrowing habitat near the shore of the Clinch River where the water table may be closest to the ground surface. Earth moving close to the river is not anticipated and no impacts to the valley flame crayfish, if present, are expected.

Cumulative effects to threatened and endangered species are not anticipated as Section 7 consultation would be completed and would adhere to conservation and mitigation measures.

3.8.4.2.3.4 On-site Transmission Upgrades

The construction of the battery transmission line connections corridor would include the conversion of forested habitat (24.4 acres) to herbaceous or scrub-shrub habitat, which would impact the Bachman's sparrow, Swainson's warbler, bald eagle, and osprey if using this habitat or nesting in immediately adjacent areas. These species would likely avoid of the area and preference adjacent comparable habitat either on or off of the Kingston Reservation. Should there be a potential for effects to nesting osprey, TVA would coordinate with USDA-Wildlife

Services to ensure compliance with federal law. These impacts would be minor to these species due to the prevalence of alternative habitat in the surrounding area and along the Clinch River and adherence to guidance provided by USDA.

The transmission line corridor proposed for upgrades is an existing corridor with early successional and herbaceous habitats (totaling 86.5 acres); however, the eastern portion of the corridor contains forested area (approximately 15.8 acres) that would be removed and converted to herbaceous/scrub-shrub habitat. Protected or migratory birds within the existing transmission line corridor proposed for upgrades could experience disturbance during work activities; however, effects would be minor and temporary outside of tree clearing areas. If using the herbaceous habitat, the birds would likely return to the area following upgrade activities.

Construction of battery transmission line connections has the potential to result in permanent loss of forested habitat due for migratory birds. Different species of migratory birds may use transmission line corridors as habitat following construction of the project. To the extent practicable, tree removal would be limited to November 15 to March 31 when most wildlife is not nesting and many species of birds have migrated away from the region, thereby avoiding or minimizing the potential for direct effects. Impacts to migratory birds under this action would be minor as nearby suitable habitat is present and habitats on site, although altered from current condition, would still provide resources for some migratory species.

The battery transmission line connections corridor would include the removal of 23.9 acres of high-quality bat roosting habitat and 0.1 acre of moderate-quality bat roosting habitat for Indiana bat, northern long-eared bat, and tricolored bat, and little brown bat. The corridor following completion of the action would regenerate as a maintained ROW that could provide foraging habitat for these three protected bat species, as well as the gray bat. The on-site transmission line corridor proposed for upgrades would also require the removal of approximately 15.1 acres of high-quality bat roosting habitat, which would be converted to herbaceous/scrub-shrub habitat and would likely function as bat foraging habitat. Habitat removal activities associated with this action were addressed in TVA's programmatic consultation with the USFWS on routine actions and federally listed bats in accordance with ESA Section 7(a)(2), completed in April 2018 (USFWS 2018). For those activities with potential to affect bats, TVA committed to implement specific conservation measures when direct and indirect effects to federally listed bat species are expected. Additional information about the BO and conservation measures are described in Section 3.8.4.2.3.4. Proposed actions would not jeopardize the continued existence of tricolored bat, nor would they affect populations of little brown bat.

The eastern slender glass lizard could be present within the existing transmission line corridor proposed for upgrades. Additional habitat (24.3 acres) may be gained by this species with the construction of the battery transmission line connections corridor, and the expansion of the transmission line corridor proposed for upgrades. Impacts to habitat would be minor and temporary at discrete locations where upgrade activities would occur. Therefore, impacts to this species are expected to be minor. If suspected to be present at the time of construction or upgrade activities, TVA would initiate further consultation with the agencies to develop conservation measures, which would minimize or eliminate effects to this species; therefore, no direct impacts are anticipated to the eastern slender glass lizard and a minor beneficial effect of expanded habitat is possible.

A small portion (0.4 acre) of the forested margin along the Clinch River where the protected fetter bush was observed previously falls within the boundary of the on-site transmission line corridor proposed for upgrades and would be permanently impacted by forest clearing. The area would be resurveyed during the appropriate blooming season to confirm the presence or absence of the fetter bush prior to initiating construction activities. If fetter bush is identified, TVA would continue consultation with the TDEC regarding conservation measures for this species.

Cumulative effects to threatened and endangered species are not anticipated as Section 7 consultation would be completed and would adhere to conservation and mitigation measures.

3.8.4.2.3.5 Off-site Transmission Line Upgrades

Although potential habitat exists for many federally and state-listed species identified in Table 3.8-23, impacts are expected to be minor, if at all. Tree removal is not anticipated for upgrades; however, some tree and vegetation trimming could be conducted to facilitate upgrade activities or to provide proper clearance for construction vehicles on access roads. Upgrades to the transmission lines would require limited ground disturbance, primarily from existing access roads and short-term disturbances from heavy equipment moving along the transmission line ROWs to perform equipment upgrades. No threatened or endangered species were identified within the proposed work areas of the transmission corridors during field surveys performed during summer 2022 (HDR 2022b, 2022c). As such, these actions are not expected to impact protected species associated with forested areas.

Field surveys included a survey of transmission line towers for osprey nesting. Some construction activities are prohibited while birds are actively nesting. While osprey are actively nesting (typically March-August), activities are limited to vegetative maintenance (i.e., mowers, bushhogs, select herbicide spraying). Should there be a potential for effects to nesting osprey along the transmission line ROWs, TVA would coordinate with USDA-Wildlife Services to ensure compliance with federal law.

Routine vegetation management of the transmission line ROWs would continue following completion of the proposed upgrades to assure a safe and reliable transmission system. Management activities would likely include herbicide treatment and mowing to control vegetation growth throughout the ROW (TVA 2018a). Additional details on ROW maintenance is provided in Section 3.8.1.1.2.4.

Cumulative effects to threatened and endangered species are not anticipated as Section 7 consultation would be completed, and the upgrades would adhere to conservation and mitigation measures.

3.8.4.2.3.6 Construction and Operation of a Natural Gas Pipeline

Construction of the natural gas pipeline and associated aboveground facilities would require clearing forested areas (755 acres) and maintenance of early successional and/or herbaceous habitat (agricultural fields, herbaceous and scrub-shrub habitat; 1,097 acres), as well as crossing of streams and wetlands. The ETNG Construction ROW crosses a total of 549 waterbodies, including 192 perennial streams, 150 intermittent streams, 195 ephemeral channels, and 30 ponds or impoundments. In addition to surface waters, the pipeline would also cross 291 wetlands totaling 26.2 acres, including emergent, scrub-shrub, and forested wetlands.

Species that may be impacted by the construction and operation activities in the ETNG Construction ROW include those associated with the aforementioned habitat types and are listed as having potential habitat presence listed in Table 3.8-25. Prevalent habitat in the adjacent and surrounding area of the pipeline would minimize effects to species within the corridor. Mobile species are likely to leave the area once construction activities commence and may return upon completion of the project if habitat is appropriate. While species associated with forested habitat may leave areas cleared for the ETNG Construction ROW, species associated with early successional, or field habitat, may colonize the permanent ROW following construction of this Action Alternative. Species seeking forested areas would return to the TWS as it regenerates.

Detailed analyses of effects to state- and federal listed species are being conducted by ETNG as part of FERC 7(c) application filings. As suitable habitats are identified by ETNG, the pipeline route may be adjusted to avoid these habitats and effects to federal and state listed species. ETNG is also consulting with the USFWS and state agencies on the potential effects to threatened and endangered species. Adherence to any Conservation Measures resulting from these consultations is expected to ensure proposed actions would not result insignificant effects to listed species.

Removal of suitable summer roosting habitat for federally listed bats will require consultation with USFWS under Section 7 of the ESA. Depending on habitat qualifications such as tree species type, tree diameter breast height, canopy cover, forest continuity, proximity of forest edge and availability of water, up to 755 acres of forested habitat could function as roosting and foraging habitat, with more open areas of herbaceous or shrub-type covers which may provide additional foraging habitat. Confirmation of suitable bat roosting and foraging habitat is currently on-going by ETNG through field evaluations. Existing foraging habitat (potentially 1,097 acres of herbaceous, agricultural, and scrub-shrub habitat, in addition to the forested habitat) would not be expected to be impacted after the construction of the project. However, existing roosting habitat would be converted to foraging habitat with the conversion to herbaceous and/or shrub cover. Impacts to bat species would be minimized by limiting tree removal to winter months when these bats are not roosting in trees. Tree removal during this timeframe would also avoid direct effects to most nesting migratory songbirds of conservation concern.

Eight species of fish, 3 species of crayfish, and 31 aquatic mollusk species were identified on the state and federal resource lists as having potential for occurrence within the ETNG Construction ROW. The ETNG Construction ROW also crosses many aquatic habitats including large and small streams, creeks, major waterbodies, and named rivers that are in close proximity to the Obed Wild and Scenic River complex.

Migratory birds are most vulnerable to construction impacts when nesting, which generally occurs in the late spring and summer. To minimize impacts to migratory bird species and bat species, ETNG would conduct most clearing activities outside the migratory bird nesting season (generally April 15 through August 1), if practicable from a scheduling perspective after receipt of the permits necessary to begin construction. Similarly, clearing trees during the winter season is also a protective measure for bat species, which would be roosting in caves during this period. ETNG would continue to coordinate with the USFWS and state resource agencies to identify potential impacts to migratory bird species and implement avoidance and minimization measures to reduce potential impacts to these species. These measures include:

- routing Project facilities to avoid sensitive resources where possible;
- maximizing the use of existing pipeline and utility ROWs;
- limiting the construction and operation ROW widths to the minimum necessary;
- conducting mitigation for effects to sensitive resources (i.e., wetlands) through agency permit conditions;

- adhering to the measures outlined in Project E&SCP during construction of the Project facilities; and
- limiting routine ROW maintenance clearing and prohibiting clearing during the migratory bird nesting season (March 1 to August 31).

TVA has independently reviewed and concurs with the species-related findings in ETNG's Resource Report 3 (ETNG 2022d). Approximately 93 percent of the project pipeline facilities would be within or adjacent to the existing natural gas pipeline ROW; therefore, tree clearing activities would be limited in scope and spread over the entire project area. Given the predominance of open areas associated with construction of the project facilities and implementation of the minimization measures listed above, it is unlikely that construction would have an adverse effect on migratory birds.

Wetland and waterbody crossings along the ETNG Construction ROW may be conducted by HDD or dry open cut methods, which could minimize potential impacts to protected species and their habitats if in the area as compared to the wet open cut method. Applicable surveys for protected species and associated consultation with the agencies would be conducted prior to construction activities commencing. Erosion and sediment control BMPs would be deployed and USACE and TDEC permits would be obtained.

Routine vegetation management of the permanent ROW would have periodic effects on habitats within the ROW over the long-term. Methods may vary but are likely to include use of herbicides and various mechanical measures to control vegetation. Protected species, if present, are expected to be displaced intermittently in conjunction with the presence of maintenance crews and the alteration of habitats. Over time, wildlife would become habituated to the herbaceous habitat of the permanent ROW and those species associated with fields or shrub habitat may be found in the corridor.

Cumulative effects to threatened and endangered species are not anticipated, as past/present and RFFAs have or would likely complete Section 7 consultation and would adhere to conservation and mitigation measures. Cumulative loss of habitats may occur but would be minimized through the use of BMPs and proper siting of facilities.

3.8.4.2.3.7 Summary of Alternative A

TVA Actions

No impacts to protected plant, fish, mussel, or crayfish species are expected due to the construction and operation of the CC/Aero CT Plant, 3- to 4-MW Solar Facility, 100-MW BESS, natural gas pipeline, or transmission line corridors. Birds using forested habitat proposed for clearing or conversion, or disturbance of protected and/or migratory birds using existing on- and off-site transmission line corridors would experience minor impacts from demolition, construction, and upgrade activities. Bats would experience moderate impacts from roosting habitat removal and/or conversion to foraging habitat for actions on Kingston Reservation or within the off-site transmission line corridors. Transmission line corridors (on- and off-site) would undergo or continue to undergo routine maintenance activities, which would also disturb species for short periods. Overall, impacts to protected species from the CC/Aero CT plant, 3- to 4-MW Solar Facility, 100-MW BESS, and transmission line corridors are minor, short-term, and/or periodic. Impacts to protected species would be minimized through appropriate consultation with the agencies, BMPs (minimization and conservation measures), and guidelines.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Impacts to protected species in the ETNG Construction ROW would be primarily caused by clearing for the temporary construction areas and Permanent ROW, resulting in a reduction in summer roosting habitat. Nearby or adjacent forested areas may provide habitat as an alternative during the summer season. Forested areas in the temporary construction ROW, outside of the permanent ROW would be allowed to regenerate and provide forested habitat over the long term. No direct impacts would be felt by bat species during the winter period when hibernating in caves.

The natural gas pipeline would likely have adverse effects to protected bat species due to the conversion of suitable roosting/foraging forested and scrub-shrub habitat to herbaceous habitat for the expansion of existing ROW. This conversion would likely result in a loss of summer roosting and yearlong foraging habitat for Indiana bat, little brown bat, northern long-eared bat, and tricolored bat. Impacts to aquatic species are not anticipated for waterbodies crossed by HDD. Aquatic communities would experience minor to moderate, temporary impacts for stream diversion during implementation of dry open cut crossings for pipeline installation.

Plant species would experience moderate impacts if within the forested areas cleared for the ETNG Construction ROW. Plants requiring herbaceous habitats could experience minor disturbance during pipeline installation. The monarch butterfly would gain significant habitat with the conversion of forested habitat to herbaceous/scrub-shrub habitat, which may contain vital milkweed species.

Recommendations made by the USFWS include clearing of trees and maintenance mowing from October 15 to March 31 to the greatest extent practicable and revegetating disturbed areas in a manner that maximizes benefits to pollinators (e.g., milkweed species to enhance habitat for the monarch butterfly).

Significant additional cumulative effects to threatened and endangered species are not anticipated for ETNG's project activities occurring outside of TVA's ESA Section 7 consultation for their CCR management activities on the Kingston Reservation. It is anticipated that ETNG project activities occurring within or beyond the area reviewed for TVA's consultation purposes would likely adhere to similar conservation and mitigation measures identified through that consultation and will likely be processed through separate formal consultation as impacts for pipeline construction as a related, but separate activity. Further Section 7 consultation with USFWS would be required if (1) new information reveals impacts of an action that may affect listed species or critical habitat in a manner not previously considered, (2) the action is subsequently modified to include activities which were not considered during the original consultation, (3) new species are listed or critical habitat designated that might be affected by the action, or (4) the amount or extent of expected take of suitable bat habitat is exceeded.

3.8.4.2.3.8 Environmental Justice Considerations

TVA Actions

Effects to threatened and endangered species that would occur as a result of the proposed CC/Aero CT Plant, transmission line activities, and natural gas pipeline lateral are minor, short-term, and/or periodic and as such are not anticipated to have disproportionate and adverse human health or environmental effects on EJ populations. Any effects would be minimized or mitigated as required due to the protected status of threatened and endangered species.

ETNG Actions - Natural Gas Pipeline and Associated Structures
ETNG is currently evaluating potential effects to threatened and endangered species that could result from construction and operation of the natural gas pipeline. ETNG will continue to coordinate with USFWS, TWRA, and TDEC to minimize or mitigate effects as required due to the protected status of threatened and endangered species.

Effects to threatened and endangered species that could occur as a result of the Pipeline Construction ROW are minor, temporary, and/or periodic and as such are not anticipated to have disproportionate and adverse human health or environmental effects on EJ populations.

3.8.4.2.4 Alternative B

3.8.4.2.4.1 Construction and Operations of Solar and Storage Facilities
Alternative B would result in construction activities that have the potential to affect federally and state-listed species directly or indirectly. There is also the potential for cumulative effects to federally and state-listed species with the expansion of 10,000 MW of solar facilities as identified in the 2019 IRP. As noted in Table 3.2-1, TVA has evaluated typical effects associated with the development of solar facilities; approximately 48 percent of solar projects studied resulted in effects to federally listed endangered or threatened species, and 9 percent of solar projects resulted in effects to migratory birds. These estimates suggest that between 7-8 solar facilities and 8-9 BESS facilities could affect protected species, and 1-2 solar and BESS sites could result in migratory bird effects. TVA would minimize effects to protected species by siting facilities to the extent practicable on previously disturbed land, such as agricultural or silvicultural sites, or land with few sensitive wildlife habitats. Tree clearing would be limited to winter periods to the extent practicable, or presence/absence surveys otherwise conducted. Facilities constructed by third-party solar developers would establish and implement conditions of construction in consultation with the agencies; the developers with TVA power purchase agreements would be required to complete Section 7 consultation through TVA and comply with USFWS conservation measures, which would result in the minimization or mitigation of effects.

3.8.4.2.4.2 Transmission and Other Components
Alternative B would result in construction of transmission lines and components that have the potential to affect federally and state-listed species directly or indirectly. There is also the potential for cumulative effects to federally and state-listed species with the expansion of 10,000 MW of solar facilities as identified in the 2019 IRP (TVA 2019a). Based on a review of 298 transmission line projects from 2005 to 2018, 32 of 256 projects (11 percent) affected federally listed threatened or endangered species or species proposed or Candidates for listing (Table 3.3-1). Of the 290 projects reviewed, 63 (22 percent) projects affected state-listed endangered, threatened, or special concern species. Habitat and species surveys would be required for the proposed transmission lines associated with each solar or BESS site. These impacts would be more fully evaluated in future NEPA reviews and USFWS consultations for individual solar/battery project would be required under NEPA if Alternative B is selected as the preferred alternative.

3.8.4.2.4.3 Environmental Justice Considerations
Effects to threatened and endangered species that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to have amplified effects on EJ populations because typical effects associated with such facilities and activities show that effects are often avoided by siting on previously disturbed land. Where such siting is not feasible and effects may occur, any effects would be evaluated per each solar site and minimized or mitigated as required due to the protected status of threatened and endangered species.

3.9 Natural Areas, Parks, and Recreation

3.9.1 Affected Environment

Natural areas, parks, and recreation areas include sites typically managed and/or used for one or more of the objectives of recreation; plant and wildlife protection and management; scientific research and education; and scenic protection. They include national, state, and local parks and recreation areas; trails and greenways; national and state wildlife refuges, wildlife management areas (WMAs) and forests; research natural areas; and scenic areas. This section addresses the natural areas, parks, or recreation areas that are on, immediately adjacent to (within one mile), or within the vicinity of the project areas (5-mile radius) or identified as having regional significance

3.9.1.1 Kingston Reservation (No Action and D4 Activities)

The area within a 1-mile radius of KIF includes several public and commercial recreation and natural areas. Within the Kingston Reservation is a boat ramp at the discharge channel that is open to the public where nearby residents often fish (Figure 3.9-1). The public also has access to a grassy area along the lake south of the plant and on the east bank of the discharge channel (TVA 2019c) and the Kingston Steam Plant State Wildlife Observation Area. No current lease agreements exist within the Kingston Reservation for recreational activities. The Swan Pond Sports Complex exists just outside of the boundaries of the Kingston Reservation (0.14 mi north). The sports complex is located on TVA land, but TVA has an agreement with Roane County to operate and maintain the area.

The Clinch River, which borders the Reservation to the south, is classified for domestic water supply, industrial water supply, fish and aquatic life, recreation, livestock, watering and wildlife, irrigation, and navigation. The Emory River, which borders the reservation on the eastern and northern sides of the plant, is classified for domestic water supply, industrial water supply, fish and aquatic life, recreation, livestock, watering and wildlife, and irrigation. Currently both rivers are considered “not supporting” for their designated uses in the 2020 State 303(d) report for chlordane, mercury, and PCBs. The Emory River is listed in the Nationwide Rivers Inventory from RM 25 to RM 27 for its remarkable fish, geologic, recreational, scenic, and wildlife values. The section of the Emory River listed in the National Rivers Inventory is located approximately 4.6 miles west of the Kingston Reservation. See Section 3.6 for more information on surface waters in the project site.

There are multiple natural and recreational sites listed on the U.S. Protected Areas Database (US PAD) within the vicinity of Kingston Reservation (Figure 3.9-1):

- Located 1.45 miles south of the Kingston Reservation is Kingston City Park. Kingston City Park has playgrounds, boat ramps, and hiking facilities and is maintained by the City of Kingston.
- Watts Bar Reservoir is a recreation area with space for camping, hiking, fishing, and boating located 1.55 miles north of the Kingston Reservation and is managed by TVA.
- Fort Southwest Point is 2.65 miles south of the Kingston Reservation, managed by the City of Kingston, and is a historic colonial fort available for touring.
- Approximately 3.35 miles northwest of the Kingston Reservation are Paper Maker Ball Field and Flour Mill Flats Ball Field. Paper Maker is a privately owned sports field, and Flour Mill Flats is a sports field managed by the City of Harriman.

- Roane County Park is 4.75 miles southwest of the Kingston Reservation, managed by the County of Roane, and has facilities for camping, hiking, boating, and fishing.
- Long Island WMA is located 5.0 miles south of the Kingston Reservation and is managed by Tennessee Wildlife Resources Agency (TWRA).

Several public and commercial recreation areas not listed in the US PAD are located in the vicinity of the Kingston Reservation (Figure 3.9-1):

- Swan Pond Sports Complex, 0.14 mi north
- TVA Wetlands Viewing Area and Trails, 2.1 miles north
- Southwest Point Golf Course, 3.2 miles south
- Lakeside Golf Course, 3.5 miles southeast
- David Webb Riverfront Park, 2.0 miles northwest
- Kingston Waterfront Park, 2.1 miles south
- Wetlands Reserve Program Conservation Area, 1.1 miles north
- TVA Sugar Grove Habitat Protection Area, 0.1 miles east
- TVA Rayburn Bridge Habitat Protection Area, 0.1 miles south
- TVA Stowe Bluff Habitat Protection Area, 0.9 miles south

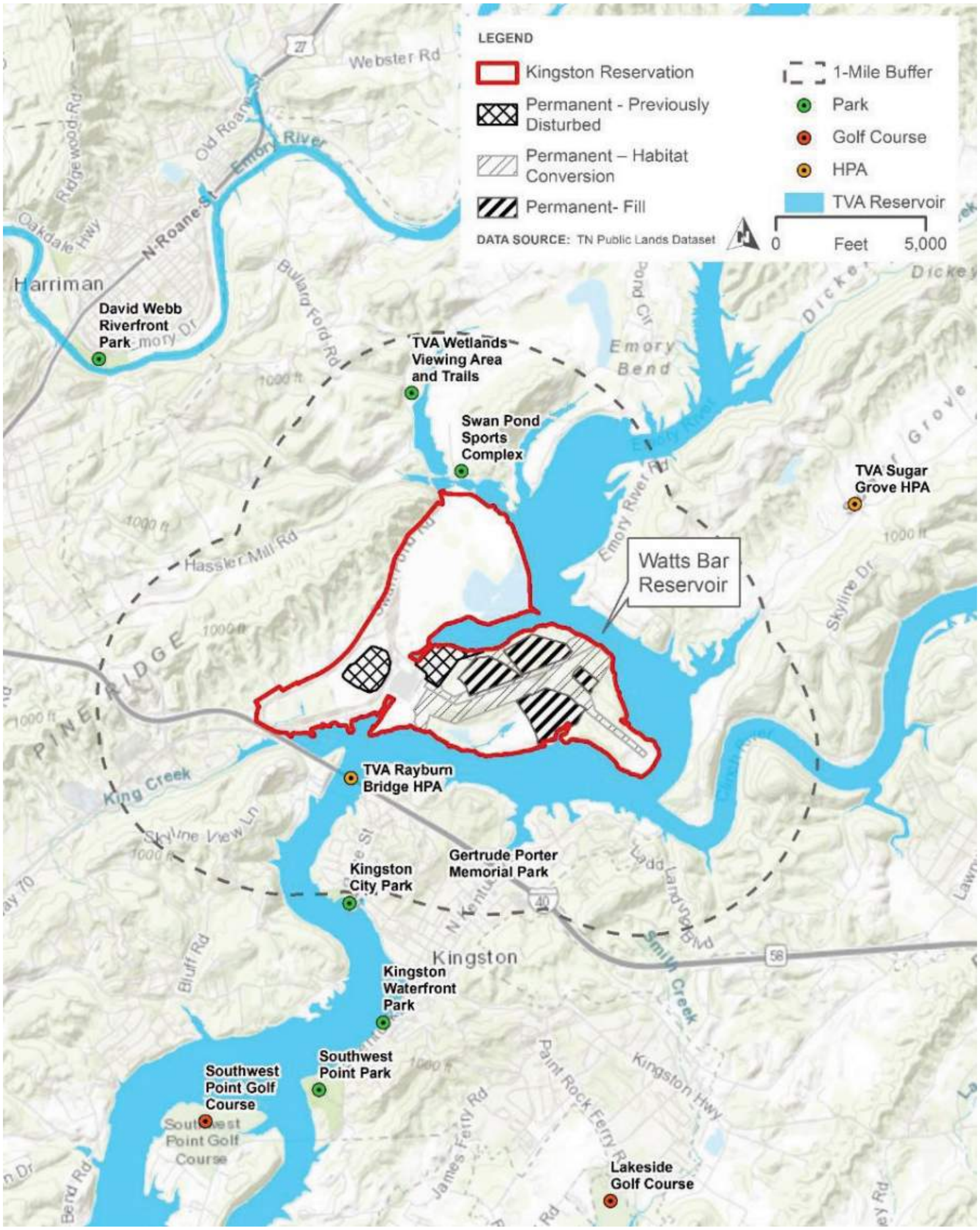

Figure 3.9-1. Natural and Recreational Areas in the Vicinity of the Kingston Reservation

3.9.1.2 East Tennessee Region

Major recreational and natural areas in the Eastern Tennessee region include the Great Smoky Mountains National Park and the Obed Wild and Scenic River. The Great Smoky Mountains National Park is located approximately 30 miles, 37 miles, and 38 miles southeast of the off-site transmission upgrades, Kingston Reservation, and natural gas pipeline, respectively. It is the most visited national park in the U.S. and in 2022, nearly 13 million visitors experienced the park's world-renowned biological diversity and scenic landscapes and natural areas. Visitors to the park have a variety of recreational opportunities to choose from including hiking, camping, nature watching, fishing, and touring areas of social, historical, or cultural significance (NPS 2023).

The Obed Wild and Scenic River is located approximately 0.5 mile west of the natural gas pipeline, five miles east of the off-site transmission upgrades, and 14 miles northwest of the Kingston Reservation. It is Tennessee's only wild and scenic river and one of the last free-flowing river systems in the eastern U.S.

3.9.1.3 Alternative A

3.9.1.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Natural areas, parks, and recreation within the proposed CC/Aero CT Plant site, switchyard, transmission lines, and associated components would be the same as those described within the Kingston Reservation in Section 3.9.1.1. None of the natural or recreational areas identified in the vicinity of the Kingston Reservation are within the footprint of the proposed CC/Aero CT Plant site.

3.9.1.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.9.1.1 apply to the proposed 3- to 4-MW solar facility location on the Kingston Reservation. None of the natural or recreational areas identified in the vicinity of the Kingston Reservation are within the proposed solar facility footprint.

3.9.1.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.9.1.1 apply to the proposed 100-MW BESS on the Kingston Reservation. None of the natural or recreational areas identified in the vicinity of the Kingston Reservation are within the proposed BESS footprint.

3.9.1.3.4 On-site Transmission Upgrades

The affected environment for on-site transmission upgrades is the same as described in Section 3.9.1.1. The on-site transmission upgrades do not directly overlap any recreational areas on-site.

3.9.1.3.5 Off-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines: five transmission lines near the Kingston Reservation (L5302, L5108, L5280, L5381, and L5116), and one in Crossville (L5383), as described in Section 2.1.3.6. Existing natural areas, parks, and recreational areas within the vicinity of each transmission line are described below.

3.9.1.3.5.1 Eastern Transmission Corridor

Existing transmission lines L5302, L5108, L5280, L5381, and L5116 extend from the current Kingston Reservation travelling eastbound and terminate in the city of Oak Ridge. Several access roads are proposed largely along routes that have already been previously cleared for other, unrelated activities. According to the US PAD, there are 18 sites located within the Eastern Transmission Corridor.

- Kingston Fossil Plant
- Kingston Coal Generating Facility
- Watts Bar Reservoir is a recreation area with space for camping, hiking, fishing, and boating, managed by TVA; and
- Oak Ridge Reservation (ORR) Wildlife Management Area (WMA), managed by the TWRA in consultation with TDEC, including:
    - Oak Ridge National Laboratory
    - Black Oak Ridge Conservation Easement
    - Black Oak Ridge Mixed Pine and Hardwood Forest
    - McKinney Ridge Hemlocks
    - Duct Island Road Bluffs
    - Fringeless Orchid Wetlands
    - Bear Creek
    - Pine Ridge Wetlands
    - Walker Branch Embayment Barren
    - Chestnut Ridge Barren and Wetland
    - Chestnut Ridge Springs Area
    - Unnamed Tributary to East Fork Poplar Creek
    - Grassy Creek
    - Manhattan Project National Historic Park
    - North Ridge Trail

TDEC public lands and TVA reservoirs near the transmission line corridors are illustrated in Figure 3.9-2a through Figure 3.9-2d and depicted on figures in Appendix D-6.

3.9.1.3.5.2 Western Transmission Corridor

Transmission Line L5383 extends southeastward from a substation in unincorporated Crossville on Plateau Road and terminates north of the Crossville city limits. There are no sites listed on the US PAD that exist within an 0.5 mile of the Western Transmission Corridor. However, the Charles Russell Obed Reserve, a 50-acre conservation easement, exits within a 0.5-mile radius (Figure 3.9-3).

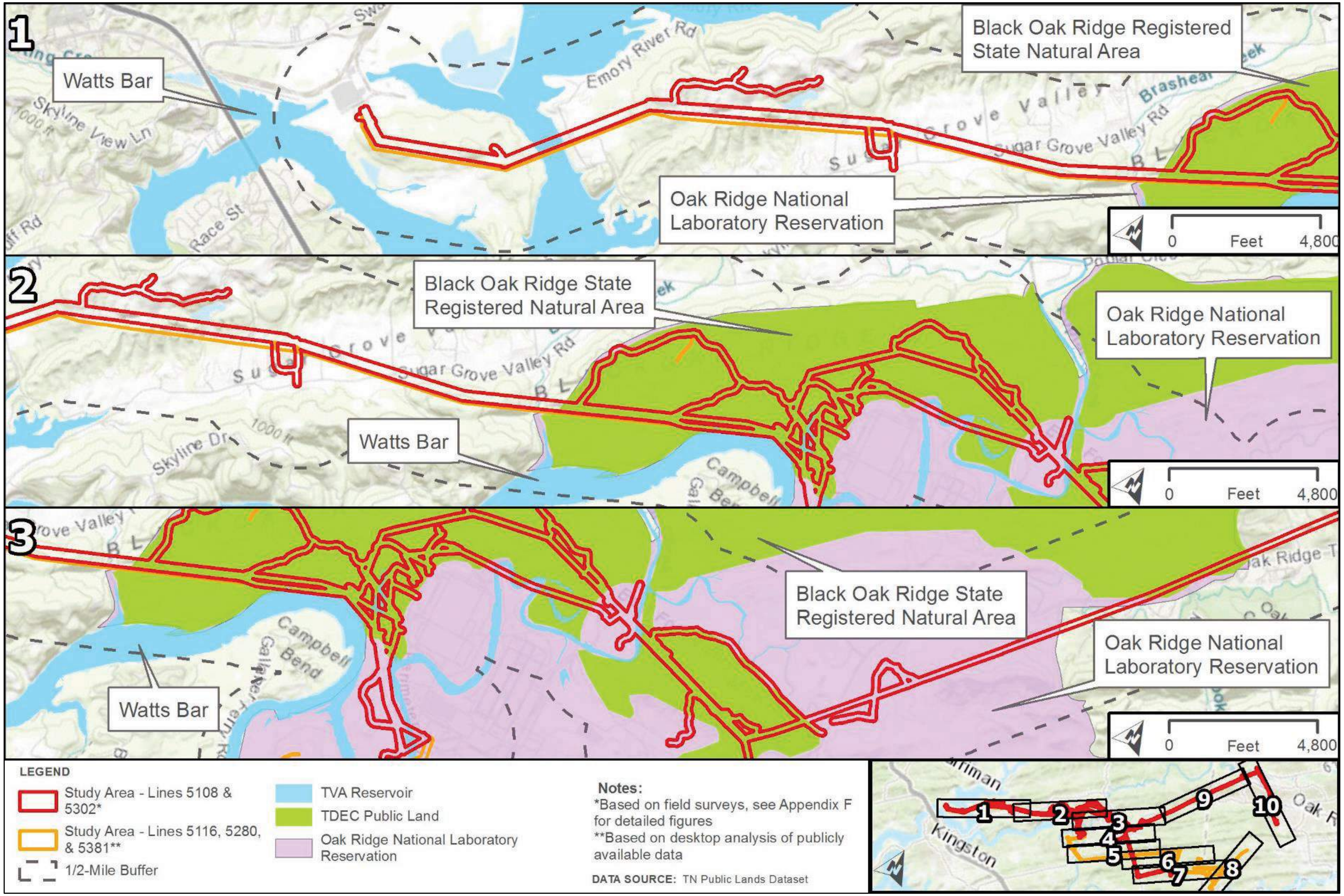

Figure 3.9-2a. **Public Lands and Reservoirs in the Vicinity of the Proposed Alternative A Transmission Line Upgrades along the Eastern Transmission Corridor**

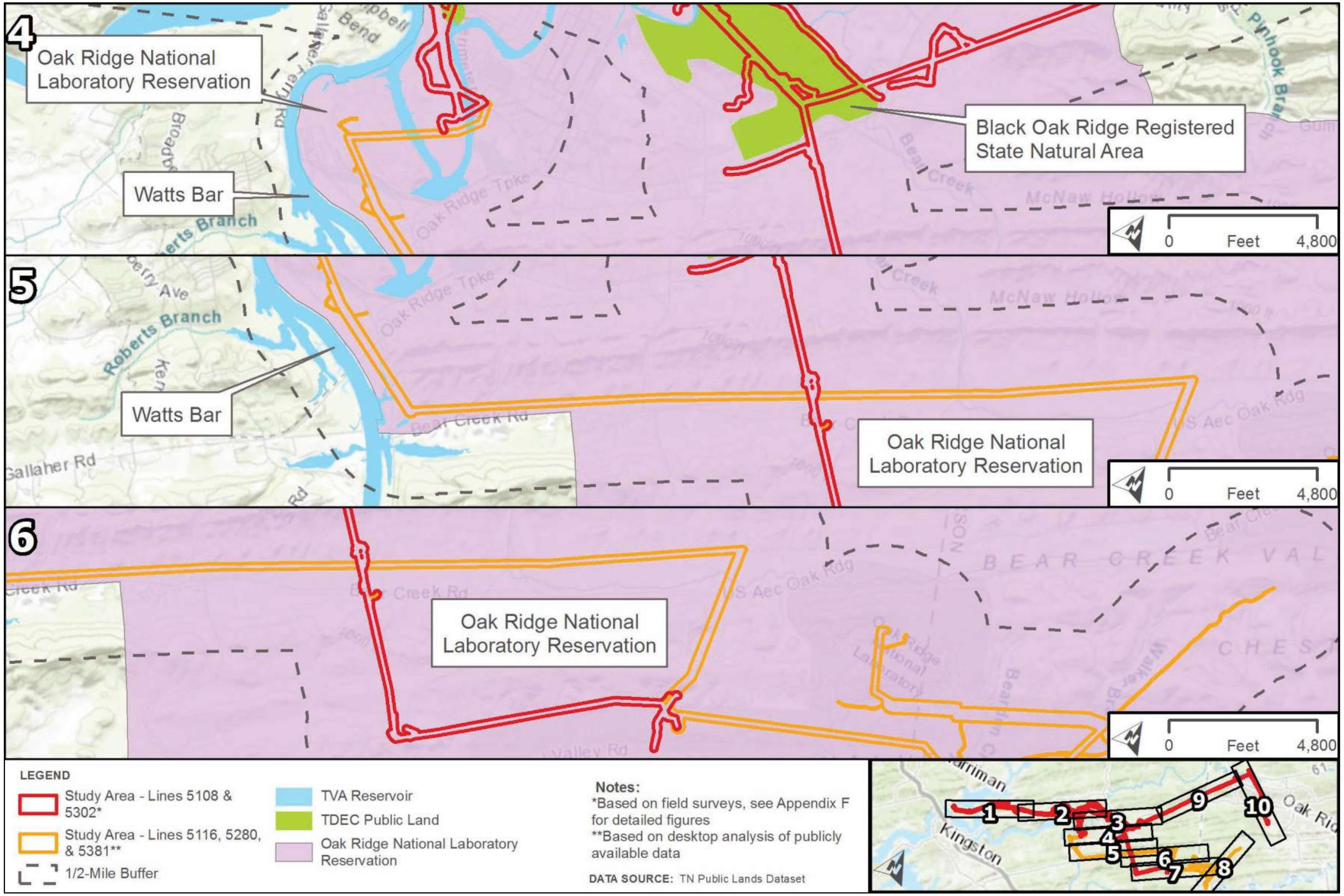

Figure 3.9-2b. Public Lands and Reservoirs in the Vicinity of the Proposed Alternative A Transmission Line Upgrades along the Eastern Transmission Corridor

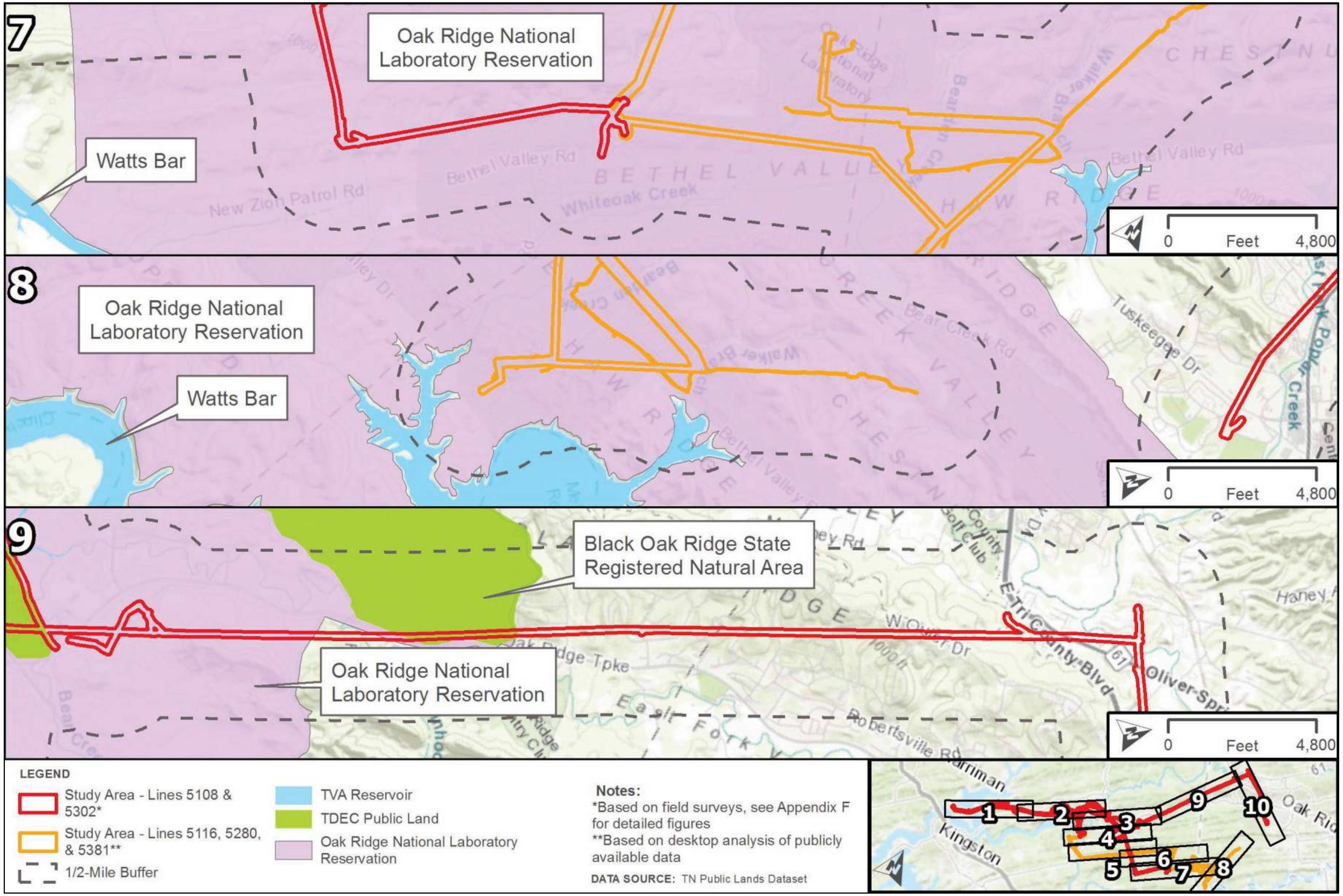

Figure 3.9-2c. **Public Lands and Reservoirs in the Vicinity of the Proposed Alternative A Transmission Line Upgrades along the Eastern Transmission Corridor**

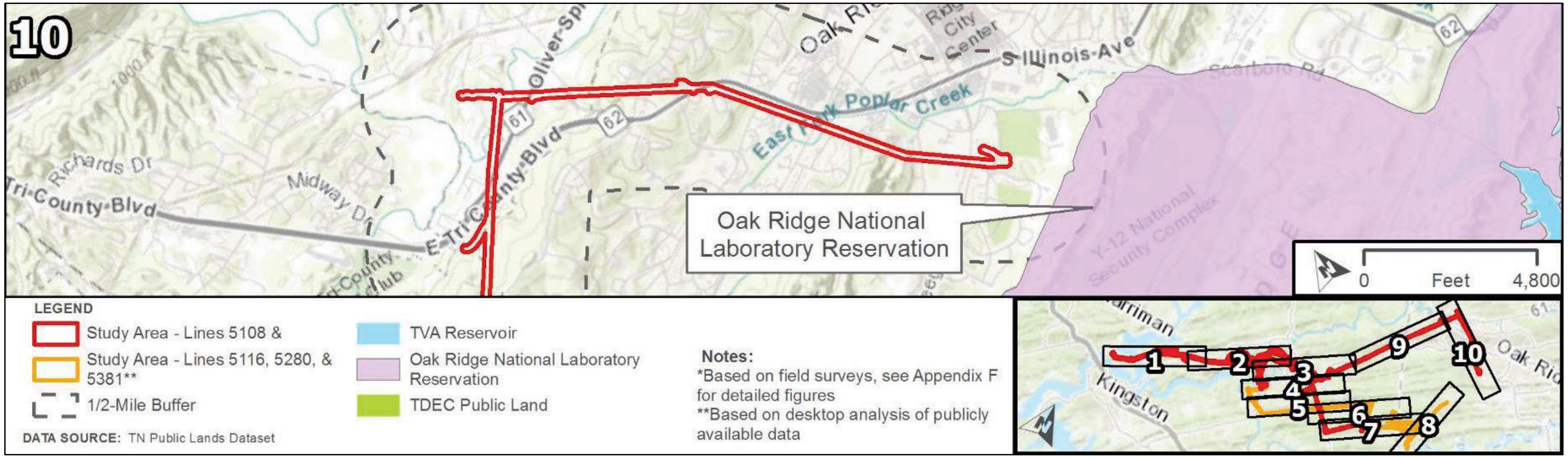

Figure 3.9-2d. Public Land and Reservoirs in the Vicinity of the Proposed Alternative A Transmission Line Upgrades along the Eastern Transmission Corridor

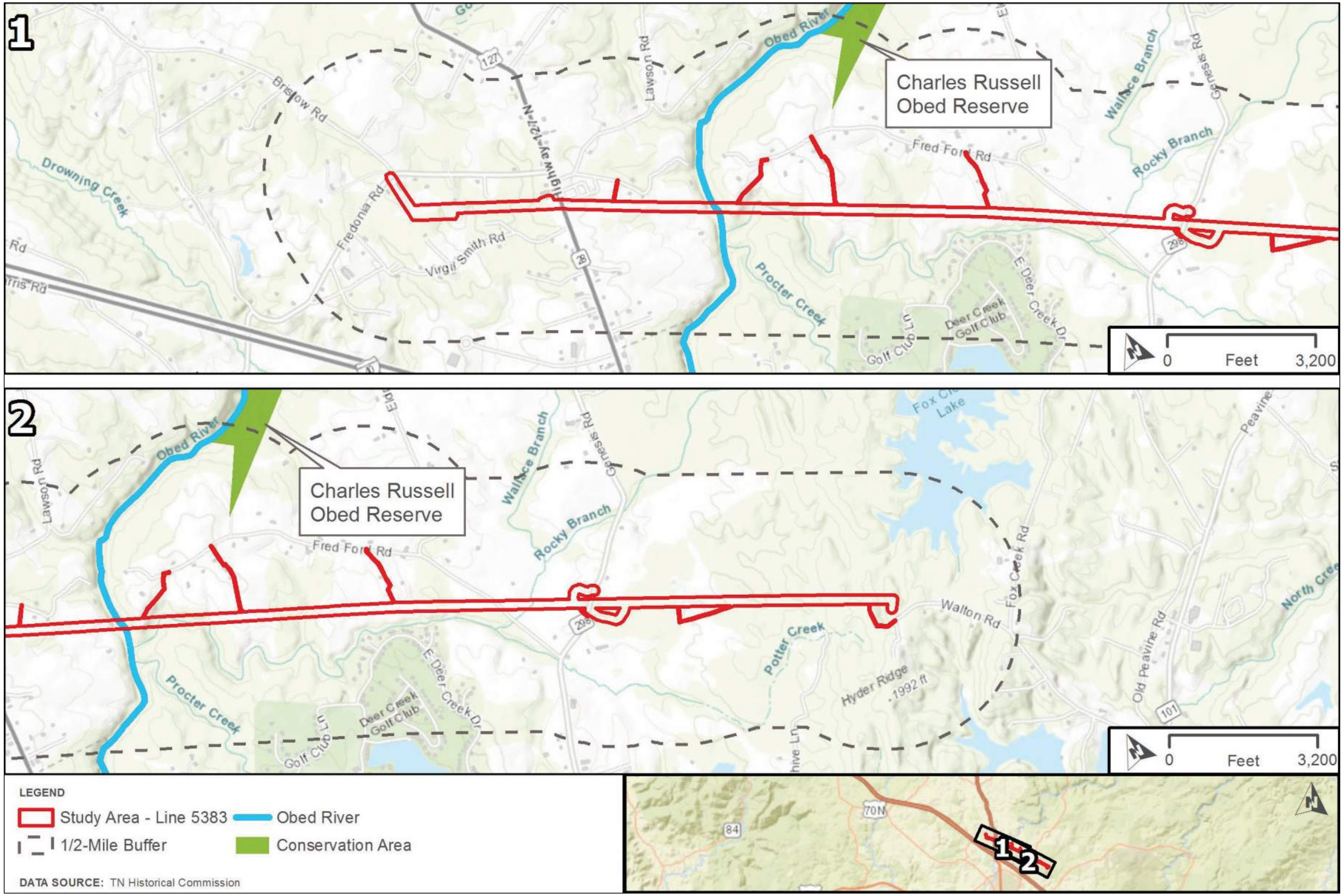

Figure 3.9-3. Conservation Areas in the Vicinity of the Proposed Alternative A Transmission Line Upgrades Along the Western Transmission Corridor

3.9.1.3.6 Construction and Operation of a Natural Gas Pipeline

Natural areas, parks, and recreation areas located within five miles of the ETNG Construction ROW are listed in Table 3.9-1.

Table 3.9-1. Natural Areas, Recreation Areas, and Parks within Five Miles of the Alternative A Pipeline

Natural Area, Recreation Area, or Park	COUNTY
ORNL Lands Potential National Natural Landmark	Multiple
Rayburn Bridge	Roane
Cumberland River Bluffs at Hartsville	Trousdale
Monterey Lakes	Putnam
Bridgewater Cave Protection Planning Site	Smith
Designated Critical Habitat (DCH) Unit 12: Funns Branch, Short’s Bladderpod	Jackson
DCH Unit 13: Wartrace Creek, Short’s Bladderpod	Jackson
DCH Unit 10: Coleman-Winston Bridge, Short’s Bladderpod	Trousdale
DCH Unit 11: Cordell Hull Res, Short’s Bladderpod	Smith
DCH Unit 9: Old Hickory Lake, Short’s Bladderpod	Trousdale
DCH Spotfin Chub – Little Tennessee River	Multiple
Flynn Creek Cryptoexplosion Structure Potential National Natural Landmark	Jackson
Cumberland River Bluffs at Oldham Road	Trousdale
DCH Short’s Bladderpod	Multiple
Williams Tract Protection Planning Site	Putnam
Stowe Bluff	Roane
DCH Obed River Unit 3	Multiple
Sugar Grove	Roane
ORNL Reservation And ORR	Multiple
Haile Cave	Jackson
Dud’s Cave Protection Planning Site	Jackson
Cummins Falls	Jackson
Piney Creek Sandstone Glade	Putnam
Cumberland River Bluffs at Oldham Road	Trousdale
Tanager Hill Protection Planning Site-Rare Plants	Putnam
ORR Lower Poplar Creek Rookery [Ra30]	Roane
DCH Purple Bean	Multiple
Cumberland River No. 3 State Mussel Sanctuary	Smith
Catoosa State Wildlife Management Area	Multiple

Natural Area, Recreation Area, or Park	COUNTY
Hartsville Investment Recovery Center	Multiple
Kingston Fossil Plant	Roane
Obed Outstanding National Resource Water	Multiple
Cumberland Forests	Multiple
Wetlands Reserve Program	Roane
Cumberland River No. 2 State Mussel Sanctuary	Multiple
Tuckaway	Putnam
Cordell Hull State Wildlife Management Area	Multiple
Frozen Head State Natural Area	Multiple
Blackburn Fork State Scenic River	Jackson
Old Hickory Reservoir Reservation	Multiple
Tennessee Technological University Campus	Putnam
Flat Fork Homeplace Flat Fork Homeplace	Morgan
Potter Farm	Morgan
Solomon Hollow Apiary	Morgan
Tanger Hill Registered State Natural Area	Putnam
ORR Black Oak Ridge Conservation Easement	Roane
Cumberland River No. 1 State Mussel Sanctuary	Multiple
Old Hickory State Wildlife Management Area	Multiple
Southwest Point Park	Roane
Watts Bar Reservoir Reservation	Multiple
ORNL Reservation	Multiple
Watts Bar Dam Reservation	Multiple
Lone Mountain State Forest	Morgan
Kingston City Park	Roane
Cumberland Trail State Park	Multiple
Kingston Steam Plant State Wildlife Observation Area	Roane
Sugar Grove TVA Habitat Protection Area	Roane
Rayburn Bridge TVA Habitat Protection Area	Roane
Stowe Bluff TVA Habitat Protection Area	Roane
Campbell Bend Barrens State Natural Area	Roane
Upper Cumberland Wildlife Rehabilitation Center	Putnam
Tanager Hill Registered State Natural Area	Putnam
Flat Fork Stream Mitigation Site	Morgan

Natural Area, Recreation Area, or Park	COUNTY
Goose Creek	Multiple
East Blackburn Fork	Multiple
Witt Creek	Morgan
Falling Water River	Multiple
Flynn Creek	Jackson
Emory River	Multiple
West Fork Obey River	Multiple
Spring Creek	Multiple
Rock Creek	Morgan
Crab Orchard Creek	Multiple
Cummins Falls State Park	Jackson
Old Hickory Lock 5 Refuge	Multiple
TDEC Emory River Conservation Easement	Multiple
ORR Leatherwood Bluffs	Roane
West Wind Farms LLC	Morgan
Big South Fork of The Cumberland	Multiple
East Fork Obey River	Multiple
Cordell Hull Lake – Us Army Corps of Engineers	Multiple
Simmers Property Conservation Easement – Land Trust for Tn	Putnam
ORR Blackoak Ridge Mixed Pine and Hardwood Forest	Roane
ORR Campbell Bend Bluffs and Forest	Roane
ORR Upper Poplar Creek Rookery	Roane
ORR Roberts Branch Wetlands	Roane
ORR Duct Island Road Bluffs	Roane
G.D. Coorts Memorial Arboretum	Putnam
Cumberland Trail 1	Multiple
Foothills Land Conservancy Property	Fentress
Gerber/Smythe Property Conservation Easement – Land Trust for Tn	Putnam
Beasley Farm – Land Trust of Tn Conservation Easement	Smith
Crooked Fork	Morgan
North Prong Clear Fork	Multiple
Dixona Farm Conservation Easement – Land Trust for Tennessee	Multiple
Walden Ridge Partners Llc Conservation Easement – Foothills Land Conservancy	Roane
Barger Property – Land Trust of Tn Conservation Easement	Putnam

Natural Area, Recreation Area, or Park	COUNTY
Crowder Cemetery Barrens Designated State Natural Area	Roane
Obed Wild and Scenic River Fee – The Nature Conservancy – Fee Ownership (NE)	Morgan
Obed Wild and Scenic River Fee – The Nature Conservancy - Fee Ownership (North)	Morgan
Kingston Coal Generating Facility	Roane
Wynnewood State Historic Area	Sumner
Clear Creek	Multiple
Castalian Springs Mound Site/Archaeological Project	Sumner
Agricultural Conservation Easement	Morgan
Fancher Pit	Multiple
White Creek	Morgan

ETNG reviewed USGS topographic maps, aerial photographs, and agency websites to determine if the pipeline study area crosses public lands managed by state or federal agencies; wildlife management areas; conservation lands; parks; trails; or designated natural or scenic areas. A summary of findings to date as provided in ETNG's Resource Report 8 (ETNG 2022i) is presented below:

- The pipeline crosses the Old Hickory WMA (5,360 feet of pipeline) and the Cordell Hull WMA (6,010 feet of pipeline). WMAs are managed by the TWRA.
- In Morgan County, the pipeline crosses 800 feet of the northeastern edge of the Lone Mountain State Forest, which is managed by the Tennessee Division of Forestry.
- The pipeline crosses lands identified as the Cordell Hull Recreation Area and Old Hickory Recreation area, managed by the USACE.
- Recreation opportunities in the Cordell Hull Recreation Area include fishing, hunting, camping, picnicking, boating, hiking, horseback riding, and nature photography. Campgrounds are located over 2,000 feet away from the pipeline. A small boat ramp is located 175 feet south of the pipeline.
- Recreation opportunities in the Old Hickory Recreation Area include fishing, camping, and boating. Campgrounds and boat launches are located over 1,000 feet away from the pipeline.
- The pipeline crosses a portion of the Justin P. Wilson Cumberland Trail State Park, also known as the Cumberland Trail. The Cumberland Trail is a Tennessee hiking trail managed by TDEC Division of Natural Areas and maintained primarily by volunteers. The pipeline crosses the Cumberland Trail in Morgan County.
- A review of conservation easements identified one site within the pipeline – the Dixona Farm, located in Smith and Trousdale counties. The Dixona Farm is a 148-acre historic farm site currently managed by The Land Trust for Tennessee. The pipeline appears to cross an area of open pasture.

- The pipeline crosses tributaries to the Obed River, which is designated as a Wild and Scenic River. The pipeline does not cross the Obed River.

TVA has independently reviewed and concurs with the findings in ETNG's Resource Reports. ETNG would coordinate with the relevant agencies regarding potential crossings of these recreation and special use areas. See Figure 8.4-1 in ETNG Resource Report 8 for maps of public lands crossed by the pipeline (ETNG 2022i).

3.9.1.4 Alternative B

3.9.1.4.1 East Tennessee TVA Power Service Area

To offset transmission system upgrades that may be required following the retirement of KIF, TVA anticipates that most of the solar facilities proposed under Alternative B would be located within portions of East Tennessee. There are parks and natural and managed areas with ecological significance throughout the TVA Power Service Area in all physiographic regions; major recreational and natural areas in the northeastern TN region include the Great Smoky Mountains National Park, Cherokee National Forest, Chuck Swan State Forest Catoosa WMA, North Cumberland WMA, and Big South Fork National River and Recreation Area.

Individual ecologically significant areas vary in size from a few acres to thousands of acres. Many areas cross state boundaries or are managed cooperatively by multiple agencies. Waterbodies listed in the National Rivers Inventory include the Clinch River, Powell River, Doe River, Holston River, French Broad River, Emory River, Cumberland River (Big South Fork), Wolf River, Obey River, White Creek, Clear Creek, and White Oak Creek. The only Wild and Scenic River in Tennessee is the Obed River, which is in between central and eastern TN.

Power from these facilities would typically be delivered by direct connection to TVA's transmission system or via interconnections with local power companies that distribute power from TVA. TVA transmission line rights-of-way cross eleven NPS units, nine National Forests, six National Wildlife Refuges, and numerous state WMAs, state parks, and local parks (TVA 2018a). As specific sites have not yet been determined for evaluation under this alternative, typical impacts of transmission projects have been listed in Table 3.3-1.

3.9.2 Environmental Consequences

3.9.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to maintain and operate the KIF plant. TVA would implement all planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be reviewed in subsequent NEPA analyses. Dispersed recreation use patterns, especially bank fishing, would likely continue on some portions of the Kingston Reservation. There would be no Project-related impacts to natural areas, parks, and recreation areas in the vicinity of the Kingston Reservation.

3.9.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Under both action alternatives, TVA would retire, decommission, decontaminate, and deconstruct the KIF units and site. Because there are substantial distances between developed natural areas, parks, and recreation areas in the vicinity of the site and the Kingston Reservation, no impacts on these areas are anticipated. Construction impacts to the WMA present within the Kingston Reservation required as part of the retirement process would be temporary in nature. Project impacts on dispersed outdoor recreational activities should be minor. The retirement, decommissioning, decontamination, and deconstruction of the KIF plant may temporarily eliminate or reduce fishing and other dispersed recreational activities on the Kingston Reservation and in portions of the Emory and Clinch rivers located adjacent to the Kingston Reservation. However, it is expected that these dispersed recreation activities could be accommodated at other similar bank fishing spots in the surrounding area. Therefore, Project impacts on dispersed outdoor recreational activities should be minor. In addition, public access to the boat launching ramp located within the Kingston Reservation could be temporarily interrupted during deconstruction activities resulting in minor, temporary adverse impacts to boat launching opportunities. No cumulative effects to natural areas, parks, or recreation would occur.

3.9.2.2.1 Environmental Justice Considerations

Effects to natural areas, parks, and recreation that would occur as a result of KIF retirement and D4 activities would be temporary and minor. Fishing access on the Kingston Reservation may be temporarily limited or not allowed, which could result in temporary amplified effects for EJ populations while access is limited as it would reduce the number of fishing locations within the area.

3.9.2.3 Alternative A

Roane County is approximately 36 miles from the nearest federal Class I protected area (Great Smoky Mountains National Park) and nine miles from the Obed Wild and Scenic River. However, the implementation of Alternative A is expected to result in a large overall reduction in combined emissions of the four Regional Haze/Visibility regulated pollutants: NOx, PM_{10}, SO_2, and sulfuric acid. This change is a beneficial impact to nearby Class I protected areas and wild and scenic rivers, including Great Smoky Mountains National Park and Obed Wild and Scenic River (USEPA 2021e). Therefore, permanent, moderate, beneficial effects on local air quality and reductions in future regional GHG emissions are expected to have permanent long-term, minor, beneficial effects to nearby natural areas, parks, and recreation.

3.9.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Construction of the CC/Aero CT Plant, switchyard, and transmission facilities on Kingston Reservation would not occur directly on or within the boundaries of any natural areas, parks, and recreation areas identified near the Reservation and are not anticipated to disrupt existing recreation (see Section 3.9.1.1); thus, no impacts are anticipated.

3.9.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

Construction of the 3- to 4-MW Solar Facility site on the Kingston Reservation would not occur directly on any of the natural areas, parks, and recreation areas identified near the Reservation (see Section 3.9.1.1); thus, no impacts are anticipated.

3.9.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Construction of the 100-MW battery site on the Kingston Reservation on any of the three potential battery sites would not occur directly on any of the natural areas, parks, and recreation areas identified near the Reservation (see Section 3.9.1.1); thus, no impacts are anticipated.

3.9.2.3.4 On-site Transmission

The impacts to natural and recreational areas from proposed upgrades to transmission under Alternative A, including a breaker and a half 161-kV switchyard and a reroute of all existing transmission lines from the Kingston Reservation, as well as the installation of a new transmission line for the proposed battery facility, would be the same as those described in

Section 3.9.2.2, as these upgrades are expected to occur within the reservation. If future studies indicate improvements are required to the regional transmission system to maintain system stability and integrity, additional site-specific reviews would be completed.

3.9.2.3.5 Off-site Transmission

Under Proposed Alternative A, upgrades to off-site transmission lines would be necessary as described in Section 3.9.1.3.5. The extent of natural and recreation areas and parks crossed by the Eastern Transmission Corridor are provided in Table 3.9-2. There is overlap across the extent of some of these areas. Since the corridor is an existing ROW, vegetation within this area already undergoes regular maintenance activities (e.g., control and/or removal of large woody vegetation) to ensure the safe and reliable transmission of power. Trimming of trees along access roads may be conducted for equipment access.

Table 3.9-2. Summary of Natural and Recreation Areas or Parks Crossed by the Eastern Transmission Corridor under Alternative A

Natural Area, Recreation Area, or Park	Total Extent (Acres)
Kingston Fossil Plant	11.6
Kingston Coal Generating Facility	68.7
Watts Bar Reservoir	56.6
Oak Ridge Reservation WMA	1,105.2
Black Oak Ridge Conservation Easement1	311.5
Black Oak Ridge Mixed Pine and Hardwood Forest1	3.4
McKinney Ridge Hemlocks1	1.1
Duct Island Road Bluffs1	0.6
Fringeless Orchid Wetlands1	0.7
Bear Creek1	12.4
Pine Ridge Wetlands1	26.0
Walker Branch Embayment Barren1	10.9
Chestnut Ridge Barren and Wetland1	12.5
Chestnut Ridge Springs Area1	0.3
Unnamed Tributary to East Fork Poplar Creek1	1.2
Grassy Creek1	0.2
North Ridge Trail	0.9

[1] Areas are also included within the Oak Ridge Reservation

Outside of the direct project impacts mentioned above where construction areas intersect with areas of interest, impacts on dispersed outdoor recreational activities and natural areas and parks would likely only include minor and temporary impacts from construction traffic along the corridors.

3.9.2.3.6 Construction and Operation of a Natural Gas Pipeline

The proposed ETNG Construction ROW is expected to cross multiple parks, managed areas, and ecologically significant sites within the ETNG Construction ROW.

According to ETNG's Resource Report 8 (ETNG 2022i), the following impacts can be anticipated due to the pipeline crossings. See Figure 1.3-1 in Appendix 1A of ETNG's Resource Report 1 (ETNG 2022b) for detailed maps of the pipeline route and facilities:

The [pipeline] crosses multiple segments of the Old Hickory WMA beginning at MP 2.7. The length of the [pipeline] within the Old Hickory WMA totals approximately 5,360 feet. From MP 2.8 to MP 3.4 the pipeline will be constructed via HDD with minimal workspace. Through the Old Hickory WMA, the proposed pipeline will be located adjacent to the existing 3100 Line permanent ROW. Workspace and new ROW will be required outside of the existing 3100 Line ROW to safely construct the [pipeline]. A total of 7.1 acres of land within the Old Hickory WMA will be disturbed during construction; 3.1 acres of this are within the previously disturbed existing 3100 Line permanent ROW. No new permanent ROW will be required through the WMA.

[…]

The [pipeline] crosses multiple segments of the Cordell Hull WMA beginning at MP 28.0. The length of the [pipeline] within the Cordell Hull WMA totals approximately 6,010 feet; however, 3 waterbody crossings (Salt Lick Creek, Cordell Hull Reservoir, and the Cumberland River) within the WMA will be constructed via HDD with minimal workspace. Through the Cordell Hull WMA, the proposed pipeline will be located within the existing 3100 Line permanent ROW with the exception of the Salt Lick Creek crossing, which will be constructed via HDD. Some workspace will be required outside of the permanent ROW to safely construct the Project. A total of 7.8 acres of land within the Cordell Hull WMA will be disturbed during construction; 2 acres of this are within the previously disturbed existing 3100 Line permanent ROW.

[…]

In Morgan County, the [pipeline] crosses approximately 800 feet of the northeastern edge of the Lone Mountain State Forest, which is comprised of about 3,570 acres of forest and managed by the Tennessee Division of Forestry. […] The interpretive natural trail is the nearest trail to the [pipeline] area and is located approximately 300 feet southeast of the [pipeline] (Tennessee Department of Agriculture 2022). Through the Lone Mountain State Forest, the proposed pipeline will be located wholly within the existing 3100 Line permanent ROW. Some workspace will be required outside of the permanent ROW to safely construct the [pipeline]. A total of 2.1 acres of land within the Lone Mountain State Forest will be disturbed during construction, of which 0.9 acre is within the previously disturbed existing 3100 Line permanent ROW. No new permanent ROW will be required through the forest.

[…]

A review of conservation easements identified one site crossed by the [pipeline] – the Dixona Farm, located near MP 11.7 in Smith and Trousdale counties. […] While a map of the farm features is not available, the [pipeline] appears to cross an area of open pasture; the nearest structure is approximately 700 feet south of the [pipeline]. A total of 4.0 acres of land within the Dixona Farm will be disturbed during construction, of which 1.6 acres is within the previously disturbed existing 3100 Line permanent ROW. No new permanent ROW will be required through the Dixona Farm.

[…]

Near MP 101.9 in Morgan County, the [pipeline] crosses a portion of the Justin P. Wilson Cumberland Trail State Park, also known as the Cumberland Trail. While

> publicly available GIS data from TDEC indicates that the [pipeline] would cross the Cumberland Trail, maps of the Trail system show the trail ending in the town of Wartburg (Cumberland Trail State Scenic Trail 2022). [ETNG] will coordinate with TDEC to determine the extent of the Cumberland Trail in the [pipeline] Area (ETNG 2022i).

In sum, based on the analysis in the ETNG Resource Reports, which TVA has independently assessed and adopts as its own, the proposed natural gas pipeline under Alternative A is anticipated to temporarily disturb 21 acres of natural and recreational resources during construction, 7.6 of these acres are within the previously disturbed existing 3100 Line permanent ROW.

For the resources proposed to be crossed by ETNG's proposed project, ETNG would coordinate planning and construction with landowners to ensure continued recreational use during construction (to the extent practicable) and operation of the pipeline. At the time of this report, ETNG is consulting with the TWRA, NPS, and USACE regarding potential impacts to the properties described above in order to identify minimization and mitigation measures.

According to ETNG's Resource Report 8 (ETNG 2022i), effects on natural and recreational resources from construction of the pipeline would be:

> […] temporary and may include trail closures or re-routes around active construction. Temporary effects on recreational users may also include noise and visual disturbance from construction equipment and construction activities. Mitigation measures during construction may include flagging of work zones, signage, re-routes, and/or closure notifications. There would be no long-term effects to use of the lands during operation of the [pipeline].

TVA has independently reviewed and concurs with the natural areas, parks, and recreation-related findings in ETNG's Resource Report 8 (ETNG 2022i).

3.9.2.3.7 Summary of Alternative A

TVA Actions

Minor but temporary adverse effects could occur to recreational uses of the sections of the Emory and Clinch rivers adjacent to the Kingston Reservation. Public access to the boat launching ramp located in the Kingston Reservation boundary could be temporarily interrupted during construction or deconstruction activities. Adverse effects to boat launching activities would be temporary and minor during construction. Because of the temporary nature of transmission upgrades, off-site transmission impacts on dispersed outdoor recreational activities, as well as natural areas and parks, would only include minor and temporary impacts from construction traffic along the corridors aside from areas where corridors directly intersect with managed forested areas. Any tree clearing required would be maintained as open space and cause permanent moderate impacts to these recreation sites.

ETNG Actions - Natural Gas Pipeline and Associated Structures

The proposed pipeline under Alternative A is anticipated to temporarily disturb 21 acres of natural and recreational resources during construction. The minor temporary adverse effects to these resources would result from construction-related effects from increased local traffic and noise and visual disturbances from construction activity.

3.9.2.3.8 Environmental Justice Considerations

TVA Actions
Effects to natural areas, parks, and recreation that would occur as a result of the proposed construction and operation of facilities under Alternative A that may in turn affect EJ populations include the temporary closure of hunting and fishing opportunities during construction.

Additionally, temporary effects to the recreational use of the Clinch River that may occur during CC/Aero CT Plant construction could in turn affect EJ populations that utilize these areas. Effects experienced by EJ populations may be amplified based on reduced ability, financial or otherwise, to travel to alternative recreational sites, resulting in the temporary inability to hunt and fish for sustenance in these areas.

ETNG Actions - Natural Gas Pipeline and Associated Structures
Effects to natural areas, parks, and recreation that would occur as a result of the proposed construction and operation of the proposed pipeline and associated structures under Alternative A that may in turn affect EJ populations include the temporary closures of recreational facilities and potential inaccessibility of hunting and fishing opportunities during construction and an increase in noise and visual disturbances from construction equipment and activities. EJ populations that hunt, fish, and forage for sustenance near impacted natural and recreation areas may experience amplified effects due to the construction of the pipeline in Alternative A. Effects experienced by EJ populations may be amplified based on reduced ability, financial or otherwise, to travel to alternative recreational sites, resulting in the temporary inability to hunt and fish for sustenance in these areas. ETNG is still evaluating effects of their proposed project and resulting changes will be incorporated into TVA's final EIS.

3.9.2.4 Alternative B

3.9.2.4.1 Construction and Operations of Solar and Storage Facilities

Because the exact project locations for solar and/or storage projects are not known at this time, TVA has compiled a list of typical impacts associated with the construction and operation of PV facilities within the TVA region. This list was compiled by reviewing the EAs and EISs for PV projects, ranging from community scale to utility scale, between 2014 through 2022. Based on the review of 31 projects presented in Table 3.2-1, it was found that only 6.5 percent of solar projects affected parks and public lands. Based on the assumption of 15 or more 100-MW solar sites to generate at least 1,500 MW, approximately 1 site would result in effects to parks and public lands.

Individual facilities would be sited to avoid effects to natural areas, parks, and other developed recreation areas and designed to reduce any visual effects to nearby areas wherever possible. Solar and storage facilities would eliminate informal recreational uses, such as hunting from the 10,950 acres proposed to be developed. The land area required for battery storage facilities is typically only a few acres and construction-related effects are minor. Operational effects are also minor with adherence to typical mitigation measures and BMPs.

Future projects in the geographic area of analysis that include use of undeveloped lands to support industrial or other intensive developments could reduce the availability of lands suitable for recreation. In addition to the proposed construction of at least 1,500 MW of solar facilities and 2,200 MW of storage under Alternative B, TVA is proposing to add 10,000 MW of solar by 2035 to meet customer demands and system needs. This would decrease the amount of potentially available land to support dispersed outdoor recreation activities, such as hunting, fishing, or nature observation. The combined effect of these future land development actions and Alternative B would be a reduction in resources for dispersed recreation. However, in view of the relatively large amounts of rural and undeveloped lands within the counties selected, cumulative impacts on dispersed recreation opportunities are expected to be minor. Because developed outdoor recreation areas are largely located a sufficient distance from the solar or storage project sites, no direct, indirect, or cumulative impacts on these resources is expected.

3.9.2.4.2 Transmission and Other Components

New transmission line connections, substations, etc., would typically be on or immediately adjacent to the solar/storage facility site, and they would be planned to minimize adverse impacts to natural areas, parks, and recreation areas where possible. New transmission lines would eliminate forested areas within the corridor, which could have permanent impacts on natural and recreational activities in the area.

A review of past solar PPA projects reflected an average of approximately 17.7 acres of permanent effects as a result of access roads, transmission interconnections, and upgrades for each solar facility. Based on the assumption of 15 or more 100-MW solar sites, approximately 266 acres would be affected. Upgrades are typically performed to increase the electrical capacity of the existing transmission lines and would include the items listed in Section 2.1.3.5.2.

The land area required for battery storage facilities typically ranges from only a few acres up to 828 acres and construction-related impacts are minor. Operational impacts are also minor with adherence to typical mitigation measures and BMPs.

3.9.2.4.3 Environmental Justice Considerations

Effects to recreation areas that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to have amplified effects on EJ populations because natural areas, parks, and recreation sites would generally be avoided for solar facilities. However, specific effects on EJ populations would be more fully evaluated for individual solar and storage facilities.

3.10 Land Use

Use of federal and state lands is generally regulated by laws establishing the various agencies, as well as other laws and regulations. For example, the TVA Act gives TVA the authority to regulate the use of lands it manages as well as development across, along, or in the Tennessee River or any of its tributaries. The Farmland Protection Policy Act of 1981 (7 U.S.C. 4201 et seq.) recognizes the importance of prime farmland. Various state laws and local ordinances also regulate land use, although a large portion of land in the TVA region is not subject to local zoning ordinances (TVA 2019b).

3.10.1 Affected Environment

3.10.1.1 Kingston Reservation (No Action Alternative and D4 Activities)

Land use is defined as the way people use and develop land, including leaving land undeveloped or using land for agricultural, residential, commercial, and industrial purposes. Much of the construction under Alternative A would be on the 2,254-acre Kingston Reservation near the city of Kingston in unincorporated Roane County (Figure 2.1-5). This site offers the advantages of (1) having been previously disturbed within existing TVA property and (2) having existing transmission interconnection to the TVA transmission system. The proposed options for the CC/Aero CT Plant site include mostly previously disturbed areas. The Tennessee Trustee classifies the project area, including the project site, as commercial (Tennessee Trustee 2022).

Images generated with the National Land Cover Dataset (NLCD) evaluation, visualization, and analysis tool show the Kingston Reservation as largely deciduous forest, developed medium/high intensity area, and hay/pasture (Figure 3.10-1). The 2022 field investigations revealed a larger percentage of wetlands on the Kingston site and within the boundaries of the proposed CC/Aero CT Plant site than what is depicted on desktop NLCD results (HDR 2022b). See Section 3.6 for more information on field survey findings.

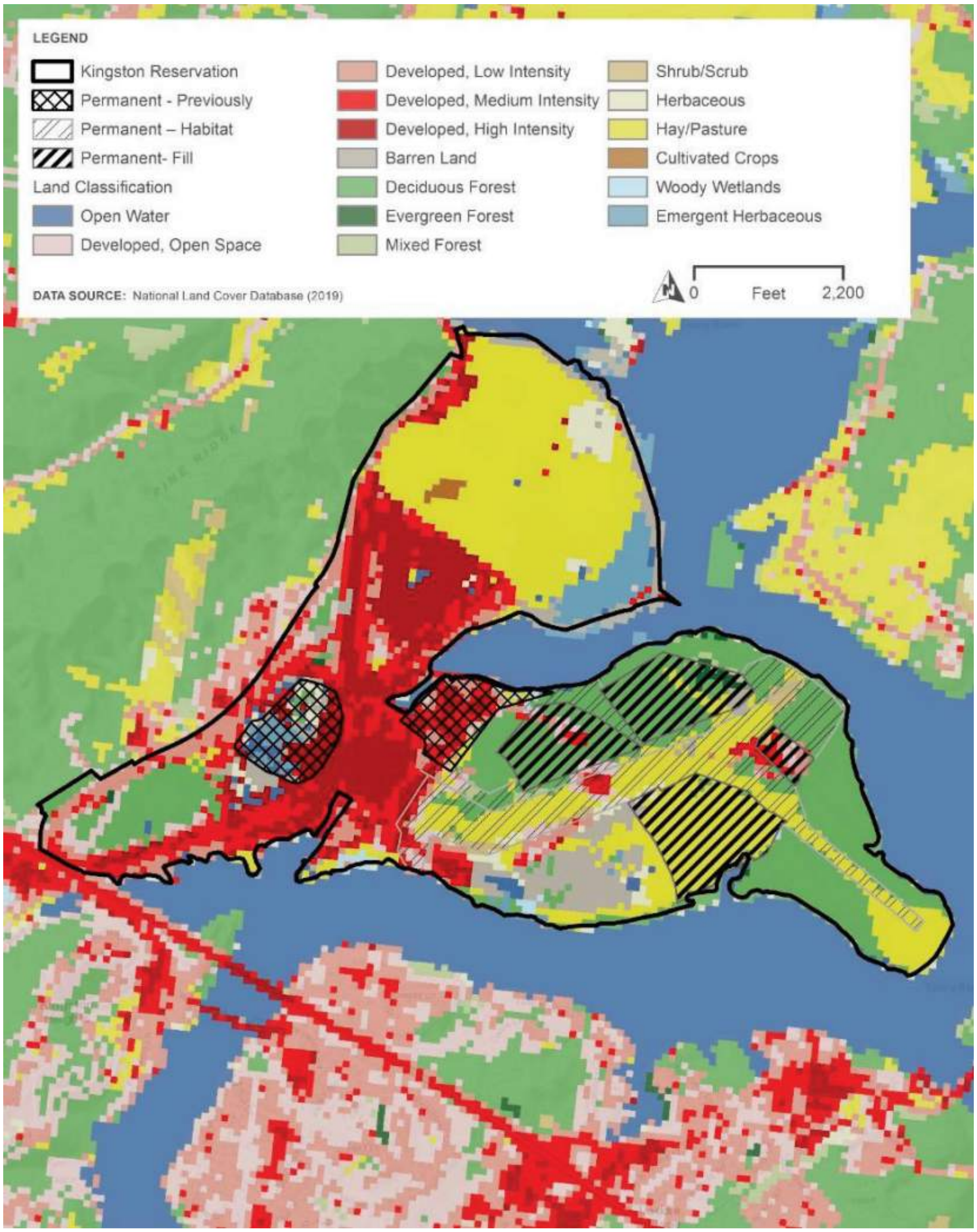

Figure 3.10-1. Land Cover Within and Adjacent to the Kingston Reservation (Source: NLCD 2019)

The Kingston Reservation consists of flat to gently rolling terrain that ranges in elevation from approximately 737 to 922 feet above mean sea level. Topography is highest in the western portion of the reservation, decreasing in elevation towards the northeast (Figure 3.10-2). The Kingston Reservation is located on a peninsula formed by the confluence of the Clinch and Emory rivers approximately 35 miles west of downtown Knoxville. State road TN-22 lies west of the plant, intersecting Swan Pond Rd, which runs along the northern boundary of the plant and allows access to the plant where it intersects with Steam Plant Main Access Rd. A rail line owned by both CSX and Norfolk Southern runs through the plant and makes a loop around the northeastern section, which contains the ash pile, a pond, and a large, forested area (TVA 2019c). A historic cemetery, the Green Cemetery, is located on the KIF Reservation but is outside the project footprint.

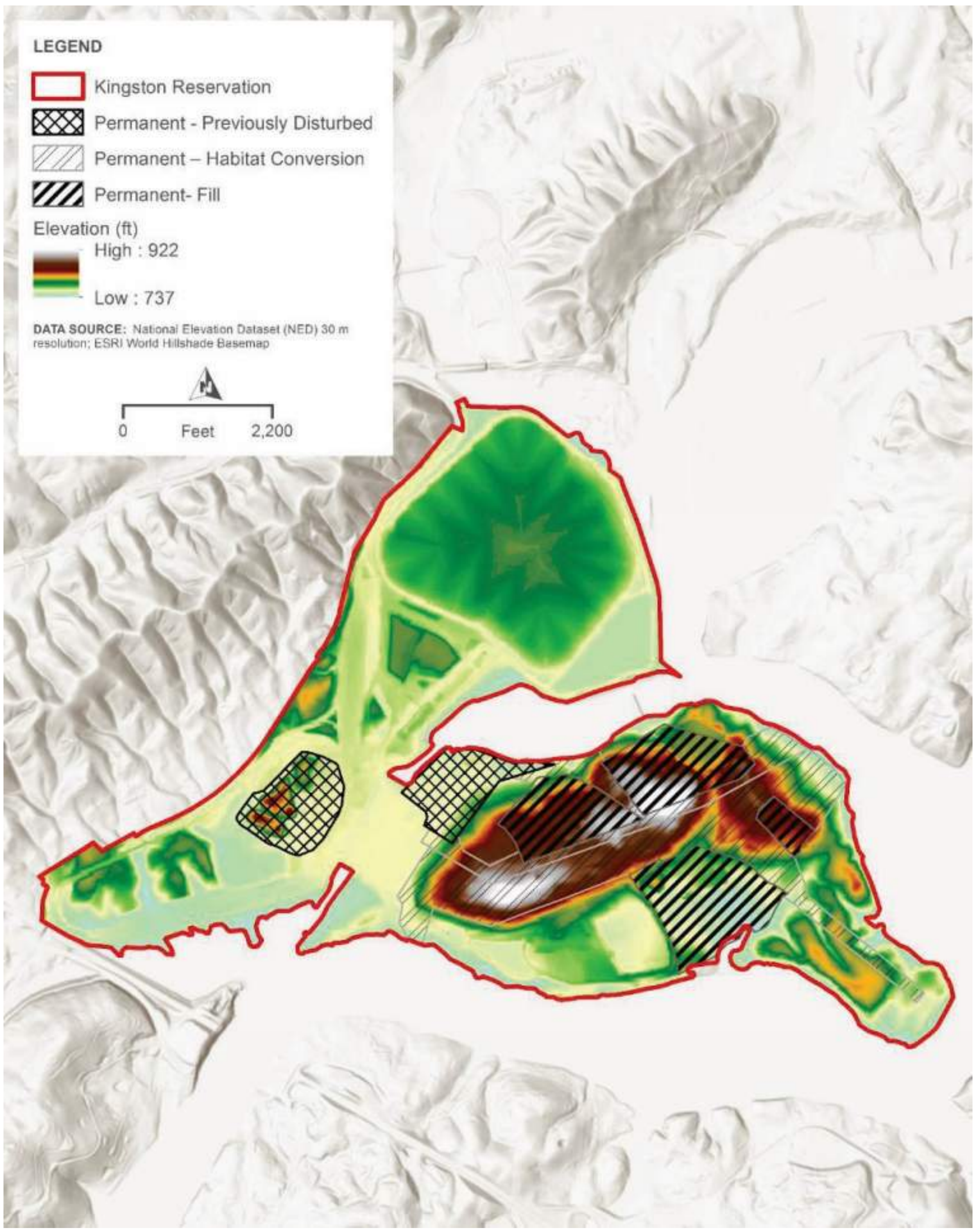

Figure 3.10-2. Elevation within the Alternative A Proposed Combine Cycle/Aero Combustion Turbine Plant Site and the Kingston Reservation

Forested land makes up most of the land surrounding the reservation to the north. The Swan Pond Cemetery exists approximately 0.25 miles to the northwest of the eastern Kingston Reservation boundary. Several industrial facilities are present alongside Old Highway 149 and Temple Drive southeast of the Kingston Reservation. Small pockets of residences are present along Scotts Chapel Road west of the Reservation. The fossil plant is located near the City of Kingston, which has a population of 5,953 (U.S. Census Bureau [USCB] 2020a). The next closest municipality is the City of Harriman, which contains 5,892 residents and is approximately 5 miles north of the reservation (USCB 2020a).

Available historical aerial photographs and USGS topographic quadrangles indicate land use near the project area undergoing development dating back to the first available map in 1935, which showed the existence of many of the same major roadways and corridors as can be seen today. The construction of the KIF facilities significantly changed the project site in the mid-1950s and 1960s. Industrial development has continued since the coal plant was completed in the 1950s as TVA expanded CCR storage areas and other industrial development, some associated with TVA (e.g., the wallboard plant), mostly to east and southeast of the Kingston Reservation. The acreage and percentage of each land cover type identified from a review of the NLCD (2019) for the Kingston Reservation, including the proposed Alternative A CC/Aero CT Plant site, are summarized in Table 3.10-1.

Table 3.10-1. Land Cover Within the Kingston Reservation

NLCD Land Cover Type	Area (Acres)	% of Total Land
Barren Land	74.55	5.94
Cultivated Crops	3.04	0.24
Deciduous Forest	279.02	22.23
Developed; High Intensity	163.06	12.99
Developed; Low Intensity	79.02	6.3
Developed; Medium Intensity	129.77	10.34
Developed; Open Space	34.15	2.72
Emergent Herbaceous Wetlands	33.72	2.69
Evergreen Forest	5.95	0.47
Hay/Pasture	381.57	30.4
Herbaceous	27.88	2.22
Mixed Forest	4.38	0.35
Open Water	25.01	1.99
Scrub/Shrub	8.45	0.67
Woody Wetlands	5.59	0.45
Total	**1,255.16**	**100.0%**

Source: NLCD 2019

3.10.1.2 Alternative A

3.10.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The proposed CC/Aero CT Plant location consists of 55 acres within the eastern portion of the Kingston Reservation, where land use consists largely of hay/pasture fields. The proposed switchyard is 8.5 acres of developed medium and low-density land (Figure 3.10-1).

The acreage and percent of each land cover type identified from a review of the NLCD (2019) for the components associated with the proposed Alternative A are summarized in Table 3.10-2.

Table 3.10-2. Land Cover Within the Alternative A Footprints on Kingston Reservation

Land Cover Type	CC/Aero CT Plant		Switchyard		3-4-MW Solar Site		Battery Site 1		Battery Site 2		Battery Site 3		Battery Transmission Connects		On-site Transmission Upgrades	
	Area (ac.)	% of Total Area	Area (ac.)	% of Total Area	Area (ac.)	% of Total Area	Area (ac.)	% of Total Area	Area (ac.)	% of Total Area	Area (ac.)	% of Total Area	Area (ac.)	% of Total Area	Area (ac.)	% of Total Area
Barren Land	0.73	1.33		0.00%	4.26	12.18		0		0	1.58	3.96	0.51	1.24	1.15	0.9
Cultivated Crops		0		0		0		0		0		0		0		0
Deciduous Forest	2.04	3.71	1.01	11.85	1.51	4.31	0.56	1.86	29.31	83.75	30.56	76.4	25.37	61.87	25.61	20.01
Developed; High Intensity		0	0.24	2.86	12.89	36.82	8.16	27.2		0		0	0.56	1.36	2.07	1.62
Developed; Low Intensity		0	2.98	35.02		0	5.09	16.97	1.33	3.81		0	1.03	2.51	4.71	3.68
Developed; Medium Intensity		0	2.42	28.43	1.3	3.71	10.85	36.16	1.59	4.55		0	0.9	2.18	7.39	5.78
Developed; Open Space		0	1.05	12.33		0	1.35	4.49	2.72	7.76		0	2.64	6.43	7.52	5.88
Emergent Herbaceous Wetlands		0		0	6.41	18.32	0.23	0.77		0		0	0.13	0.33		0
Evergreen Forest		0		0		0	0.06	0.21		0	3.16	7.9	0.22	0.53		0
Hay/Pasture	50.47	91.76	0.39	4.59		0	1.97	6.57		0	3.87	9.68	5.38	13.12	69.6	54.37
Herbaceous	0.81	1.48		0	3.65	10.44		0		0		0		0	3.06	2.39
Mixed Forest		0		0		0		0	0.04	0.12	0.86	2.14	2	4.87	0.19	0.14
Open Water		0		0	4.85	13.85	0.41	1.37		0		0	0.55	1.33		0
Scrub/Shrub		0	0.42	4.93		0		0		0		0	1.06	2.59	6.33	4.95
Woody Wetlands	0.18	0.33		0		0	0.92	3.06		0		0	0.41	1.01		0
Total Acres	**54.2**		**8.5**		**35**		**31**		**35**		**40**		**41.4**		**128**	

3.10.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.10.1.1 apply to the proposed 3- to 4-MW solar facility location on the Kingston Reservation. The proposed solar facility would occupy 35 acres of mostly developed high density land, which is the existing coal yard used for the KIF (Figure 3.10-1, Table 3.10-2).

3.10.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.10.1.1 apply to the proposed 100- MW BESS on the Kingston Reservation. Battery Site 1 is 30 acres of mostly developed high and medium density land; Battery Site 2 is 35 acres of deciduous forest; and Battery Site 3 is 40 acres of mostly deciduous forest (Figure 3.10-1, Table 3.10-2).

3.10.1.2.4 On-site Transmission

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant and switchyard. TVA would also install a new transmission line for the proposed battery facility. Therefore, the affected environment for on-site transmission upgrades is described in Section 3.10.1.1.

3.10.1.2.5 Off-site Transmission

Under Alternative A, TVA would make improvements to existing transmission lines, five within the vicinity of the Kingston Reservation (L5108, L5302, L5381, L5280, L5116) and one in Crossville (L5383). Descriptions of these improvements are provided in Section 2.1.3.5.2. Existing land use for each transmission line is defined below.

3.10.1.2.5.1 Eastern Transmission Corridor

Transmission Lines L5108, L5302, L5381, L5280, and L5116 extend from the current Kingston Reservation travelling eastbound and terminate in the city of Oak Ridge. Transmission line L5302 extends from the current Kingston Reservation eastward and terminates at the ORNL on Bethel Valley Road, near the city of Oak Ridge. Several access roads are proposed largely along routes that have already been cleared.

Land use within the Eastern Transmission Corridor according to the NLCD, is summarized in Table 3.10-3 and is largely hay/pasture and forest land with smaller areas of developed space and open water (Figure 3.10-3a through Figure 3.10-3d). There is slight variability in elevation across the transmission line corridor. Generally, the corridor has low relief with a maximum elevation of approximately 1,185 feet and a minimum elevation of 737 feet (Figure 3.10-4a through Figure 3.10-4d).

Table 3.10-3 Land Cover Within and Adjacent to the Proposed Alternative A Eastern Transmission Corridors

NLCD Land Use	Area (acres)	Percent of Total Land
Barren Land	3.0	0.2
Deciduous Forest	442.3	27.46
Developed, High Intensity	14.8	0.9

NLCD Land Use	Area (acres)	Percent of Total Land
Developed, Low Intensity	133.3	8.3
Developed, Medium Intensity	55.0	3.4
Developed, Open Space	191.0	11.9
Emergent Herbaceous Wetlands	1.2	<0.1
Evergreen Forest	12.3	0.8
Hay/Pasture	556.7	34.6
Herbaceous	27.0	1.7
Mixed Forest	41.1	2.6
Open Water	19.1	1.2
Shrub/Scrub	86.1	5.4
Woody Wetlands	26.3	1.6
Total	**1,609**	**100**

Source: NLCD 2019

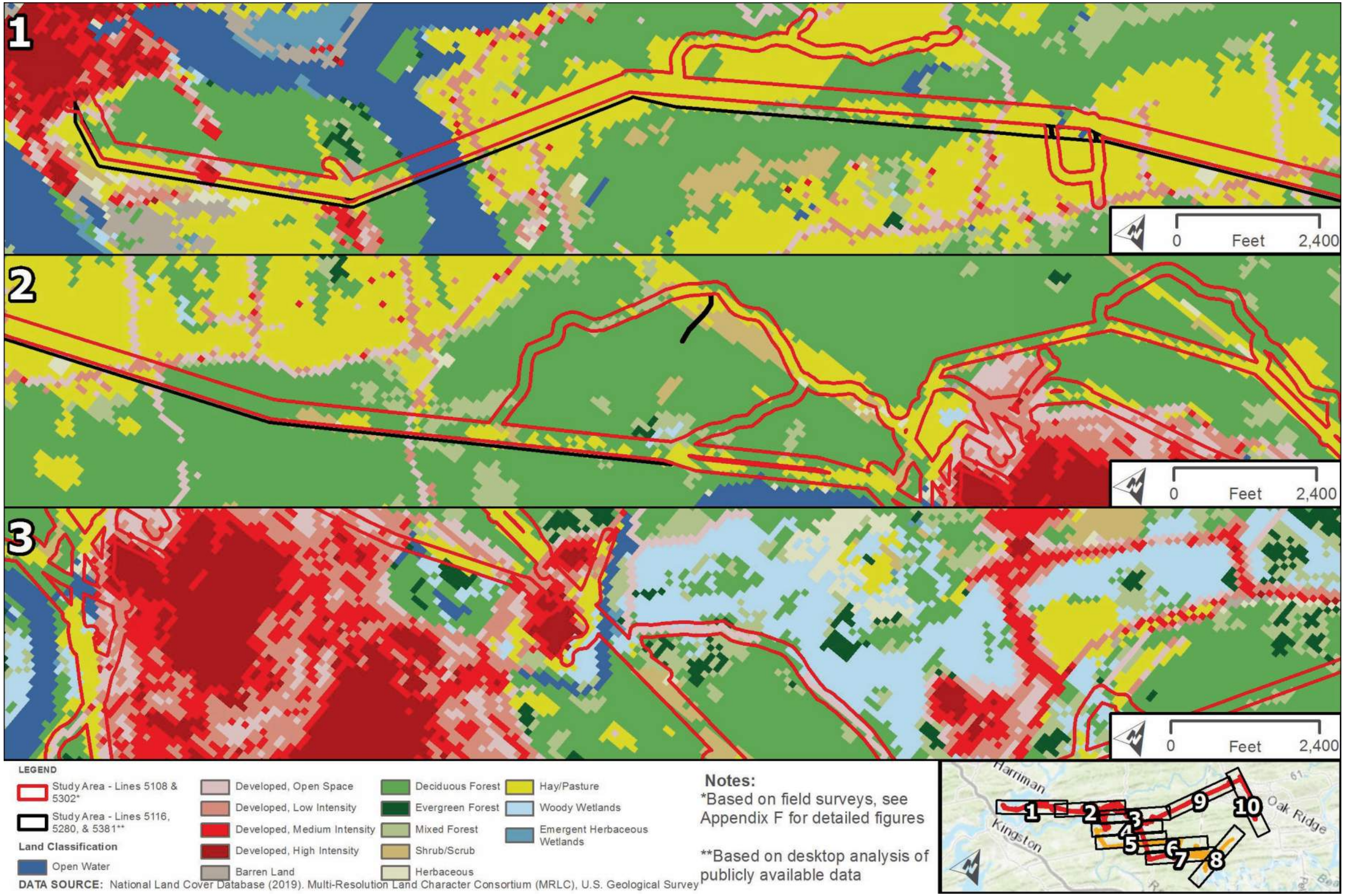

Figure 3.10-3a. Land Cover Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor (Source: NLCD 2019)

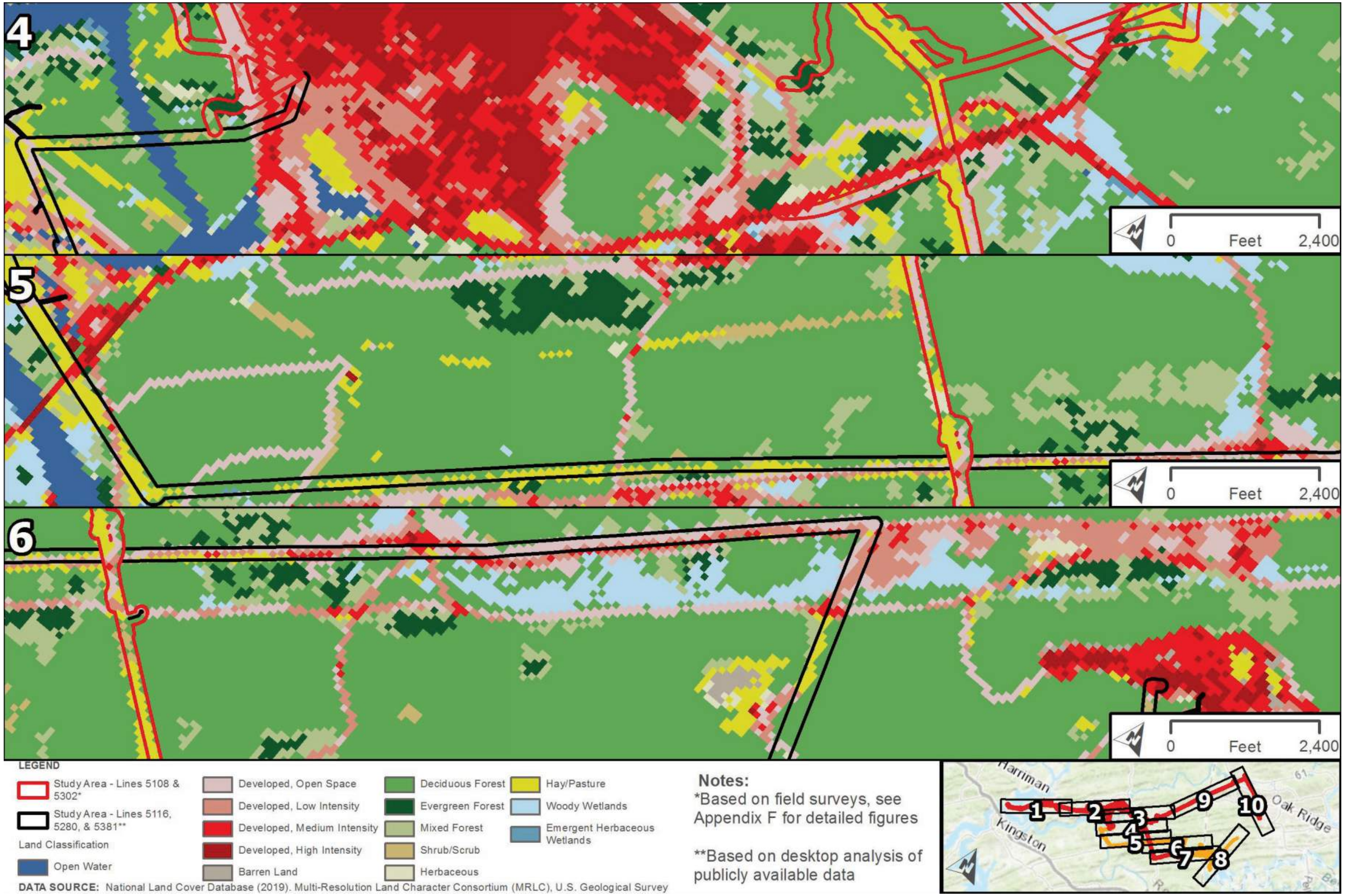

Figure 3.10-3b. Land Cover Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor (Source: NLCD 2019)

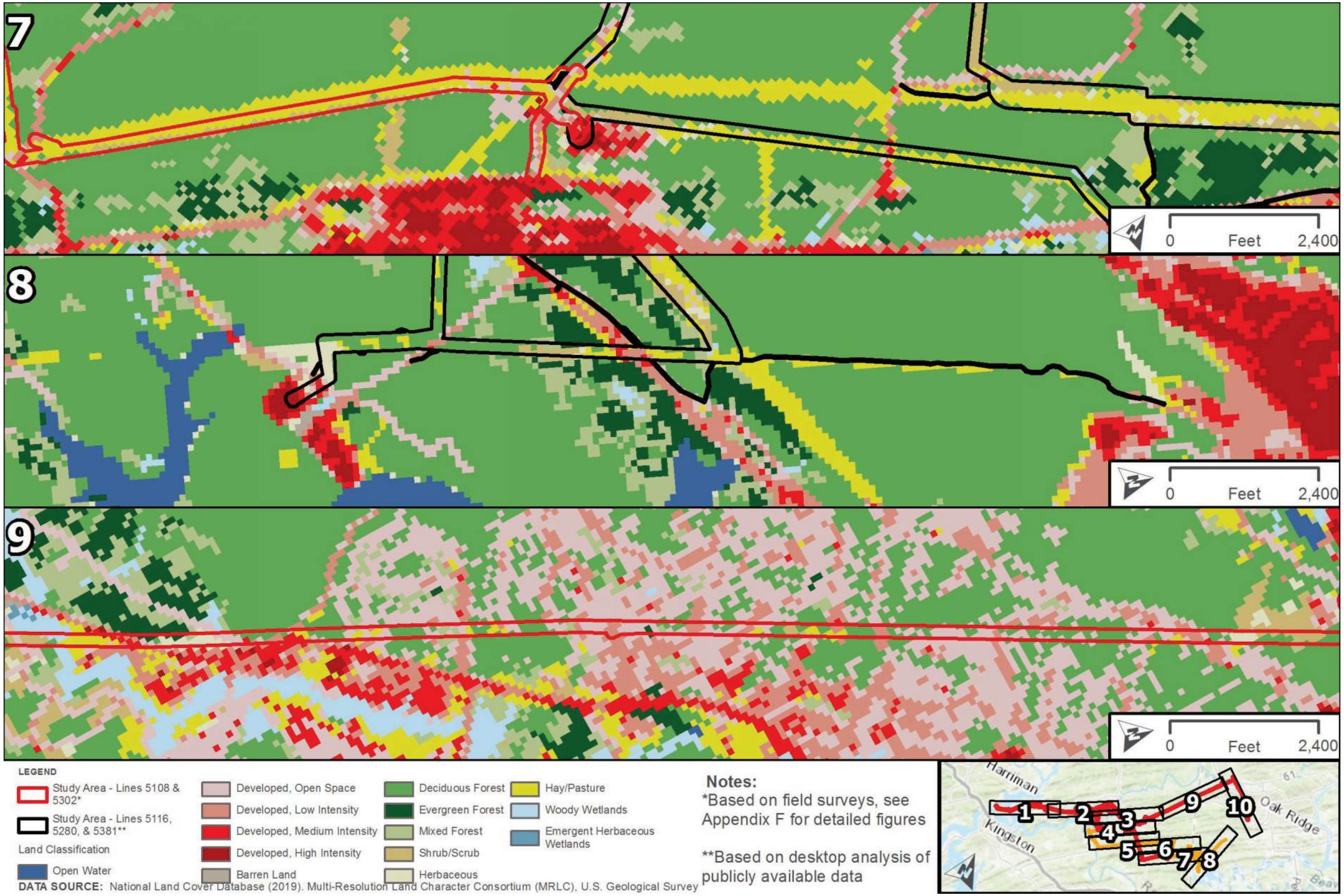

Figure 3.10-3c. Land Cover Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor (Source: NLCD 2019)

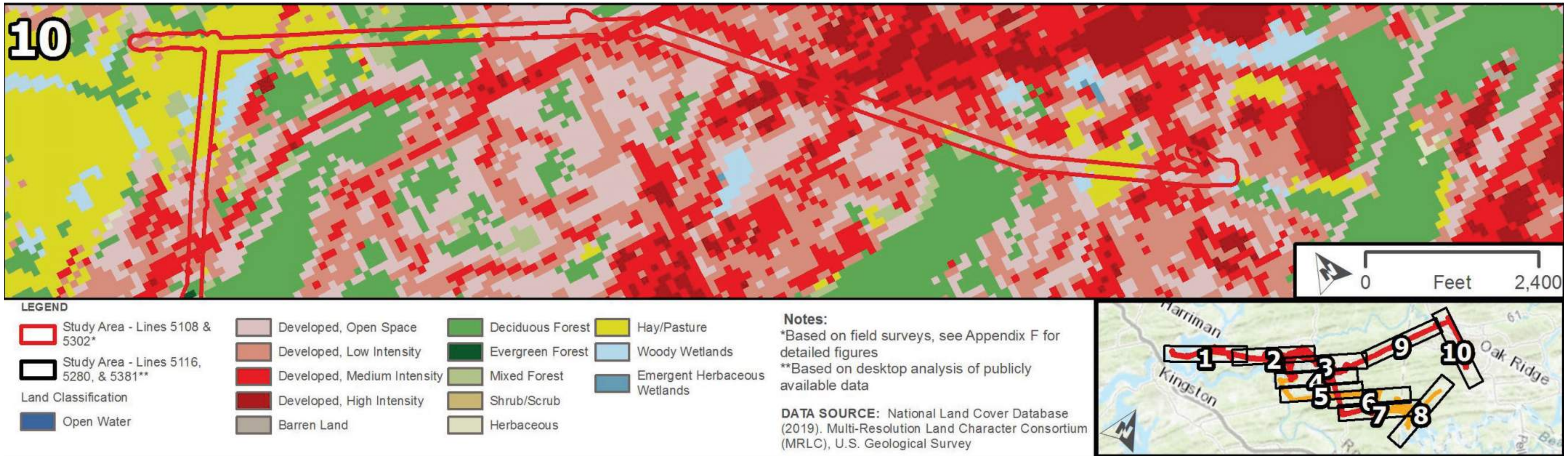

Figure 3.10-3d. Land Cover Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor (Source: NLCD 2019)

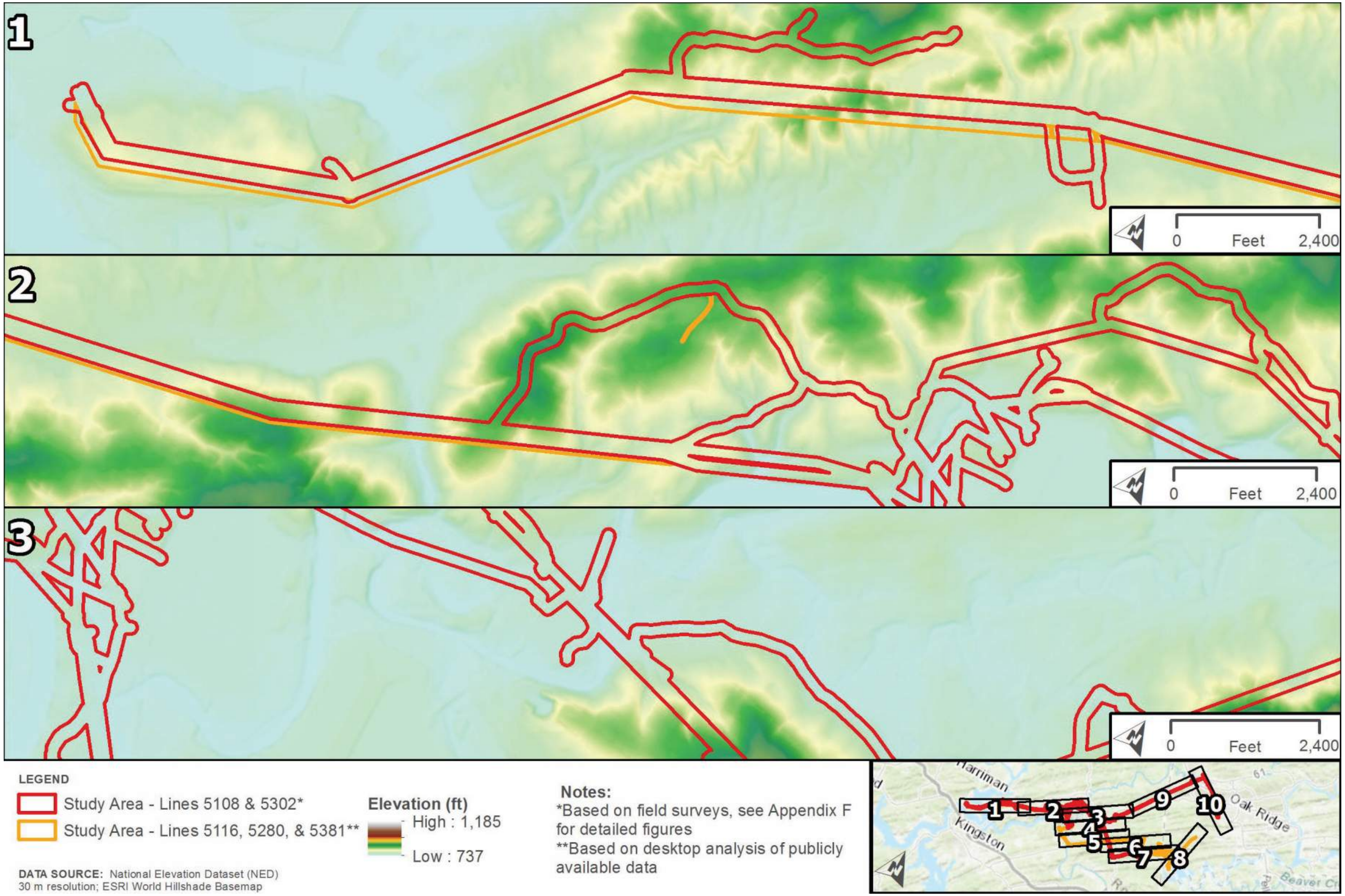

Figure 3.10-4a. Elevation Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

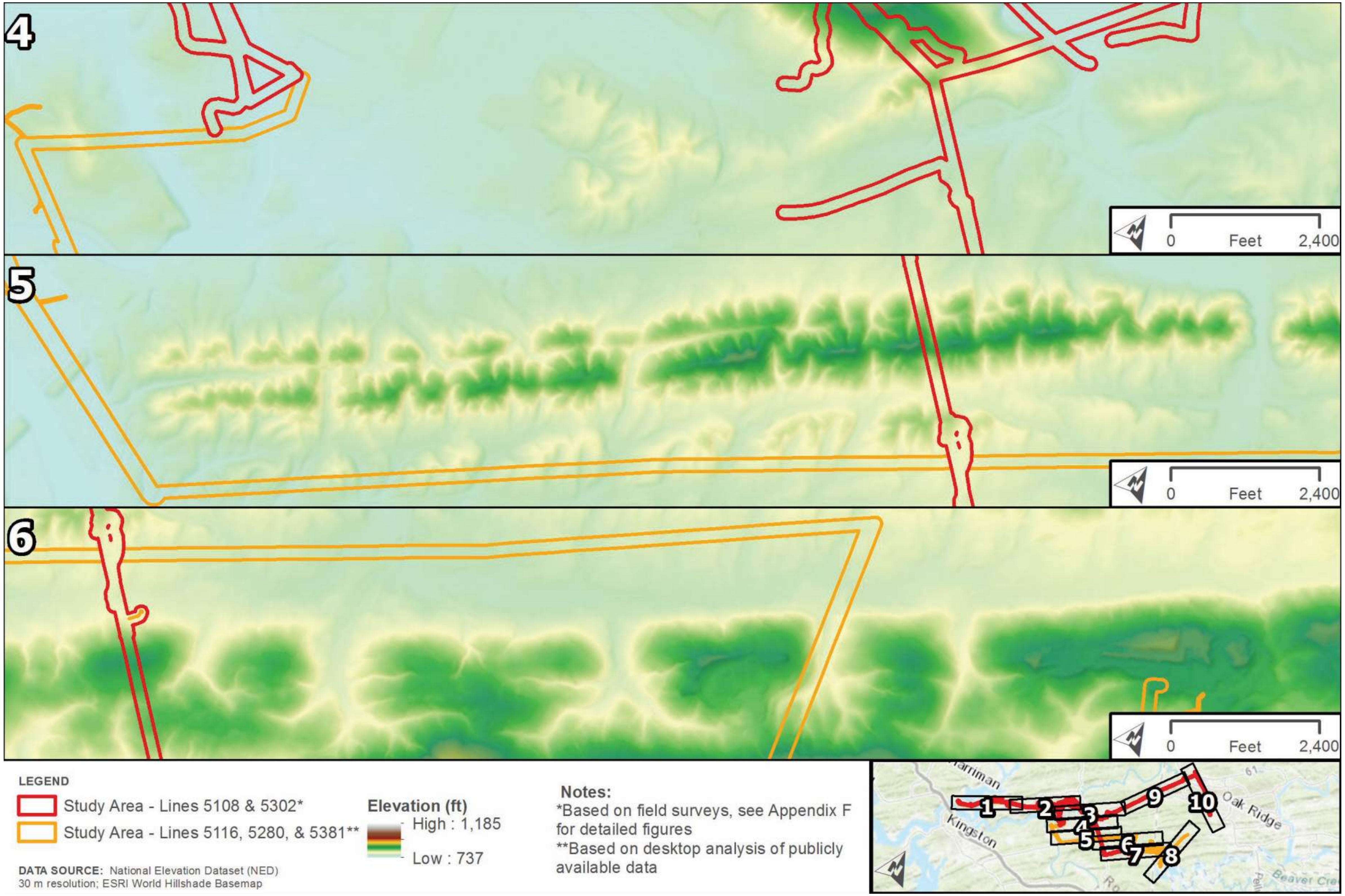

Figure 3.10-4b. Elevation Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

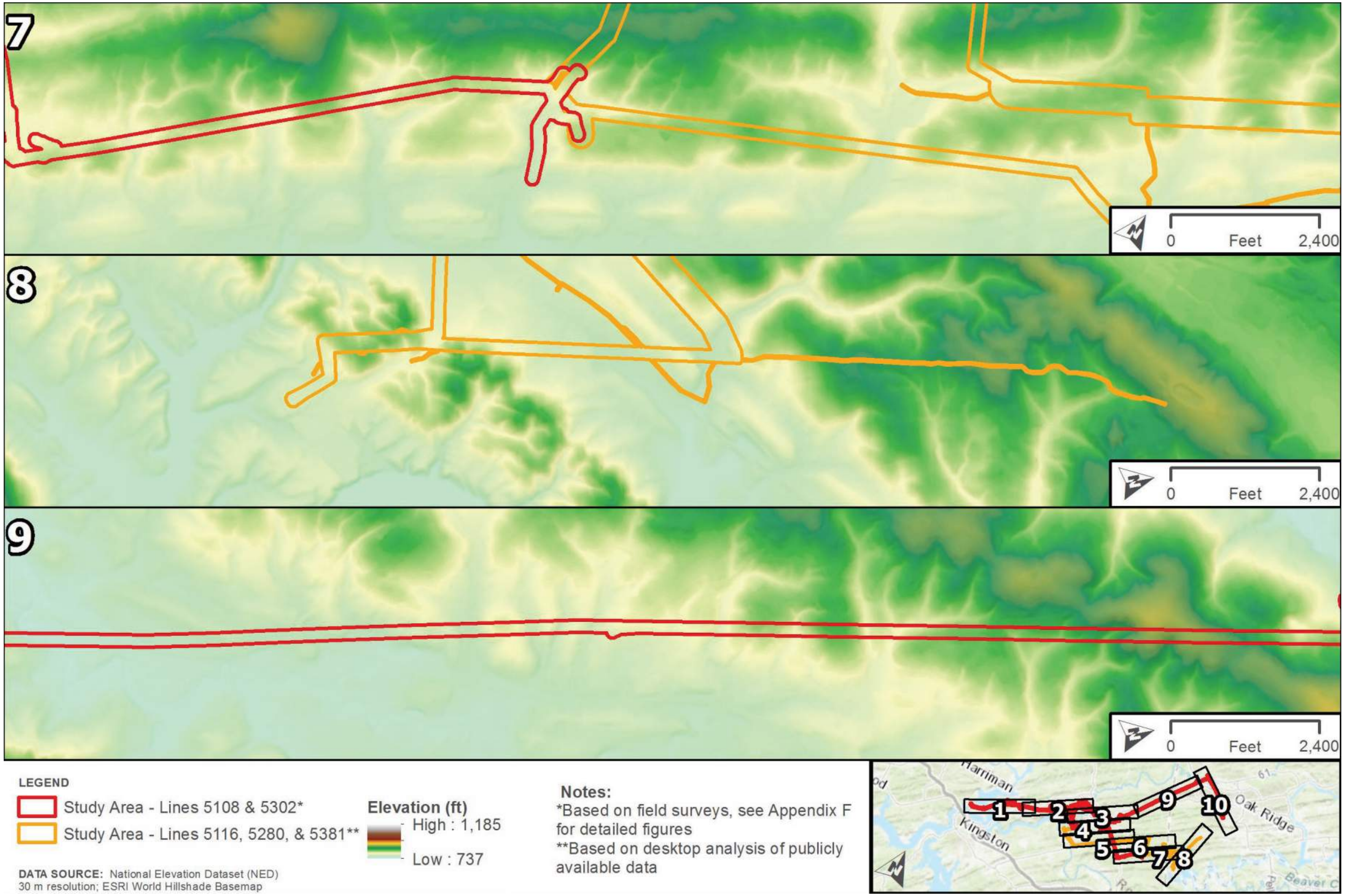

Figure 3.10-4c. Elevation Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

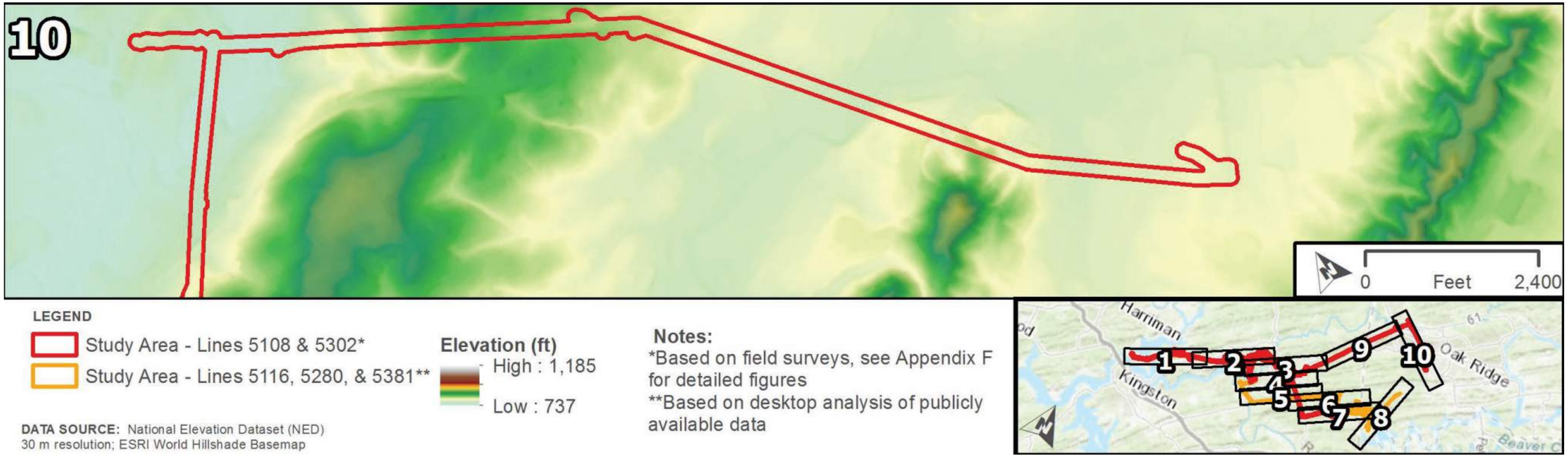

Figure 3.10-4d. Elevation Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Eastern Transmission Corridor

3.10.1.2.5.2 Western Transmission Corridor

Transmission line L5383 extends southeastward from a substation in unincorporated Crossville on Plateau Road and terminates north of the Crossville city limits. Land use within the Western Transmission Corridor is summarized in Table 3.10-4 and is largely hay/pasture with small areas of cleared forest land and developed space (Figure 3.10-5). Elevation is fairly consistent with a minimum of 1,659 feet and a maximum of 2,041 feet across the corridor with slight dips near waterbodies (Figure 3.10-6). Several access roads are proposed along the route in agricultural areas.

Table 3.10-4. Land Cover Within and Adjacent to the Proposed Alternative A Transmission L5383 Corridor

NLCD Land Use	Area (acres)	% of Total Land
Barren Land	0.57	0.4
Deciduous Forest	11.0	9.1
Developed, Low Intensity	3.0	2.5
Developed, Medium Intensity	2.2	1.8
Developed, Open Space	3.1	2.6
Hay/Pasture	81.0	66.9
Herbaceous	6.8	5.6
Mixed Forest	4.8	4.0
Shrub/Scrub	8.7	7.2

Source: NLCD 2019

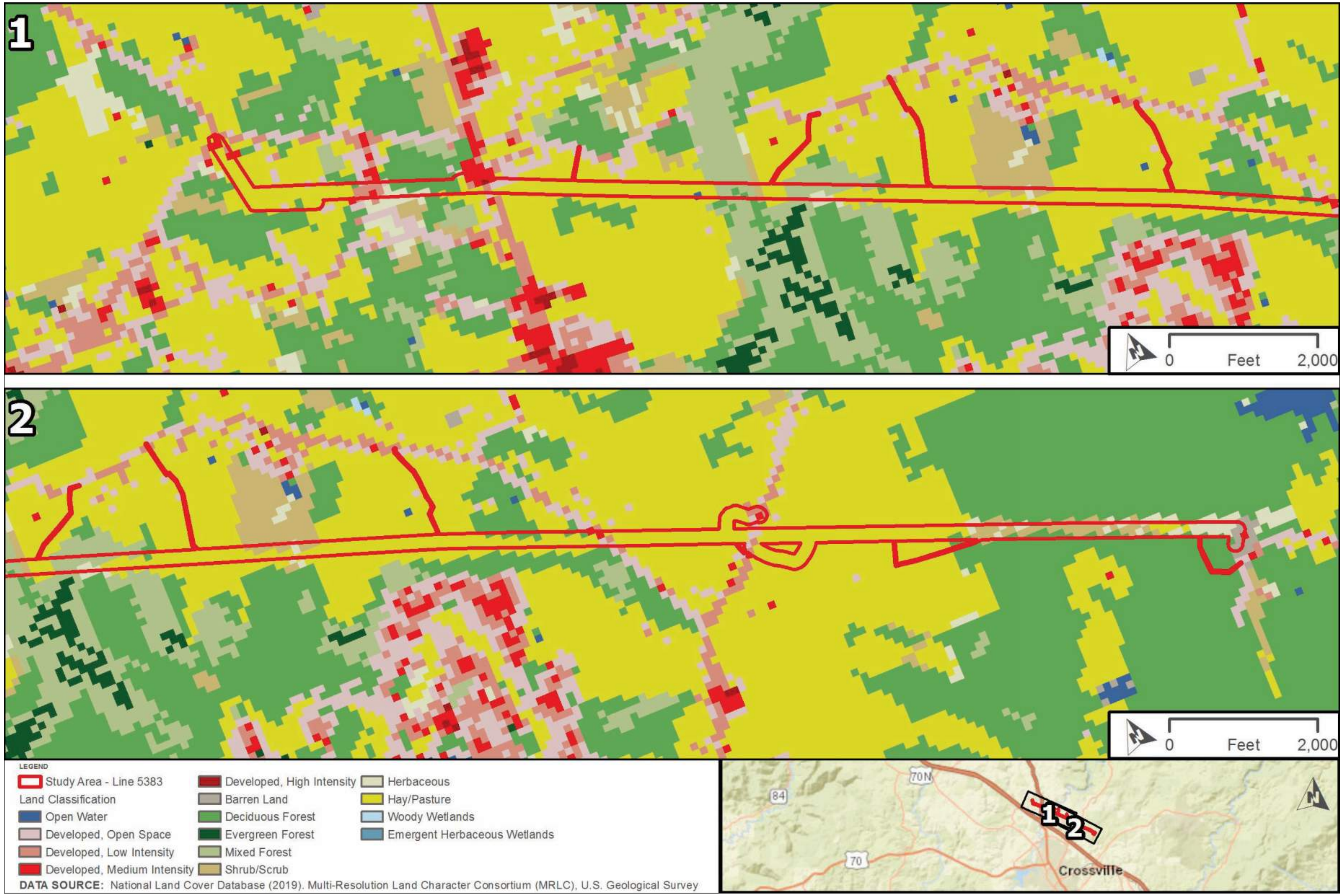

Figure 3.10-5. Land Cover Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Western Transmission Corridor (Source: NLCD 2019)

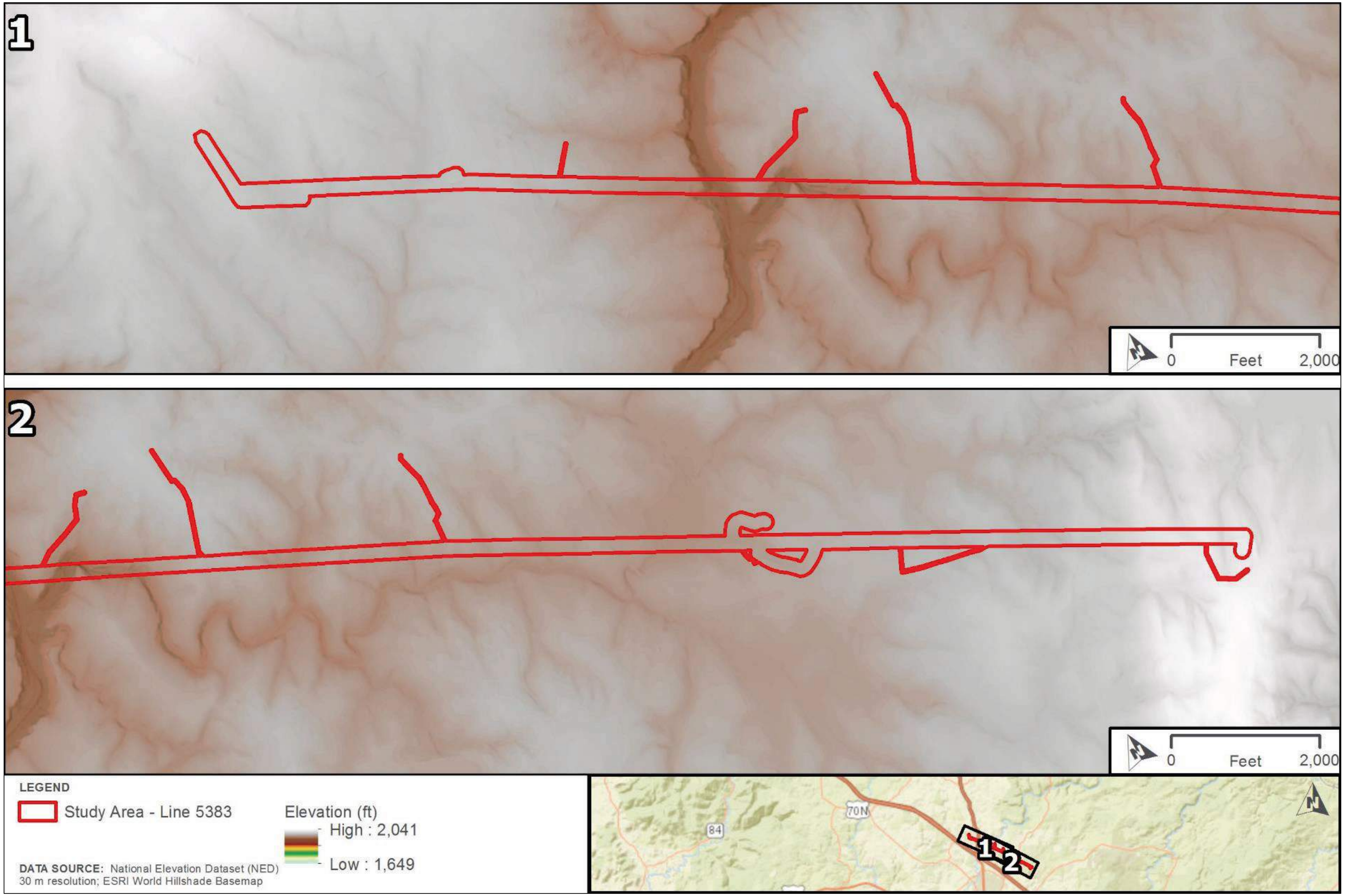

Figure 3.10-6. Elevation Within and Adjacent to the Proposed Alternative A Transmission Line Upgrades Along the Western Transmission Corridor

3.10.1.2.6 Construction and Operation of a Natural Gas Pipeline

Land use categories were identified in the ETNG Construction ROW based on the NLCD (Appendix D-5) and consist of agriculture, forest/woodland, wetland, open land, residential, industrial/commercial lands, and open water. A summary of the land use categories within the study area is provided in Table 3.10-5 and Table 3.10-6 (NRCS 2022). ETNG currently estimates that the acreage required for pipeline construction is approximately 1,873 acres with 722 acres being required for operations (ETNG 2022i). Elevations vary from low to high within the ETNG Construction ROW as it traverses five physiographic provinces including the peaks and valleys of the Valley and Ridge province, as illustrated in Figure 3.10-4a through Figure 3.10-4d.

Table 3.10-5 Land Cover Within and Adjacent to the Proposed Alternative A ETNG Construction ROW

Land Cover Types	Miles Crossed	% of Total ETNG Construction ROW
Open Land	18.0	15
Agricultural	51.1	42
Forested	46.3	38
Industrial/Commercial	2.5	2
Residential	0.7	<1
Open Water	0.8	<1
Wetland	3.0	2

Source: ETNG 2022i

The predominate land use within the proposed Hartsville Compressor Station footprint is agriculture, with smaller areas of forest, industrial, open land, open water, and wetlands. The Columbia M&R Station vicinity is predominantly agricultural with smaller areas of forest and wetland, and the Texas Eastern and Midwestern Gas M&R area is industrial. The total workspace required for construction of the aboveground facilities associated with the gas pipeline is 83 acres. Approximately 27 acres would be required for operation.

Table 3.10-6. Land Cover Within and Adjacent to the Proposed Aboveground Facilities

Facility	Tennessee County	Existing or New	Existing Land Uses	Predominate Land Use	Construction (acres)	Operation (acres)
Hartsville Compressor Station	Trousdale	New	AG, FW, ID, OL, OW, W	AG	67.6	15.8
Columbia M&R Station	Trousdale	New	AG, FW, W	AG	8.2	3.9
Texas Eastern and Midwestern Gas M&R	Trousdale	Existing	ID	ID	0.9	0.9
Kingston M&R Station	TBD	New	TBD	TBD	TBD	TBD
Gainesboro Crossover	Jackson	New	AG	AG	3.6	3.6
Clarkrange Crossover	Fentress	New	FW, OL	FW	2.7	2.7
Harriman Lateral Crossover	TBD	New	TBD	TBD	TBD	TBD
Kingston Receiver Site	Roane	New	ID	ID	0.1	0.1

Source: ETNG 2022i

a/ Existing land uses within the proposed facility sites. OL = Open Land (non-agricultural), AG = Agricultural, FW = Forested/Woodland, ID = Industrial/Commercial, RE = Residential, OW = Open Water, W = Wetland

b/ Construction requirements for aboveground facilities are comprised of the permanent operation area, temporary workspace, and ATWS where applicable.
c/ Acreage includes all areas inside perimeter fencing. Temporary construction workspace outside of these areas are to be restored.

3.10.1.3 Alternative B

3.10.1.3.1 East Tennessee TVA Power Service Area

TVA anticipates that a portion of the solar facilities proposed under Alternative B would need to be located within portions of the East Tennessee region in order to offset transmission system upgrades that may be required following the retirement of KIF.

Forestland is predicted to decrease between 1997 and 2060 in the majority of counties in the TVA region, with several counties in the vicinity of Memphis, Nashville, Huntsville, Chattanooga, Knoxville, and the Tri-Cities area of Tennessee predicted to lose more than 25 percent of forest area (Wear and Greis 2013). Loss of forest area within the TVA region is primarily a result of increasing urbanization and development. Most of the TVA region in eastern Tennessee is expected to increase in urban land use by the year 2060 (Wear and Greis 2013).

Agriculture is a major land use and industry in the TVA region. In 2012, 41 percent of the land area in the TVA region was farmland that comprised 151,000 individual farms (USDA 2014). Between 2012 and 2017, statewide data for Tennessee show a small increase in the number of farms (USDA 2019c). The number of small farms (between 1 and 9 acres) in Tennessee has increased between 2012 and 2017, following a national trend (USDA 2019c). Average farm sizes range between 155 and 326 acres for states within the TVA region and have generally increased in size between 1997 and 2017. East Tennessee farms typically grow hay, corn, and soybeans, as well as raising beef cattle.

For the state of Tennessee, cropland and pastureland comprise 17 and 16 percent, respectively, of rural, non-Federal land in 2017 (USDA 2018b). Both cropland and pastureland have decreased in area since 1982; however, the rate of cropland and pastureland loss in Tennessee has declined between 2012 and 2015 (USDA 2018b). Farms in the TVA region produce a large variety of products that vary across the region. Region-wide, the major crop items by land area are forage crops (hay and crops grown for silage), soy, corn, and cotton. The major farm commodities by sales are cattle and calves, poultry and eggs, grains and beans, cotton, and nursery products (USDA 2014). Between 2012 and 2017, statewide data for Tennessee shows decreases in the number of farms and acres producing short rotation woody crops (USDA 2019c).

Power from these facilities would typically be delivered by direct connection to TVA's transmission system or via interconnections with local power companies that distribute power from TVA. As specific sites have not yet been determined for evaluation under this alternative, typical impacts of solar and transmission projects have been listed under Table 3.2-1 and Table 3.3-1.

3.10.2 Environmental Consequences

3.10.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to maintain and operate the KIF Plant, and TVA would implement all planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be reviewed in subsequent NEPA analyses. Existing land uses in the areas of the action alternatives would likely remain industrial and forested.

3.10.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Under both action alternatives, TVA would retire, decommission, decontaminate, and deconstruct the KIF units and site. Land uses within the Kingston Reservation would remain industrial regardless of the action alternative selected to replace its generation. All previously approved CCR projects would continue to be implemented. Deconstruction of all aboveground structures within the project site to a depth of 3 feet below final grade would result in disturbance to the soil in the immediate vicinity of the structures. All structures with below-grade features would be filled with material from the deconstruction process as well as imported fill. As the entire project site is a previously disturbed area and would continue to be designated for nonagricultural purposes, no impacts to prime farmland are anticipated. Once the D4 activities are completed, there is the potential for land use changes if the coal plant site is redeveloped. Cumulative effects to land use would not occur associated with the CCR management activities on the Kingston Reservation.

3.10.2.2.1 Environmental Justice Considerations

Effects to land use from D4 activities under Alternative A would be limited to the TVA-owned Kingston Reservation. No EJ populations are present in the immediate Kingston Reservation vicinity (Figure 3.4-3), meaning that effects would not be amplified for EJ populations.

3.10.2.3 Alternative A

3.10.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Under Alternative A, TVA would retire the KIF, demolish the units, and construct and operate a CC/Aero CT Plant on the Kingston Reservation. The land use of the current units would change from disturbed earth and hay/pasture to industrial uses. Land use of the 55-acre CC/Aero CT Plant site would be permanently converted from 92 percent hay/pasture to developed. Although the 8.5 acres associated with the switchyard would be permanently filled for the construction of the switchyard, impacts would be minor as the site was previously disturbed for industrial use (Figure 3.10-1, Table 3.10-2).

The activities associated with Alternative A would not have any indirect effects on land use, as further changes to the rural area would not be expected to be stimulated by the CC/Aero CT Plant. The Project could continue the current land's industrial use for at least 30 years. No cumulative effects to land use would occur.

3.10.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The 35 acres associated with the 3- to 4-MW solar facility would have minor permanent impacts to land use, as these sites were previously disturbed for use as an existing coal yard used for the KIF, as shown on Figure 2.1-5 (Figure 3.10-1, Table 3.10-2).

3.10.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Changes to land use related to the 100-MW BESS depends on which site is selected. Battery site 1 (30 acres) would have the fewest impacts due to its location on previously disturbed land, which is already considered primarily medium- and high- intensity developed, therefore land use would largely go unchanged for this site (Figure 3.10-1, Table 3.10-2). Battery sites 2 (35 acres) and 3 (40 acres) would have large permanent impacts, as these sites are both forested and would require vegetation clearing, grading, and fill prior to construction with final land use classified as developed.

3.10.2.3.4 On-site Transmission Upgrades

The NLCD classifies the on-site transmission corridor as primarily as hay/pasture with margins of forested area and small portions of developed land (Figure 3.10-1). Under Alternative A, the land use of this area would not change. TVA would make upgrades to the transmission line corridor and continue the regular maintenance schedule that the existing transmission line corridor currently undergoes.

Changes in land use would occur with the installation of the Battery Transmission Corridor. According to the NLCD, this corridor consists of mostly forested land (Figure 3.10-1) which would undergo permanent land use (and habitat) conversion to maintained herbaceous, hay/pasture, or shrub/scrub area.

3.10.2.3.5 Off-site Transmission Upgrades

Under Alternative A, the land use of the off-site transmission corridors would not change. TVA would make upgrades to the transmission line corridors and continue the regular maintenance schedule that these areas currently undergo.

3.10.2.3.6 Construction and Operation of a Natural Gas Pipeline

Anticipated impacts to land use in the ETNG Construction ROW from the construction, operation, and maintenance of the pipeline would include installation of the pipeline and construction and operation of the new compressor station and M&R stations identified as the ETNG Construction ROW. Permanent conversion of current land uses would be limited to the aboveground facilities and where forested land is converted to maintained open space along the pipeline ROW. Additionally, approximately 55 acres or approximately 9 miles of new 50-foot-wide permanent easement would be created and maintained by ETNG for the pipeline. Expanded easements would be required along 123 miles of the main and lateral lines, with ten of those miles being new or greenfield, and 15 additional miles of new easements adjacent to the existing pipeline ROW for a total of 25 miles of new easement. Further, another 6 miles would require additional line rights.

In upland areas, routine maintenance would involve clearing the entire 50-foot-wide ROW every 3 years. However, to facilitate periodic corrosion surveys, a 10-foot-wide strip centered on the pipeline may be mowed annually to maintain herbaceous growth. In wetlands and riparian areas, routine maintenance would involve maintenance at a frequency necessary to maintain a 10-foot-wide corridor centered on the pipeline in an herbaceous state and removal of trees within 15 feet of the pipeline in accordance with FERC’s Procedures. Forested land would be permanently converted to herbaceous and scrub-shrub land within the permanent easement as a result of maintenance.

See Table 3.10-7 for a comprehensive list of land use types impacted by pipeline facilities.

Table 3.10-7. Land Uses Affected by Construction and Operation of the Pipeline (in acres)

Facility/County, State	Agricultural		Open Land		Forested		Residential		Industrial/ Commercial		Open Water		Wetlands		Total	
	C	O	C	O	C	O	C	O	C	O	C	O	C	O	C	O
Pipeline Right-of-Way[30]	**617.3**	**302.1**	**182.9**	**106.3**	**611.3**	**267.9**	**8.4**	**4.2**	**30.3**	**17.8**	**2.4**	**1.5**	**25.7**	**16.2**	**1478.3**	**716.1**
ATWS[31]	160.1	0.0	39.4	0.0	123.7	0.0	2.7	0.0	5.7	0.0	0.0	0.0	0.3	0.0	331.8	0.0
Staging Areas	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Access Roads	**13.6**	**3.2**	**7.9**	**0.6**	**14.2**	**0.3**	**2.7**	**1.6**	**24.7**	**0.6**	**0.0**	**0.0**	**0.0**	**0.0**	**63.1**	**6.3**
Aboveground Facilities																
Hartsville Compressor Station	64.8	15.8	0.1	0.0	1.9	0.0	0.0	0.0	0.4	0.0	0.3	0.0	0.1	0.0	67.6	15.8
Columbia Gulf Meter Station	7.6	3.9	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	8.2	3.9
Texas Eastern and Midwestern Gas M&R[2]	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.0	0.0	0.0	0.0	0.9	0.9
Kingston M&R Station No. TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Gainsboro Crossover	3.6	3.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.6
Clarkrange Crossover	0.0	0.0	0.1	0.1	2.6	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	2.7
Harriman Lateral Crossover	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Kingston Receiver Site	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
PROJECT TOTAL:	**867.0**	**328.6**	**230.3**	**107.0**	**754.2**	**270.9**	**13.8**	**5.8**	**62.0**	**19.3**	**2.7**	**1.5**	**26.2**	**16.2**	**1,956.2**	**749.4**

C: Construction
O: Operation
Source: ETNG 2022i

[30] Area for the mainline valves is included in the land requirements for the new pipeline permanent ROW.
[31] Modifications would be within existing M&R Station; no expansion is proposed.

The land types along the pipeline ROW, as described in ETNG's Resource Report 8 (ETNG 2022i), are identified below (ETNG 2022i):

Open Land
Open land consists of open fields, existing ROW, herbaceous and scrub-shrub upland areas, and non-forested upland areas. Approximately 230 acres of open land will be temporarily impacted during construction of the [pipeline], which includes 107 acres of open land within [ETNG]'s existing permanent ROW. Open land areas within temporary workspace and ATWS areas would be allowed to revert to open land use after completion of construction. Permanent impacts on open land after construction will be primarily limited to the operational pipeline ROW. Routine vegetation maintenance will be conducted within a 50-foot-wide strip of the permanent ROW with a frequency of not more than once every three years. In addition, a 10-foot-wide strip over the pipeline will be maintained in an herbaceous state by mowing, cutting, and trimming on an annual basis. Approximately 0.7 acre of open land will be converted into industrial land for permanent access roads and operation of the Clarkrange Crossover Site.

Agricultural Land
Agricultural land in the [pipeline] area is used predominantly for row crops (corn, wheat), sod, hay crops and pasture, and cattle. No specialty crops, organic farms, or tree farms will be impacted. The [pipeline] will temporarily impact approximately 867 acres of agricultural land, which includes 288 acres of agricultural land within [ETNG's]s existing permanent ROW. The primary impacts on agricultural land during construction will include temporary reductions in agricultural production in areas of cultivated cropland and potential reduced yields of future crops. Agricultural land in the construction area generally will be taken out of production for one growing season. Impacts on prime farmland are discussed in more detail in ETNG's Resource Report 7 (ETNG 2022h).

Landowners will be compensated for crop loss during construction. In accordance with the Erosion and Sediment Control Plan and FERC Upland Erosion Control, Revegetation, and Maintenance Plan (FERC Plan), and in coordination with the landowner, [ETNG] will segregate topsoil in agricultural land. Topsoil will be stockpiled separately from the subsoil on the construction ROW. Topsoil will be replaced in the proper order during backfilling and final grading to help ensure postconstruction revegetation success. Although no drain tiles or irrigation systems have been identified by landowners to date, [ETNG] will monitor and repair any drain tiles affected by construction and will maintain irrigation systems unless otherwise coordinated with the landowner.

Approximately 329 acres of agricultural land will be affected by operation of the Project, including 302 acres within the permanent pipeline ROW. The 50-foot-wide portion of the permanent ROW will be maintained, centered on the new pipeline; however, as agricultural lands will be restored to pre-construction use and crops can be planted in the permanent ROW, there will be no permanent impact associated with the operation of the pipeline. The remaining 26 acres will be permanently converted to industrial land for permanent access roads and operation of the aboveground facilities. [ETNG] will consult with applicable agricultural agencies for information on agricultural practices and land uses in the [pipeline] area. Information gained through consultation with the agencies and the landowners will be in the final resource reports included in the Project Application.

Forest/Woodland

Various stands of mixed hardwood forest intersect the [ETNG Construction ROW] and are more fully described in [ETNG]'s Resource Report 3, Section 3.4.2 [(ETNG 2022d)].[32] These forests have not been identified as old growth, are not used for forest product production and have not been identified as critical habitats or habitats of concern. Upland forests and woodlands will be cleared of trees and woody vegetation within [pipeline] workspaces to provide an adequate and safe work surface. After construction, trees and vegetation would typically be allowed to regrow in areas used as temporary workspace.

Forested areas within the 50-foot-wide portion of the permanent ROW would undergo routine vegetation maintenance every 3 years; these areas are converted to open land and would not be restored to forest. Forested areas crossed by HDD would not undergo routine vegetation maintenance between the HDD entry and exit pits. [ETNG] will work with landowners to maintain access to wooded portions of their property during pipeline construction, as requested. In obtaining land rights, [ETNG] will fully compensate landowners for the value of trees felled based upon a timber appraisal provided by a local timber expert.

Industrial/Commercial Land

Open land consists of open fields, existing ROW, herbaceous and scrub-shrub upland areas, and non-forested upland areas. Open land areas within temporary workspace and ATWS areas would be allowed to revert to open land use after completion of construction. Routine vegetation maintenance would be conducted within a 50-foot-wide strip of the permanent ROW with a frequency of not more than once every three years. As noted above, a 10-foot-wide strip over the pipeline could be maintained in an herbaceous state by mowing, cutting, and trimming on an annual basis.

Residential Land

Approximately 14 acres of residential land will be impacted by construction activities within the [ETNG Construction ROW]. Upon completion of construction, residential lands will be restored to pre-construction conditions to the extent practicable. Landowners will be notified of planned construction activities a minimum of seven days prior to construction. Traffic in residential areas will be managed as described in Section 8.3. [of ETNG's Resource Report 8], and speed limits will be strictly controlled for construction equipment and associated vehicles. Water trucks will be used to spray down the construction area if dust control is needed. In addition, [ETNG] is coordinating with landowners and has adopted modifications to workspaces based on landowner input. […]

Open Water

Open water includes waterbodies greater than 100 feet in width. Major waterbody crossings and proposed crossing methods are identified in [ETNG's] Resource Report 2, Table 2.3-4. Resource Report 2 also provides detailed information on potential waterbody effects associated with construction and operation of the [pipeline], as well as minimization measures.

[32] According to ETNG's Resource Report 3, Table 3.4-1 483 acres of forest would be temporarily impacted, and 271 acres would be permanently impacted (ETNG 2022d).

> <u>Wetlands</u>
> Approximately 26 acres of wetland will be temporarily impacted during construction of the [pipeline] within largely reduced construction ROWs, of which approximately 16 acres will be affected by operation. Wetlands are discussed further in [ETNG's] Resource Report 2.
>
> <u>Special Land Uses</u>
> Special land uses include areas such as land associated with schools, parks, places of worship, cemeteries, sports facilities, campgrounds, golf courses, and ball fields. [ETNG] is in the process of identifying special land uses crossed by the Project by reviewing field reconnaissance results, aerial photography, and USGS 7.5-minute topographical maps. To date, no special land uses have been identified within the [pipeline] workspaces. Additional information regarding any special land uses and mitigation, if identified, will be included in the final Resource Report 8 included in the Project Application.

TVA has independently reviewed and concurs with the land use-related findings in ETNG's Resource Report 8 (ETNG 2022i).

Overall, permanent adverse impacts would occur to all land use types aside from open land, as all other land use types would be permanently converted to maintained open land. Open land would be temporarily impacted during construction but would revert to open land during operations.

3.10.2.3.7 Summary of Alternative A

TVA Actions

Permanent impacts to land use would occur as a result of Alternative A. The approximately 55 acres associated with the CC/Aero CT Plant would be converted from largely hay/pasture to industrial. The land use of the existing on-site transmission corridor would continue as it currently is. Land use of the proposed Battery Transmission Corridor would change from forested areas to herbaceous, hay/pasture, or scrub/shrub. Temporary impacts from disturbance during construction or upgrades would not result in long-term land use changes, as the areas would return to their original land use type after construction is completed.

The 8.5 acres associated with the switchyard and 35 acres associated with the solar facility site would have minor to negligible impacts to land use, as these sites were previously disturbed for industrial use. Temporary impacts would be imposed during construction. Depending on which battery site is selected, 30-40 acres may be impacted. No changes to land use would occur if Battery Site 1 is chosen, as this area already consists of medium and high intensity development. Battery sites 2 (35 acres) and 3 (40 acres) would have large permanent impacts, as these sites are both forested and would require vegetation clearing prior to construction, with ultimate change in land use to developed area. Additional impacts to land use may occur because of transmission lines, structures, and connections associated with the BESS. Overall, moderate, adverse, permanent impacts would occur due to Alternative A construction. No cumulative effects to land use would occur.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Pipeline construction would impact 230.3 acres of open land temporarily and 0.7 acres permanently; 867.0 acres of agricultural land temporarily and 26.2 acres permanently; 483.0 acres of forested land temporarily and 271.0 acres permanently; 13.8 acres of residential area temporarily; and 10 acres of wetlands temporarily and 16.2 acres permanently, including aboveground facilities. Overall, moderate, adverse, permanent and temporary impacts would occur due to Alternative A construction. No cumulative effects to land use would occur.

3.10.2.3.8 Environmental Justice Considerations

Effects to land use that would occur as a result of the proposed CC/Aero CT Plant construction would be limited to the immediate TVA-owned Kingston Reservation. The effects to land use on the Kingston Reservation would have no impact on human populations due to having no residential settlements.

Neither the temporary or permanent effects to land use associated with construction of the ETNG Construction ROW would be likely to result in amplified effects to EJ populations because land could return to its previous use for livelihood or sustenance after the completion of pipeline construction activities.

3.10.2.4 Alternative B

3.10.2.4.1 Construction and Operations of Solar and Storage Facilities

Under Alternative B, TVA would construct and operate 1,500 MW of solar and 2,200 MW of battery storage at various sites within portions of East Tennessee, which would require about 10,950 acres for the solar facilities and 828 acres for the battery storage facilities. Most operating and planned and approved TVA utility-scale solar facilities have been constructed on previously cleared pasture, hayfield, or crop land, and most have required little grading to smooth or level the site. Almost all TVA solar projects have affected farmland and resulted in changing the land use of farmed portions of the facility sites from agricultural to industrial. Although construction and operation of the PV facility usually eliminates agricultural production on the area, it typically does not adversely affect soil productivity or the ability to resume agricultural production once the PV facilities are removed. Impacts to farmland, particularly areas designated as prime farmland, are described in more detail in Section 3.5. Forested portions of the sites were also changed to industrial land use. Other land uses on or in the vicinity of the solar facilities have generally not been affected (Table 3.2-1). The current land use and zoning of a site is a factor in the solar and storage site selection process, and some communities in the TVA region have ordinances addressing solar facilities. Some of these facilities require screening to reduce visual/land use impacts. The land area required for battery storage facilities is typically only a few acres and construction-related impacts are minor.

Based on typical impacts of solar sites, Alternative B would result in the conversion of about 8,825 acres of largely agricultural land to industrial use,[33] although livestock grazing is likely occurring now on at least some of the solar facility sites (Table 3.2-1). Revegetation of solar sites with native and/or non-invasive grasses and herbaceous vegetation would help minimize effects to open, grassy habitats.

Future projects in the geographic area of analysis that include use of undeveloped lands to support industrial or other intensive developments could result in a change in land use. In addition to the 1,500 MW of solar facilities under Alternative B, TVA is proposing to add 10,000 MW of solar by 2035 to meet customer demands and system needs. This would also change undeveloped or agricultural sites to industrial land use. The combined effect of these future land development actions and Alternative B would likely result in cumulative effects in land use changes. However, in view of the relatively large amounts of rural and undeveloped lands within the counties selected, cumulative impacts on land use are expected to be moderate.

[33] Table 3.2-1: (7.3 acres per MW x 1,500 MW added) = (10,950 acres required x 80.6% prime farmland conversion) = 8,825 acres converted from largely agricultural land to industrial use

3.10.2.4.2 Transmission and Other Components

New transmission line connections and substations would typically be on or immediately adjacent to the solar or storage facilities, and they would be planned to minimize adverse land use impacts. New transmission lines would eliminate forest management land use within the maintained ROW but not agricultural land use. New substations and switching stations would result in conversion to industrial land use. Cumulative effects to land use would also occur from additional transmission lines and substations associated with the addition of 10,000 MW of solar TVA plans to implement by 2035 (TVA 2019a).

3.10.2.4.3 Environmental Justice Considerations

Based on the number of solar sites that would be needed to replace generation at KIF, there is potential for moderate effects to land use through conversion of agricultural land, particularly cropland, to developed land with the potential for later restoration of agricultural use. These land use conversions have the potential for amplified effects on EJ populations, depending on the number and location of solar facilities. Focused analyses for each proposed solar site would more fully evaluate whether identified EJ populations would experience amplified effects from specific project activities.

3.11 Transportation

3.11.1 Affected Environment

3.11.1.1 Kingston Reservation (No Action and D4 Activities)

The Kingston Reservation is served by highway, railway, and waterway modes of transportation. The closest airport is the Meadowlake Airport (a private airport), 5.6 miles south of the site. The closest public use airport is Rockwood Airport, approximately 8.0 miles west of the Kingston Reservation. Primary arterial roadway access is provided by HW-70 and I-40 to the south of the site location with Steam Plant Road serving as the main entrance. Existing traffic conditions generated by KIF are composed of a mix of cars and light duty trucks, as well as medium duty to heavy duty trucks. The 2020-21 Annual Average Daily Traffic (AADT) counts for key roadways near the Kingston Reservation, all of which are 2-lane, are presented in Table 3.11-1.

Table 3.11-1. Average Daily Traffic Volume (2020-21) on Major Roadways Near Kingston

Location (Station Number)	Existing AADT
Steam Plant Road (73000013)	2556
I-40 south of the Kingston Reservation (73000062)	49,070
Highway 70 south of the Kingston Reservation (73000038)	11,173

Source: Tennessee Department of Transportation, 2020-21[34]

3.11.1.2 Alternative A

3.11.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The proposed CC/Aero CT Plant site may be accessed by an unnamed existing road in the plant; however, no traffic data is available from TDOT for this road. Steam Plant Road connects to this unnamed road and serves as the nearest traffic data point. The 2020-21 AADT counts for key roadways near the Kingston Reservation are presented in Table 3.11-1.

[34] Transportation Data Management System (ms2soft.com)

3.11.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.11.1.1 apply to the proposed 3- to 4-MW solar facility location on the Kingston Reservation.

3.11.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.11.1.1 apply to the proposed 100-MW BESS on the Kingston Reservation.

3.11.1.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission connections to the proposed CC/Aero CT Plant and switchyard. TVA would also install new transmission lines for the proposed battery station. Therefore, the affected environment for on-site transmission upgrades is described in Section 3.11.1.1.

3.11.1.2.5 Off-site Transmission Upgrades

Off-site upgrades may be needed such that 161-kV transmission lines may need to be reconductored or rebuilt. If future studies indicate improvements are required to the regional transmission system to maintain system stability and integrity, additional site-specific reviews would be completed.

3.11.1.2.5.1 Eastern Transmission Corridor

The Eastern Transmission Corridor extends eastward from the current Kingston Reservation, terminating in the city of Oak Ridge. Several access roads are proposed largely along routes that have already been cleared. Larger roadways, such as I-40, SR-58, SR-95, SR-61, and SR-62, would be used to access the corridor along with a number of smaller, rural roads in the vicinity of the corridor.

3.11.1.2.5.2 Western Transmission Corridor

The Western Transmission Corridor (L5383) extends southeast from a substation in unincorporated Crossville on Plateau Road and terminates north of the Crossville city limits. Larger roadways, such as I-40, SR-127, and SR-298, would be used to access the corridor along with several smaller, rural roads in the vicinity of the corridor.

3.11.1.2.6 Construction and Operation of a Natural Gas Pipeline

The proposed gas pipeline overview map is shown in Figure 2.1-5. The ETNG Construction ROW is served by highway and railway modes of transportation. The 2020-21 AADT counts are presented in Table 3.11-2. The proposed ETNG Construction ROW intersects a number of major roadways, including Hwy 25, Hwy 141, Hwy 80, Hwy 85, Hwy 53, Hwy 56, Hwy 135, Hwy 136, Hwy 111, Hwy 84, Hwy 164, Hwy 62, Hwy 127, Hwy 27, and Hwy 61, in addition to a number of smaller rural and local roadways.

Table 3.11-2. Average Daily Traffic Volume (2020-21) on Roadways Intersected by Alternative A Pipeline

Location (Station Number)	Existing AADT
Hwy. 25 W. Near Sumner Co Line (85000025)	6876
Hwy. 141, River St. Hartsville (85000045)	6214
Hwy. 25 E. Near Smith Co Line (85000040)	5124
Hwy. 80, Pleasant Shade Hwy North of Carthage (80000017)	1728
Hwy. 85, Gladdice Hwy. Near Smith Co Line (44000065)	674
Hwy. 53, Granville Hwy. SW of Gainesboro (44000042)	516
Hwy. 56, S. Grundy Quarles Hwy. Near Putnam Co Line (44000062)	4074
Hwy. 135, Dodson Branch Rd. Near Jackson Co Line (71000138)	2958
Hwy. 136, Hilham Rd. N of Cookeville (71000064)	5128
State Hwy. 111 Near Overton Co Line (71000168)	16629
State Hwy. 84 Near Putnam Co Line (67000041)	2973
Hwy. 164, Hanging Limb Rd. Near Hanging Limb (67000044)	1493
Hwy. 62, W. Deer Lodge Hwy. W. Clarkrange (25000038)	4289
Hwy. 127, S. York Hwy. S. Clarkrange (25000037)	5309
Hwy. 27, Morgan County Hwy. E. of Wartburg (65000028)	4266
State Hwy. 61 Northeast of Harriman (73000097)	4329

Source: Tennessee Department of Transportation 2020-21

3.11.1.3 Alternative B

3.11.1.3.1 East Tennessee TVA Power Service Area

TVA anticipates that the solar facilities proposed under Alternative B would be located within portions of the East Tennessee region in order to offset transmission system upgrades that may otherwise be required following the retirement of KIF. As specific sites have not yet been determined for evaluation under this alternative, typical transportation impacts of solar and storage construction and transmission projects have been listed under Section 3.2 and Section 3.3.

3.11.2 Environmental Consequences

3.11.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to maintain and operate KIF. TVA would implement all planned actions related to the current and future management and storage of CCRs at the coal plants, which have either been reviewed or would be reviewed in subsequent NEPA analyses. Under this alternative, traffic to and from the fossil plant would remain the same.

3.11.2.2 Retirement, Decommissioning, Deactivation, Decontamination, and Deconstruction of KIF Plant

Although traffic on HW-70, Steam Plant Road, and Swan Pond Road may increase during D4 activities as equipment is transported on and off-site, traffic would ultimately be reduced as a result of deconstruction of the KIF Plant. Routine plant deliveries would also be discontinued, including coal and limestone, and employment at the plant would be reduced.

Traffic is assumed to be distributed during a peak morning period (to the site) and a peak evening period (away from the site). Deconstruction-related vehicles (dozers, excavators, articulating dump trucks, backhoes, graders, loaders, etc.) would be delivered to or removed from the proposed project sites on flatbed trailers. The routes affected by this increased traffic volume have not yet been determined, but it can be assumed that the roadways listed in Table 3.11-1 would be affected. Overall, the traffic volume generated by the construction workforce and the construction-related vehicles would be relatively minor and temporary.

Most of the deconstruction materials would be transported by truck and train off-site for recycling and disposal at approved landfills. Recycling and disposal sites have not been determined at this time; thus, haul routes cannot be specified. However, it is estimated that there likely would be an increase in trips near the site for waste disposal and recycling, which would cause minor and temporary increases in traffic volume.

TVA may elect to implement a reclamation process to recover the maximum amount of reusable fuel from the stockpiled material. Stockpiled coal would be burned on-site, prior to retirement. Any remaining product would be transported off-site for use or disposal. Scrap metal and other recyclable material would be transported to locations as determined by the demolition contractor. The remaining material would be hauled to the off-site landfill for disposal. Hazardous material, PCB, used oil and universal waste would be disposed of off-site with vendors/locations on TVA's Environmental Restricted Awards List.

Based on this level of use, impacts to traffic operations are expected to be relatively minor. Implementation of this action would cause minor impacts to the roadway network and localized roadway degradation along the route to the off-site destinations because of increased truck traffic. In addition, the proposed transport of material stockpiled on the site over public roadways would result in an increase in the number of vehicle miles traveled on those roadways. It is anticipated that the additional trips required for waste disposal and project traffic would not change the existing level of service of roadways near the site. However, the increase in vehicle miles is a factor in injury and fatal traffic crash rates. Therefore, there would be a minor impact related to increased traffic and driver safety.

Cumulative impacts to roadways may occur as a result of the CCR management activities also occurring on the Kingston Reservation, especially if the D4 and CCR management construction occur at the same time. TVA would mitigate congestion or delays near the project sites by implementing appropriate traffic controls, as needed, such as by staging of trucks, spacing logistics, staggering work shifts, or timing truck traffic to occur during lighter traffic hours. With implementation of these mitigation measures, cumulative impacts of the proposed actions to transportation are expected to be minor.

3.11.2.2.1 Environmental Justice Considerations

Effects to transportation that may occur as a result of Kingston coal facility retirement and D4 activities are not anticipated to have amplified effects on EJ populations. These effects would be temporary, minor, and concentrated primarily on Highway 40, Steam Plant Road, and Swan

Pond Road within a relatively small area around the TVA-owned reservation, where EJ populations are not present.

3.11.2.3 Alternative A

3.11.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Vehicular traffic on public roads near the Kingston Reservation would increase during construction due to construction workers and materials moving to and from the plant. The average construction workforce would be about 500 people with occasional higher peaks. TVA estimates a maximum of 600 workers would be employed on-site at the peak of the approximately three-year construction period. This does not include the construction workforce needed for transmission line upgrades, as this work is not centralized in one location for any significant period of time. Temporary gravel parking lot(s) would be constructed on-site to provide adequate parking for construction staff. Construction materials and plant components would primarily be delivered by truck and large components may be delivered by barge and unloaded at the existing barge landing.

Project materials and equipment would be delivered to the CC/Aero CT Plant site by highway for smaller items and railway or waterway for larger items. Roads within the Kingston Reservation would be maintained during the construction process. Any temporary access roads constructed off-site would be designed in accordance with USDOT and relevant local requirements. Equipment used during the construction phase would include trucks, truck-mounted augers and drills, excavators, as well as tracked cranes and bulldozers. Once constructed, 30-40 employees could be needed to operate the CC/Aero CT Plant in addition to remaining KIF staff.

Workforce traffic would mainly consist of a mix of passenger cars and light duty trucks. Traffic is expected assumed to be distributed during a peak morning period (to the site) and a peak evening period (away from the site). Assuming one person per commuting vehicle, there would be a daily average morning inbound traffic volume of 500 vehicles and a daily outbound traffic volume of 500 vehicles for a total of 1,000 vehicles per day with a maximum of 1,200 vehicles per day. Additional traffic may cause some traffic delays. Overall, the impact from traffic volume generated by the construction workforce and the construction-related vehicles would have a moderate, temporary impact.

Hazardous materials, PCB, used oil, and universal waste would be sent for off-site disposal/recycling with vendors/locations on TVA's Environmental Restricted Awards List. Nonhazardous wastes would be sent for disposal as directed by the contractor. During construction, it can be assumed that there would be an increase in trips near the site for waste disposal and recycling, which would cause minor and temporary increases in traffic volume.

Implementation of this alternative would cause minor disturbances to the roadway network, and localized roadway degradation along the route to the off-site destinations because of increased truck traffic. Anticipated changes in traffic volume on nearby roadways during construction of Alternative A on the Kingston Reservation are provided in Table 3.11-3. The temporary increased traffic over public roadways would result in an increase in the number of vehicle miles traveled on those roadways. This increase in vehicle miles is a factor in injury and fatal traffic crash rates and would have a minor impact related to increased traffic and driver safety.

Table 3.11-3. Changes in Traffic on Nearby Roadways During Construction of the Alternative A CC/Aero CT Plant

Location (Station Number)	Existing AADT	Existing AADT Plus Construction Traffic	Temporary Traffic Increase during Construction (%)
Steam Plant Road (73000013)	2,556	3,556	39.1%
I-40 south of the Kingston Reservation (73000062)	49,070	50,070	2.0%
Highway 70 south of the Kingston Reservation (73000038)	11,173	12,173	9.0%

Source: Tennessee Department of Transportation, 2020-21

Cumulative impacts to roadways may occur because of the CCR management activities also occurring on the Kingston Reservation, especially if the D4 activities and CCR management construction occur at the same time. TVA would mitigate congestion or delays near the project sites by implementing appropriate traffic controls, as needed such as by staging of trucks, spacing logistics, staggering work shifts, or timing truck traffic to occur during lighter traffic hours. With implementation of these mitigation measures, cumulative impacts of the proposed actions to transportation are expected to be minor.

3.11.2.3.2 Construction and Operation of a 3- to 4-MW-Solar Facility on Kingston Reservation

Impacts to traffic from the construction of the proposed solar facility would be similar to and increase the volume of impacts associated with the construction of the CC/Aero CT Plant and switchyard described in Section 3.11.2.3.1. Increased traffic levels during construction would be a moderate, temporary impact and would add to the overall traffic impacts anticipated from Alternative A.

3.11.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Impacts to traffic from the construction and operation of the proposed BESS would be similar to yet increase the volume of impacts associated with the construction of the CC/Aero CT Plant and switchyard described in Section 3.11.2.3.1. Increased traffic levels during construction would be a moderate, temporary impact and would add to the overall impacts anticipated from Alternative A.

3.11.2.3.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission connections to the proposed CC/Aero CT Plant and switchyard. TVA would also install new transmission lines for the proposed battery facility. Therefore, the environmental consequences for on-site transmission upgrades on transportation are the same as those described in Sections 3.11.2.2 and 3.11.2.3.1.

3.11.2.3.5 Off-site Transmission Upgrades

Minor transportation impacts would occur during the upgrades proposed within the Eastern Transmission Corridor and Western Transmission Corridor as a result of increased workforce traffic during the construction of the transmission upgrades associated with Alternative A, described in Section 2.1.3.5.2. This work is not centralized in one location for any significant period of time. As transmission workforce has not been estimated, a quantitative analysis of the traffic change as a result of these upgrades cannot be conducted at this time.

The temporary increased traffic over public roadways would result in an increase in the number of vehicle miles traveled on those roadways. This increase in vehicle miles is a factor in injury and fatal traffic crash rates and would have a minor temporary impact related to increased traffic and driver safety. No cumulative effects are anticipated.

3.11.2.3.6 Construction and Operation of a Natural Gas Pipeline

Vehicular traffic on public roads as well as near the proposed gas pipeline would increase during construction due to construction workers and materials moving to and from the plant and pipeline construction areas.

Road crossings would be constructed via open cut or conventional bore method. The pipeline would be installed a minimum of five feet below the road surface. Road surfaces, where disturbed, would be restored to pre-construction conditions or better. For private roads crossed via open cut, a steel plate, or similar, would be laid down to accommodate through-traffic during installation of the pipeline, or ETNG would work with landowners to provide alternative access. As needed, temporary detour of traffic using appropriate signage would be established. Activity within the travel lanes would be limited to foot traffic. Road closures would be arranged in coordination with the appropriate transportation authority.

The use of conventional boring for road crossings is intended to help ensure no surface impacts to the road would occur and any traffic interruption would be minor in Trousdale, Smith, Jackson, Putnam, Overton, Fentress, Morgan, and Roane counties, where construction is planned to occur.

The impact of construction of the pipeline on the transportation system is provided in ETNG's Resource Report 5 (ETNG 2022f), which TVA has independently reviewed, as provided below:

> Construction of the [pipeline] will result in minor, [temporary] effects on the transportation system in the [pipeline] analysis are due to road crossings, equipment and material deliveries, and construction workers commuting to the [pipeline] workspace.
>
> […]
>
> Construction will be scheduled for work within roadways and specific crossings to avoid commuter traffic and schedules for school buses and local transit buses to the greatest extent practical. Appropriate traffic management and signage will be set up and necessary safety measures will be developed in compliance with applicable permits for work in the public roadway. Roadway opening permits will be obtained from applicable state and county agencies.
>
> The movement of construction equipment and materials and the daily commuting of employees to and from the construction work areas may also slightly increase traffic volumes in the [pipeline] analysis area. Traffic congestion could occur if each construction worker commuting to work used a personal vehicle to travel to the work site and if most of this travel took place during peak traffic hours. The total traffic volume from construction worker commutes and equipment/material deliveries is anticipated to be small relative to existing traffic volumes on most roadways used to access [pipeline] facilities. Some local roads may experience temporary increases in [pipeline]-related traffic. To minimize traffic congestion, [ETNG] will encourage construction workers to share rides to the [pipeline]. Contractors may also provide buses to move workers from common parking areas to the construction work areas.

ETNG would hire one additional permanent employee to support ongoing pipeline and compressor station operations (ETNG 2022f), which would have a negligible to minor impact on local transportation routes and traffic.

3.11.2.3.7 Summary of Alternative A

TVA Actions

The majority of traffic impacts resulting from Alternative A would be on public roads near the Kingston Reservation, as transmission and pipeline activities associated with Alternative A are more dispersed than those from the CC/Aero CT Plant construction and would have a reduced localized impact to any particular set of roadways. Assuming one person per commuting vehicle, there would be a daily average morning inbound traffic volume of 500 vehicles and a daily outbound traffic volume of 500 vehicles for a total of 1,000 vehicles per day to the CC/Aero CT Plant site, with a maximum of 1,200 vehicles per day. Minor increases in traffic volume would also occur as a result of the construction and operation of the proposed solar facility, BESS, and installation of new transmission lines. Overall, the effect from traffic volume generated by the construction workforce and the construction-related vehicles would have a moderate, temporary impact to driver safety and roadway degradation. As added traffic due to operations would be significantly less than construction, permanent impacts would be minor.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Vehicular traffic on public roads as well as near the proposed gas pipeline would increase during construction due to construction workers and materials moving to and from the plant and pipeline construction areas Minor temporary impacts on traffic and transportation routes are possible. Permanent impacts on traffic and transportation routes would be negligible.

3.11.2.3.8 Environmental Justice Considerations

TVA Actions

Effects to transportation that may occur as a result of the proposed CC/Aero CT Plant are not anticipated to have amplified effects on EJ populations. These effects would be mostly temporary, moderate and related to construction activities. Moreover, they would be limited to a relatively small area, along public roads around the TVA-owned reservation where EJ populations are not present.

Construction traffic on the three-lane US. Highway 27 (US 27) between the intersections of Harriman Highway and Knoxville Highway may experience the greatest impacts. The EJ-qualifying block groups that are closest to this road consist of CT 1104 BG 3, CT 1103 BG 1, and CT 1103 BG 3.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Minor temporary affects to transportation may occur as a result of the activites associated with the ETNG Construction ROW and effects experienced by EJ populations may be amplified.

3.11.2.4 Alternative B

3.11.2.4.1 Construction and Operations of Solar and Storage Facilities

Since the exact project locations for the proposed solar and storage facilities are not known at this time, site-specific transportation impacts cannot be assessed. However, traffic associated with the construction of solar facilities would include semi-truck trips to deliver materials and construction equipment to the site and remove packaging materials; employee passenger vehicles; dump trucks; and concrete trucks. During operations, project-specific traffic would largely be reduced to daily employee trips for security, maintenance, and repairs on-site with occasional larger vehicles, such as crane trucks and forklifts, being transported on-site for maintenance as needed. For reference, 80 employees were utilized during the construction period of the 20-MW TVA Cumberland Solar Project (4 employees per MW), and 250 employees were utilized during the construction period of the 150-MW TVA Elora Solar Energy Center (or 1.7 employees per MW) (TVA 2017a, 2020d). Temporary traffic increases may be mitigated, if necessary, by broadcasting delays and highlighting alternate routes on news channels, radio, and on signage or adding temporary high occupancy vehicle lanes.

Minor cumulative impacts to traffic and transportation may occur if Alternative B coincides with the proposed expansion of 10,000 MW of solar facilities by 2035. Additional construction traffic and workforce traffic may be experienced on highways and local roads. However, impacts would be short term and coordination could occur to minimize impacts to local travelers.

3.11.2.4.2 Transmission and Other Components

Minor transportation impacts would occur as a result of increased workforce traffic during the construction of the transmission lines associated with the solar and storage sites under Alternative B. This work is not centralized in one location for any significant period of time. Transportation changes as a result of transmission construction cannot be determined at this time and would be part of future NEPA reviews, but it is expected that increases in traffic volume would be minor and temporary.

3.11.2.4.3 Environmental Justice Considerations

Transportation effects occurring as a result of the proposed solar facilities and transmission line activities would be temporary, minor, and concentrated on public roads within a relatively small area around the project sites and transmission line activities. No amplified effects to EJ communities are expected from Alternative B. Detailed EJ impacts would be further verified for each solar facility and transmission line activity under future NEPA reviews.

3.12 Utilities

3.12.1 Affected Environment

3.12.1.1 Kingston Reservation (No Action and D4 Activities)

The Kingston Reservation is in an industrial, forested, and agricultural area of unincorporated Roane County near the town limits of Harriman. In addition to various mobile providers, telecommunication services in the project site vicinity are provided by Xfinity, AT&T, HughesNet, EarthLink, Highland Telephone Cooperative, and Viasat (AT&T 2022; HughesNet 2022; EarthLink 2022; Highland Telephone Cooperative 2022; Viasat 2022).

Electrical service is provided by the Harriman Utility Board, which distributes power provided by TVA (Roane ECD n.d.). Existing power lines are present in the project area along Swan Pond Road and other major and minor roads in the vicinity. Twelve 161-kV transmission lines originate at the Kingston Reservation and extend in a northwest-southeast orientation. An additional 69-kV transmission line originates off-site at the Melton Hill Dam and runs in a north-southeast orientation through the site (USEIA 2021).

As of 2019, the coal-fired units at KIF had a water withdrawal rate of 956.6 MGD and a return of 955.7 MGD. With a net generation of 3,857,821 MWh/year, KIF has a water use factor of 83,006 gallons/MWh (TVA 2019b). According to the Roane ECD, water service in the project site vicinity is provided by the Cumberland Utility District and the Harriman Utility Board (Cumberland Utility District 2022; Harriman Utility Board 2022). The Harriman Utility Board also provides gas and sewer services to the areas within the vicinity of the Kingston Reservation.

3.12.1.2 Alternative A

3.12.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Utilities in the vicinity of the chosen CC/Aero CT Plant are the same as the Kingston Reservation and are generally described in Section 3.12.1.1.

3.12.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3 or 4-MW-solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.12.1.1 apply to the proposed 3- to 4-MW solar facility location on the Kingston Reservation.

3.12.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.12.1.1 apply to the proposed 100-MW BESS on the Kingston Reservation.

3.12.1.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission connections to the proposed CC/Aero CT Plants and switchyard. TVA would also install new transmission lines for the proposed battery facility. Therefore, the affected environment for on-site transmission upgrades is described in Section 3.12.1.1.

3.12.1.2.5 Off-site Transmission Upgrades

Off-site upgrades may be needed such that 161-kV transmission lines may need to be reconductored or rebuilt. If future studies indicate improvements are required to the regional transmission system to maintain system stability and integrity, additional site-specific reviews would be completed.

3.12.1.2.5.1 Eastern Transmission Corridor

The L5108, L5302, L5280, L5381, and L5116 transmission lines are within the Eastern Transmission Corridor in Roane and Anderson counties. In addition to various mobile providers, telecommunication services in the corridor vicinity are provided by AT&T and Taylor Telecom, and electric services are provided by the Clinton Utilities Board, the Cumberland Utility District, and Rockwood Electric Utility.

3.12.1.2.5.2 Western Transmission Corridor

Transmission line L5383 is within Cumberland County. In addition to various mobile providers, telecommunication services in the corridor vicinity are provided by Cumberland Connect, and electric services are provided by Cumberland Electric Membership Corporation.

3.12.1.2.6 Construction and Operation of a Natural Gas Pipeline

The approximately 122-mile-long pipeline and structures associated with Alternative A runs through Trousdale, Smith, Jackson, Putnam, Overton, Fentress, Morgan, and Roane counties. The corridor is largely developed agricultural open space in rural areas with some roadway intersections. To power the electric motor driven compressor station, ETNG would primarily utilize energy from the on-site solar farm. Other necessary power for the compressor station would come from Tri-County Electric via a 161-kV transmission line delivery point, which would require coordination with TVA for a tap point just outside of the existing Hartsville Substation and metering package. These lines can then be used to feed ETNG's new 161-kv / 13.8-KV substation that would be sited adjacent to the compressor station.

The pipeline construction route would cross existing pipelines, overhead powerlines, and other potential utility lines. Prior to construction existing utility lines would be located and marked to prevent accidental damage during pipeline and facility construction. ETNG's contractors would contact the "One Call" system, or state or local utility operators, to verify and mark all underground utilities crossed or along pipeline construction workspaces to minimize the potential for damage to other buried facilities in the area. Where there is a question as to the location of utilities, such as water, cable, gas, and sewer lines, they would be located by field instrumentation and test pits prior to initiation of trenching.

The proposed gas pipeline overview map shown on Figure 2.1-5 identifies the approximate route of the corridor that would be primarily built within or adjacent to an existing ETNG pipeline ROW.

3.12.1.3 Alternative B

3.12.1.3.1 East Tennessee TVA Power Service Area

Power from the proposed solar and storage facilities would typically be delivered by direct connection to TVA's transmission system or via interconnections with local power companies that distribute power from TVA. Effects on local utilities would be assessed in future NEPA reviews for each solar and storage site.

TVA anticipates that a portion of the solar facilities proposed under Alternative B would need to be located within portions of the East Tennessee region to offset transmission system upgrades that otherwise may be required following the retirement of KIF. The TVA PSA contains most of the Tennessee River Basin, which is considered one of the most water rich basins in the United States (TVA 2019a). The Tennessee River Basin, which is about half of the TVA PSA, has been defined as the most intensively used basin in the contiguous United States as measured by intensity of freshwater withdrawals in gallons per day per square mile (Hutson et al. 2004). While the withdrawal rate is highest, the basin has the lowest consumptive use in the nation by returning about 96 percent of the withdrawals back for downstream use (Bowen and Springston 2018).

In 2015, estimated average daily water withdrawals in the TVA PSA totaled 12,966 MGD (Dieter et al. 2018; Bowen and Springston 2018). About 6.6 percent of these water withdrawals were groundwater and the remainder was surface water. The largest water use (77.7 percent of all withdrawals) was for thermoelectric generation as shown on Figure 3.12-1. Even though thermoelectric generation has the greatest withdrawal, about 99.2 percent is recycled and returned for downstream use in the TVA system (Bowen and Springston 2018).

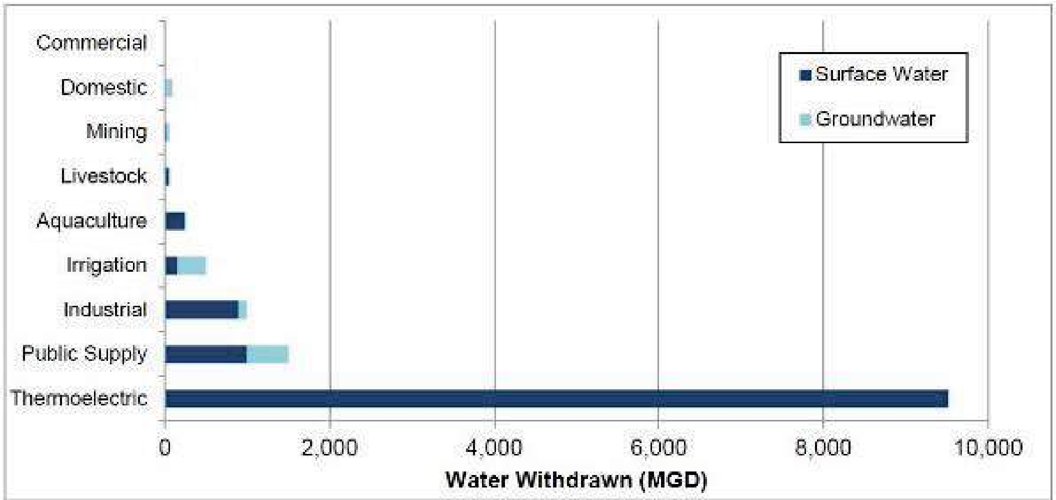

Figure 3.12-1. 2015 Water Withdrawals in the TVA Power Service Area by Source and Type of Use

Source: Dieter et al. (2018), Bowen and Springston (2018)

Since 1950, the annual increase in groundwater withdrawals for public supply in Tennessee has averaged about 2.2 percent and the increase in surface water withdrawals has averaged about 3.5 percent (Figure 3.12-2). For the first time since 1950, there was a decrease in surface water withdrawal for public supply systems in Tennessee between 2010 and 2015. Although these data are for Tennessee public water supplies, they are representative of the overall trends in water use for the TVA PSA.

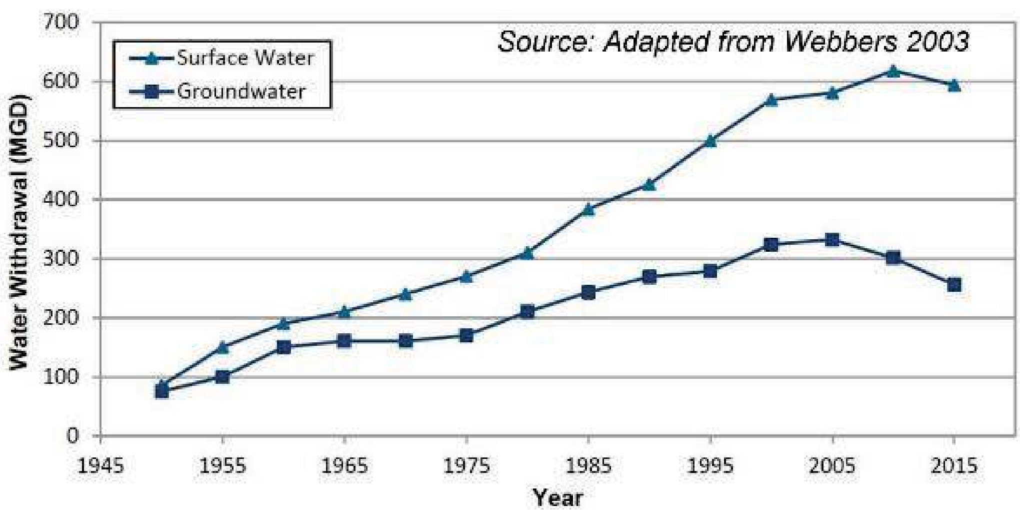

Figure 3.12-2. Groundwater and Surface Water Withdrawals by Water Public Systems in Tennessee, 1950 to 2015

3.12.2 Environmental Consequences

3.12.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate and maintain the coal-fired units at KIF. Existing on-site utilities would likely remain unchanged, with the exception of potential upgrades and maintenance. Based on the Purpose and Need (Section 1.1), the coal fleet is projected to experience increasing performance challenges, which would continue to add economic, reliability, and environmental risk to the system. Therefore, moderate, adverse, permanent impacts would occur to utilities if the No Action Alternative were to be selected.

3.12.2.2 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

Under both action alternatives, TVA would retire, decommission, decontaminate, and deconstruct the KIF units and site. All buried utilities would be cut and capped within the project boundary and abandoned in place if they are 3' below final grade and if they do not interfere with other ongoing projects in the vicinity. All hollow pipe utilities would be decommissioned and sealed with a mechanical cap or plug. The site would be restored to a final grade to provide proper drainage.

Electrical service to the Kingston Reservation would be provided by the Harriman Utility Board, and the Harriman Utility Board would coordinate with customers if outages were necessary. The project would obtain water by connection to a municipal source or by delivery via water trucks, if necessary. Thus, water service for the project may be obtained through the Harriman Utility Board. No cumulative effects to utilities are anticipated.

3.12.2.2.1 Environmental Justice Considerations

Effects to utilities that would occur as a result of the Kingston coal facility retirement and D4 activities would be temporary and minor, with only short-term outages anticipated in the immediate vicinity, where EJ populations not present.

3.12.2.3 Alternative A

3.12.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Under Alternative A, TVA would construct a new CC/Aero CT Plant of approximately 1,500 MW at the Kingston Reservation including transmission upgrades and other components. The CC/Aero CT Plant would be fueled by a reliable supply of natural gas from the ETNG's 3100 pipeline system and proposed upgrades (Figure 2.1-5). The 161-kV transmission lines from the proposed natural gas-fired facilities to the existing 161-kV system would be constructed, along with plant equipment and systems, such as natural gas metering and handling systems, instrumentation and control systems, transformers, and other major equipment described in Section 2.1.3.2.

TVA would construct a double-breaker 161-kV substation for the proposed CC/Aero CT Plant and reroute all existing transmission lines from the Kingston Reservation and re-terminate them into the new substation. TVA would install a 161-kV switch house (potentially including water and septic systems) and station service and make other transmission system modifications to transmit the energy generated by the new CC/Aero CT Plant. Off-site upgrades may be needed such that 161-kV transmission lines may be reconductored or rebuilt. More information can be seen in Section 2.1.3.5.2. Adverse impacts to existing utilities are not anticipated, and TVA would coordinate with existing telecommunications, electricity, natural gas, and water and sewer utilities prior to starting plant construction to avoid/minimize impacts and disruptions to utilities.

Natural gas-fueled CC plants require water for steam generation and condensation. As of 2015, the water use factors for TVA's CC plants ranged from 208-935 gallons/MWh. TVA has elected to use air cooling, however, at the proposed CC/Aero CT Plant to significantly minimize effects to the nearby Clinch and Emory rivers, groundwater, or overall water supply.

The facility would require potable water, which would be obtained from the existing public supply at the Kingston Reservation (Harriman Utility Board). To prevent concentration of minerals in the HRSG, it would require a demineralized water feed and boiler blowdown to remove accumulating minerals. CC compressor washing also requires demineralized water. Wash effluent would be collected in tanks and, after analysis, disposed of at an approved wastewater treatment facility off-site. Demineralized water would be made on-site and stored on-site in newly constructed tanks within the overall project footprint.

The proposed CC/Aero CT Plant would increase reliability and provide a cost-effective alternative to the existing coal-fired units. Overall, water use at the Kingston Reservation would be reduced due to the replacement of the coal units with the CC/Aero CT Plant. No cumulative effects to utilities are anticipated. While water supply use would be limited to the construction period and therefore temporary, TVA would coordinate with existing utilities to avoid/minimize impacts and disruptions to utilities during construction.

3.12.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed solar facility would only require water during construction unlike the CC/Aero CT plant, which would be obtained from the existing public supply at the Kingston Reservation (Harriman Utility Board). As described in Section 3.12.2.3.1, TVA would coordinate with existing telecommunications, electricity, natural gas, and water and sewer facilities as appropriate to ensure that adverse impacts to existing utilities would not occur from the solar facility or any required off-site connections. Minor beneficial impacts from the solar facility would occur by offsetting station service requirements allowing more of station generation to contribute to interconnection to the TVA grid.

3.12.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed BESS would only require water during construction, which would be obtained from the existing public supply at the Kingston Reservation (Harriman Utility Board). As described in Section 3.12.2.3.1, TVA would coordinate with existing telecommunications, electricity, natural gas, and water and sewer facilities as appropriate to ensure that adverse impacts to existing utilities would not occur from the storage facility or any required off-site connections. No adverse impacts to utilities are anticipated.

3.12.2.3.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT facilities and switchyard. TVA would also install a new transmission line for the proposed battery facility within the Kingston Reservation. Therefore, the environmental consequences for on-site transmission upgrades on utilities are the same as those described in Sections 3.12.2.2 and 3.12.2.3.1.

3.12.2.3.5 Off-site Transmission Upgrades

Prior to initiating construction on off-site transmission line upgrades, TVA would coordinate with the potentially affected utilities and mitigate any potential impacts to the utilities. Any utility service interruptions would be minimized and overall impacts to area utilities would be minor. Transmission line upgrades and switchyards do not require water to operate; therefore, water supply would not be impacted due to the transmission upgrades associated with this alternative.

3.12.2.3.6 Construction and Operation of a Natural Gas Pipeline

The construction and operation of a new CC/Aero CT Plant would require construction of approximately 122 miles of new natural gas pipeline and gas system infrastructure to connect the plant to the new gas pipeline. Compression requirements, if any, would be determined by the technical requirements of the CT brand chosen and where it is located on the Kingston Reservation. Service disruptions would be minimized through coordination between ETNG, TVA, and the affected utilities.

The proposed natural gas pipeline and associated structures would not require water to operate, so water supply use would be limited to the construction period. Water supply for hydrostatic testing would be pulled from nearby creeks and rivers at a withdrawal rate of less than 2,500 gallons per minute, and thus, utilities would not be impacted (ETNG 2022c). Trenches created to bury the natural gas pipeline at sufficient depth to allow for the minimum pipe cover requirements in accordance with USDOT regulations pursuant to the Natural Gas Pipeline Safety Act of 1968, landowner requests, and permit conditions. may encounter groundwater. However, because such activities and their effects to groundwater patterns or availability are localized, and generally limited to the construction phase, impacts from construction are expected to be minor.

Prior to construction, existing utility lines would be located and marked to prevent accidental damage during pipeline construction. Other than electric service provided through TVA, no project-related impacts to local utilities would occur and no cumulative effects to utilities are anticipated.

3.12.2.3.7 Summary of Alternative A

TVA Actions

Overall, permanent beneficial impacts would occur due to decreased water use for the CC/Aero CT Plant. Service disruptions associated with Alternative A construction are expected to be minimized through coordination with impacted utilities. Transmission lines, switchyards, and the solar and battery storage facilities do not require water to operate, so and water supply use would therefore be limited to the temporary period while construction of the facilities takes place and therefore temporary. Minor beneficial impacts from the solar facility would occur due to the increased power generation and interconnection to the TVA grid. Overall, permanent beneficial impacts would occur due to improved reliability and service costs as a result of Alternative A.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Project operations are not expected to result in adverse impacts to public or private water supplies unless operation and maintenance activities involving pipe excavation and repairs are needed. Should those needs arise, any associated impacts would be minor and temporary. Overall, the proposed ETNG Construction ROW would result in permanent beneficial effects to utilities by improving reliability and service costs as a result of Alternative A.

3.12.2.3.8 Environmental Justice Considerations

TVA Actions

CC/Aero CT plant-related effects to utilities would be reduced in comparison to existing conditions. Effects to utilities would be minor on the TVA-owned Kingston Reservation, where no residential populations exist.

ETNG Actions - Natural Gas Pipeline and Associated Structures
While utilities-related effects occurring as a result of the proposed natural gas pipeline activities may be experienced by EJ populations in the ETNG Construction ROW, effects are anticipated to be limited to construction, except for maintenance activities that may involve excavation and repair. The effects to EJ populations may result in amplified effects to these communities. Although TVA has assessed these impacts as minor, temporary, and potentially amplified to identified EJ populations, ETNG is still evaluating effects of its proposed project, and TVA may update its conclusions in TVA's final EIS based on ETNG's findings.

3.12.2.4 Alternative B

3.12.2.4.1 Construction and Operations of Solar and Storage Facilities
Under Alternative B, the addition of 1,500 MW of solar generating facilities paired with 2,200 MW of battery storage facilities would have a permanent, beneficial effect on power generation and grid stability. The combination of solar and battery storage allows for more flexibility in managing the variability of solar power output and can provide ancillary services that support grid reliability. However, it's worth noting that solar power output can be affected by weather conditions and time of day, and careful planning and coordination with other power sources would therefore be necessary to ensure reliable and stable power generation.

PV facilities do not typically require a water source for operation but may require potable water for on-site facilities or sewer during operation. BESS facilities typically require a water supply to support fire safety systems. Both PV and BESS facilities typically require electrical service and telecommunications services. While exact locations of solar and storage facilities are not known at this time, utility impacts would be minimized by identifying and coordinating with utilities prior to construction to avoid service disruptions. Minor, permanent impacts to existing utilities and water supply are anticipated under Alternative B. While additional solar facilities may be constructed in East Tennessee, cumulative impacts would be minor as developers and TVA would identify utility locations early and coordinate to avoid disruptions.

3.12.2.4.2 Transmission and Other Components
The construction of transmission lines associated with solar and BESS sites would have a minor beneficial impact on utilities by supporting increased power generation and storage. Minor impacts to water use may occur during construction.

3.12.2.4.3 Environmental Justice Considerations
Effects to utilities that would occur as a result of the proposed solar facilities and transmission line activity would be minor, with some service interruptions possible, minimized or mitigated. EJ communities are not expected to be impacted under Alternative B. To determine whether these effects would be amplified for EJ populations for a given solar facility the EJ impacts would be further verified under future NEPA reviews.

3.13 Cultural Resources

3.13.1 Regulatory Framework
Cultural resources include Pre-Contact (of or relating to the period before contact of an indigenous people with an outside culture) and historic archaeological sites, districts, buildings, structures, and objects, as well as locations of important historic events that lack material evidence of those events. Cultural resources are considered historic properties if included in, or considered eligible for inclusion in, the National Register of Historic Places (NRHP) maintained by the National Park Service (NPS). The eligibility of a resource for inclusion in the NRHP is based on the Secretary of the Interior's criteria for evaluation (36 CFR §60.4), which state that

significant cultural resources possess integrity of location, design, setting, materials, workmanship, feeling and association, and:

- are associated with important historical events; or
- are associated with the lives of significant historic persons; or
- embody distinctive characteristics of a type, period, or method of construction or represent the work of a master, or have high artistic value; or
- have yielded or may yield information (data) important in history or prehistory.

Because of their importance to the Nation's heritage, historic properties are protected by several laws. Federal agencies, including TVA, have a statutory obligation to facilitate the preservation of historic properties, stemming primarily from the National Historic Preservation Act (NHPA; 16 U.S.C. §§470 et seq.). Other relevant laws include the Archaeological and Historic Preservation Act (16 U.S.C. §§469-469c), Archaeological Resources Protection Act (16 U.S.C. §§470aa-470mm) and the Native American Graves Protection and Repatriation Act (25 U.S.C. §§3001-3013).

Section 106 of the NHPA requires federal agencies to consider the potential effects of their actions on historic properties in an undertaking's area of potential effects (APE) and to allow the Advisory Council on Historic Preservation an opportunity to comment on the action. Section 106 involves four steps: 1) initiate the process; 2) identify historic properties; 3) assess adverse effects; and 4) resolve adverse effects. This process is carried out in consultation with the State Historic Preservation Office (SHPO) of the state in which the action would occur and with any other interested consulting parties, including federally recognized Indian tribes ("Tribes").

APE is defined at 36 CFR part 800.16(d) (a section from the federal regulations implementing Section 106 of the NHPA) as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." APE is analogous to the affected area in a NEPA analysis but is focused specifically on the undertaking's potential effects on historic properties. The APE for the Kingston Fossil Plant Retirement project consists of multiple large areas, some of which are non-contiguous because the proposed undertaking encompasses various large-scale actions, each different in nature, occurring at various places at various times. The APE for the No Action and each Action Alternative is characterized in Section 3.13.2 at the introduction of each of the alternatives.

Section 110 of the NHPA sets out the broad historic preservation responsibilities of federal agencies and is intended to ensure that historic preservation is fully integrated into their ongoing programs. Federal agencies are responsible for identifying and protecting historic properties and avoiding unnecessary damage to them. Section 110 also charges each federal agency with the affirmative responsibility for considering projects and programs that further the purposes of the NHPA, and it declares that the costs of preservation activities are eligible project costs in all undertakings conducted or assisted by a federal agency.

Historic properties include a traditional cultural property (TCP), which is defined as a property that is eligible for inclusion on the NRHP because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history and (b) are important in maintaining the continuing cultural identity of the community (Parker and King 1998).

3.13.2 Affected Environment

Existing conditions for cultural resources are presented for the APE for the No Action and two Action Alternatives currently proposed for the KIF retirement project and represents locations where project effects to historic properties could occur. Project- affected environments are also assessed for the related proposed action, construction and operation of 122 miles of natural gas pipeline and associated structures and the transmission upgrades.

3.13.2.1 Kingston Reservation (No Action and D4 Activities)

The APE for cultural resources for the No Action Alternative and for proposed D4 activities consists of the area within the Kingston Reservation boundary. The D4 footprint is only on a portion of the Kingston Reservation. The general locations of previous cultural resources investigations completed within the reservation boundary and in the general vicinity of the Kingston Reservation are shown on Figure 3.13-1. There are 16 previously recorded archaeological sites within the Kingston Reservation (Table 3.13-1). TVA has completed archaeological surveys in recent years that have collectively included the entire KIF Reservation, have consulted with the SHPO and Tribes regarding the findings, and have reached consultation consensus with those agencies regarding the NRHP eligibility status of each site. Correspondence between the TN SHPO and TVA for this EIS and a number of projects associated with the Kingston Reservation is presented in Appendix N.

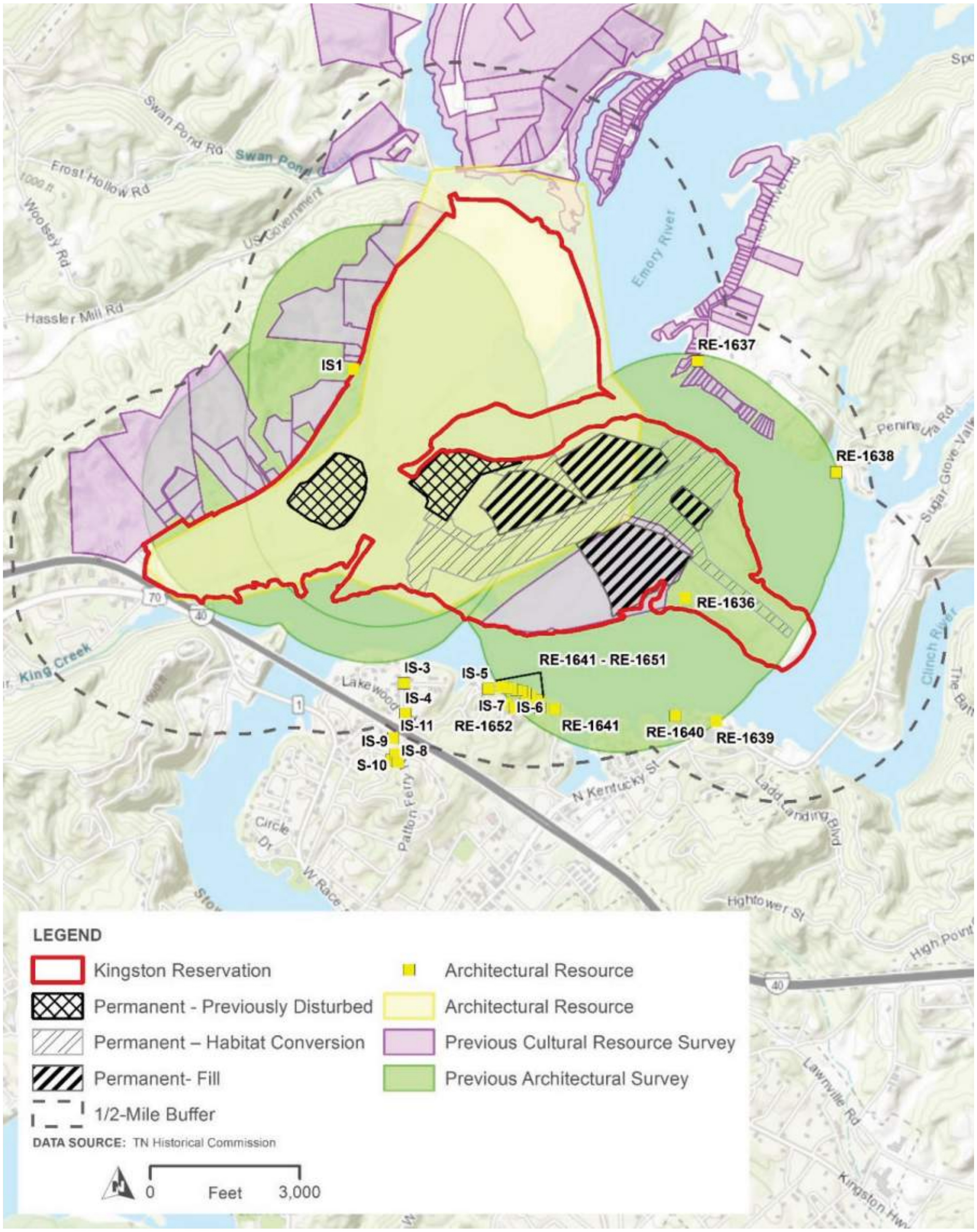

Figure 3.13-1. Historic Architectural Resources and Locations of Previous Cultural Resources Surveys Within 0.5-Mile Buffer Surrounding of the Kingston Reservation.

There are three sites in the D4 footprint (40RE44, 40RE44c, and 40RE44d). In TVA's ongoing consultation, they presented their finding that all three sites are non-extant and therefore not NRHP-eligible. Potentially eligible archaeological sites 40RE44a and 40RE622 are located on the KIF Reservation but outside the project footprint. No NRHP-eligible or potentially eligible archaeological sites are in the footprints of the proposed KIF D4 activities. Potentially eligible archaeological sites 40RE44a and 40RE622 are located on the KIF Reservation but outside the project footprint. A historic cemetery, the Green Cemetery, is located on the KIF Reservation but is outside the project footprint.

Table 3.13-1. Previously Recorded Archaeological Sites Within the Kingston Reservation

Site Number	NRHP Eligibility Status
40RE44	Non-Extant (Not Eligible)
40RE44a	Undetermined
40RE44c	Non-Extant (Not Eligible)
40RE44d	Non-Extant (Not Eligible)
40RE45	Eligible
40RE142	Not Eligible
40RE143	Not Eligible
40RE612	Not Eligible
40RE618	Not Eligible
40RE620	Not Eligible
40RE621	Not Eligible
40RE622	Undetermined
40RE623	Not Eligible
40RE624	Not Eligible
40RE625	Not Eligible
40RE626	Undetermined

TVA completed an inventory and NRHP assessment of KIF as part of a historic architectural survey for the proposed Kingston Dewatering Facility in 2015 (Karpynec and Weaver 2016). Based on that assessment TVA determined KIF ineligible for inclusion in the NRHP due to modern alterations and additions that have compromised the property's physical integrity, and the SHPO agreed.

Areas within the potential viewsheds of the CC/Aero CT Plant, switchyard, 3- to 4-MW solar array, and BESS have been included in historic architectural surveys that TVA has completed for prior undertakings by Huitt-Thornton et al. 2019; Karpynec and Weaver 2016; Karpynec and McKee 2009; and Wild et al. 2003 (as illustrated in Figure 3.13-2).Those surveys failed to identify any NRHP-listed or -eligible above ground properties in these areas.

In June 2022, on behalf of TVA, HDR conducted an architectural resources survey of a 0.5-mile buffer around the CC/Aero CT Plant and switchyard footprints of the proposed Alternative A to evaluate potential visual effects of new construction (as shown on Figure 3.13-2). During the architectural resources survey, HDR recorded a total of 17 architectural resources located within the 0.5-mile buffer around KIF, all within Roane County. The resources recorded in Roane

County include two cemeteries (RE-1636 [Green Cemetery] and RE-1637 [Suddath Cemetery]) and 15 dwellings (RE-1638 through RE-1652) built between 1960 and 1972 (HDR 2023b). These resources are summarized in Table 3.13-2.

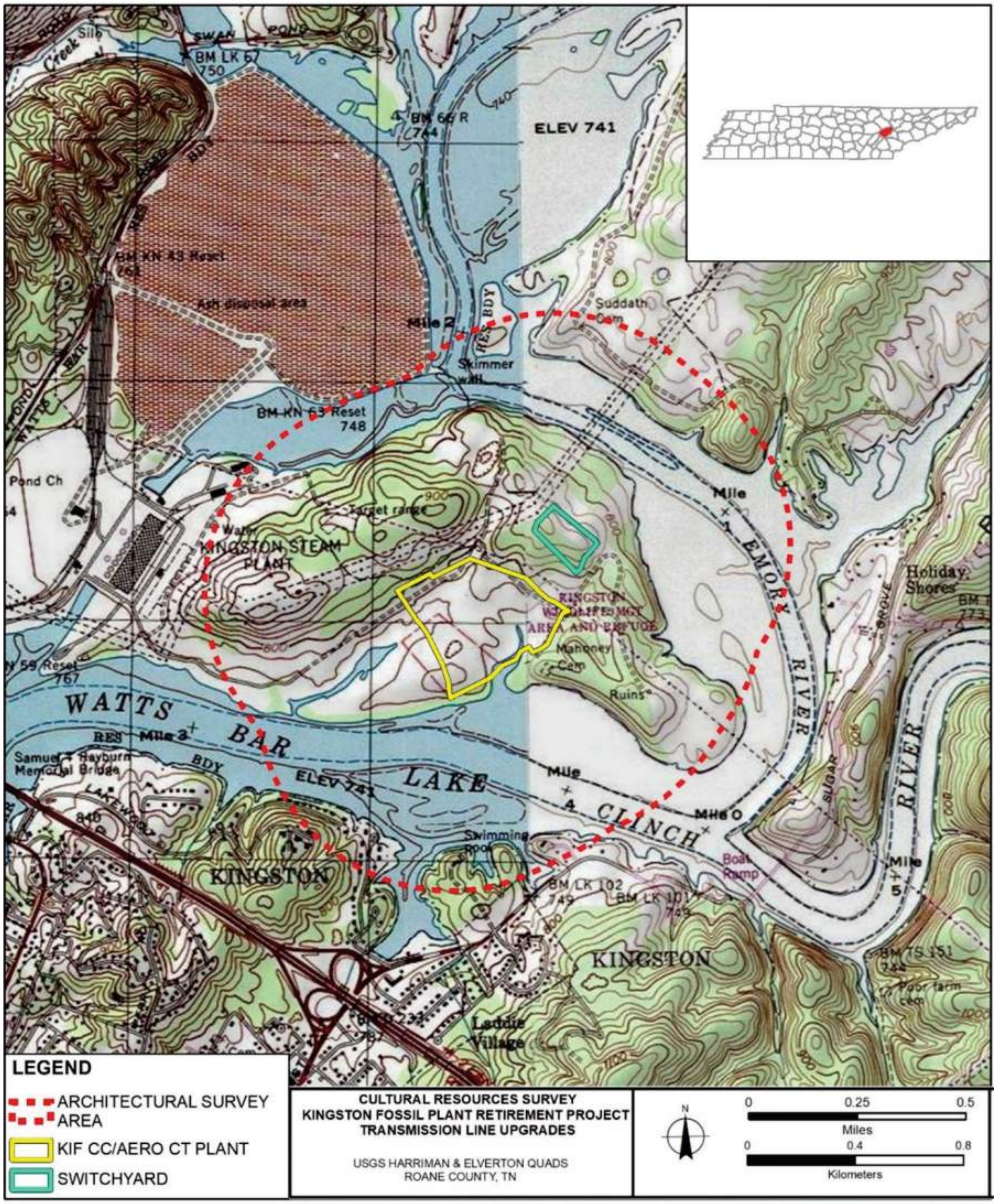

Figure 3.13-2. Architectural Resources Survey Boundary Evaluated on the Kingston Reservation (Source: HDR 2023b).

Of the 17 architectural resources recorded in this portion of the APE, only one, RE-1636 (Green Cemetery), is recommended as eligible for listing in the NRHP (HDR 2023b). TVA has determined that this cemetery should be considered eligible under Criteria Consideration D, for significance under Criterion A.

Table 3.13-2. Newly Recorded Architectural Resources within the KIF Architectural Survey Area

Number	County	Year built	Function	NRHP Recommendation
RE-1636	Roane	ca. 1870	Cemetery	Eligible
RE-1637	Roane	ca. 1880	Cemetery	Not eligible
RE-1638	Roane	1960	Dwelling	Not eligible
RE-1639	Roane	1920	Dwelling	Not eligible
RE-1640	Roane	1964	Dwelling	Not eligible
RE-1641	Roane	1953	Dwelling	Not eligible
RE-1642	Roane	1960	Dwelling	Not eligible
RE-1643	Roane	1971	Dwelling	Not eligible
RE-1644	Roane	1954	Dwelling	Not eligible
RE-1645	Roane	1970	Dwelling	Not eligible
RE-1646	Roane	1965	Dwelling	Not eligible
RE-1647	Roane	1960	Dwelling	Not eligible
RE-1648	Roane	1955	Dwelling	Not eligible
RE-1649	Roane	1960	Dwelling	Not eligible
RE-1650	Roane	1958	Dwelling	Not eligible
RE-1651	Roane	1955	Dwelling	Not eligible
RE-1652	Roane	1963	Dwelling	Not eligible

3.13.2.2 Alternative A

For Alternative A, the APE includes multiple large areas, some of which are non-contiguous because the proposed undertaking encompasses various large-scale actions, each different in nature, occurring at various places at various times. TVA determined the APE for this undertaking as including : the approximately 48-acre area where KIF D4 activities would occur; the proposed construction footprints of the CC/Aero CT Plant (55 acres) and associated switchyard (8.5 acres); the proposed footprint of the 3- to 4-MW solar array (35 acres) and three alternate sites for the BESS (between 30 and 40 acres) on the KIF Reservation; transmission line upgrades on the Kingston Reservation and existing off-site transmission lines that would be upgraded in connection with construction of the new Kingston CC/Aero CT Plant; and the anticipated viewsheds of the new CC/Aero CT Plant, switchyard, solar array, and BESS (where visual effects on NRHP-listed or –eligible historic architectural properties could occur).

Within this APE, areas where physical effects could occur are referred to in this EIS as “project footprint” and areas where only visual effects from new construction could occur are identified as “viewshed.” The project viewshed is delineated to include areas within one-half mile of the proposed new facilities (CC/Aero CT Plant, switchyard, solar, and battery storage) where those facilities would be visible. As the proposed on- or off-site transmission upgrades would occur in areas already occupied by high-voltage transmission lines and would not result in significant increases in structure heights, the transmission upgrades portion of the project is not considered to have potential for visual effects.

Project affected environments are also assessed for the related action, construction and operation of 122 miles of natural gas pipeline and associated structures.

3.13.2.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on Kingston Reservation

Green Cemetery is surrounded by mature vegetation that serves as a visual screen between the grounds and the proposed KIF Plant, minimizing the potential visual impact of the project on the historic property. The Project would not affect the integrity of the Green Cemetery nor limit its ability to convey its significance. Therefore, TVA has recommended a finding of no effects to historic properties under Alternative A. The proposed CC/Aero CT Plant site and new switchyard would be located within the Kingston Reservation property boundary; as such, cultural resources are generally as described in Section 3.13.2.1. None of the known sites identified in Section 3.13.2.1 would be located within the new switchyard site footprint. Site 40RE45 is the only recorded site eligible for listing in the NRHP that is located within the potential CC/Aero CT Plant footprint. Site 40RE45 was originally documented in 1941 as a Pre-Contact mound site but lacks a confirmed description of its exact location; therefore, the current Tennessee Division of Archaeology (TDOA) mapped site boundary is potentially inaccurate. Subsequent investigations have failed to identify evidence that would indicate remnants of a mound feature. Phase II investigations were performed during summer 2022 in mapped portions of the 40RE45 site boundary. The Phase II investigations consisted of both close interval and standard interval shovel testing combined with 1 x 1 m test units. Based on the site integrity, high artifact density, presence of intact cultural features, and diagnostic artifacts, TVA has determined site 40RE45 is eligible for listing in the NRHP under Criterion D. However, the currently proposed project footprint does not overlap with the significant archaeological deposits within the revised 40RE45 boundary. Based on this study TVA finds the site is not located in the project’s footprint. TVA is currently consulting with the TN SHPO and federally recognized Indian tribes regarding the phase II study and this finding. One site that is considered “undetermined” or potentially eligible for inclusion in the NRHP, 40RE626, is located partially within the area affected by proposed on-site transmission line upgrades. However, TVA and SHPO have agreed that the portion of the site within the KIF Reservation, which is also the portion in the project footprint, lacks characteristics that would make it eligible for the NRHP

3.13.2.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.13.2.1 apply to the proposed solar facility location on the Kingston Reservation. Site 40RE620 is in the footprint of Site 3, but TVA and SHPO agreed in 2019 that Site 40RE620 is ineligible for the NRHP. There are no archaeological sites within Sites 1 and 2 of the proposed solar facility location. Additionally, there are no NRHP-listed or eligible historic architectural resources within the half-mile buffer around the Kingston Reservation boundary.

3.13.2.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.13.2.1 apply to the proposed 100-MW BESS on the Kingston Reservation. There are no archaeological sites within the three potential BESS locations (Figure 2.1-5). Additionally, there are no NRHP-listed or –eligible historic architectural resources within the half-mile buffer around the Kingston Reservation boundary.

3.13.2.2.4 On-site Transmission

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant facilities and switchyard. Archaeological Site 40RE626, located on the northern edge of the transmission line footprint, is considered to be potentially eligible for the NRHP. However, the portion of the site within the transmission line footprint lacks intact deposits.

3.13.2.2.5 Off-site Transmission

Under Alternative A, TVA would upgrade existing transmission lines in the Eastern Transmission Corridor (L5108, L5116, L5208, L5302, and L5381) originating at the Kingston Reservation, and the Western Transmission Corridor (L5383) located in western TN. Descriptions of these improvements can be found in Section 2.1.3.5.

3.13.2.2.5.1 Eastern Transmission Corridor

Lines 5108 and 5302 – Data from Field Surveys

Architectural Resources

TVA has found (in consultation with SHPO) that the proposed transmission reconductoring and upgrade activities would not result in the potential for visual effects on above-ground resources outside the project footprint; as such, visual effects are not evaluated further for the proposed off-site transmission upgrades to L5108 and L5302.

TVA has found that the proposed transmission line upgrades would not adversely affect any potentially historic transmission lines and is consulting with the SHPO regarding this finding. Four segments meet minimum age requirements and have integrity (greater than 79 percent of original structures), but no work is proposed that could adversely affect these transmission lines.

Archaeological Resources

TVA completed archaeological surveys of transmission line corridors and 20 access roads associated with L5108, resulting in the identification of two archaeological sites (40AN277 and 40AN278) (Lipke et al. 2023). Both sites are Pre-Contact lithic scatters. TVA has determined that both sites should be considered not eligible for the NRHP and is consulting with the SHPO and federally recognized Indian tribes regarding this finding.

L5302 extends from the current Kingston Reservation travelling eastbound and terminates in the city of Oak Ridge. Several access roads are proposed largely along routes that have already been cleared. Archaeological surveys were conducted of L5302 and associated access roads; no archaeological resources were identified in this portion of the Eastern Transmission Corridor.

In coordination with TVA, a survey for aboveground architectural resources along existing transmission line corridors was determined not necessary given the lack of potential visual impacts associated with the proposed reconductoring and upgrade efforts for the existing transmission lines. When architectural resources were encountered within the transmission line corridors (a total of two resources in the Western Transmission Line Corridor), the project archaeologist coordinated with the architectural historian to record those resources. Only Green Cemetery (RE-1636) is recommended eligible for listing in the NRHP under Criteria Consideration D.

Lines 5116, 5280, and 5381 – Data from Desktop Analyses

Under Alternative A, TVA also proposes upgrades to L5116, L5280, and L5381 of the Eastern Transmission Corridor. L5116 extends eastward from the current Kingston reservation and terminates at the Bethel Valley Switching Station. Several access roads are along routes that have already been cleared. The eastern portion of L5116 is within the Oak Ridge National Security Complex. The western portion of L5116 is parallel to and partially overlapping the corridor previously evaluated for L5108. Cultural resource surveys are underway for these three additional lines; final survey results will be incorporated into the final EIS. Preliminary desktop data is presented below.

Architectural Resources

The only previously recorded historic architectural resource near the transmission line upgrades not already covered in L5108, L5302, and L5383 is Bethel Cemetery. This cemetery is listed in the NRHP (Figure 3.13-3a-d).

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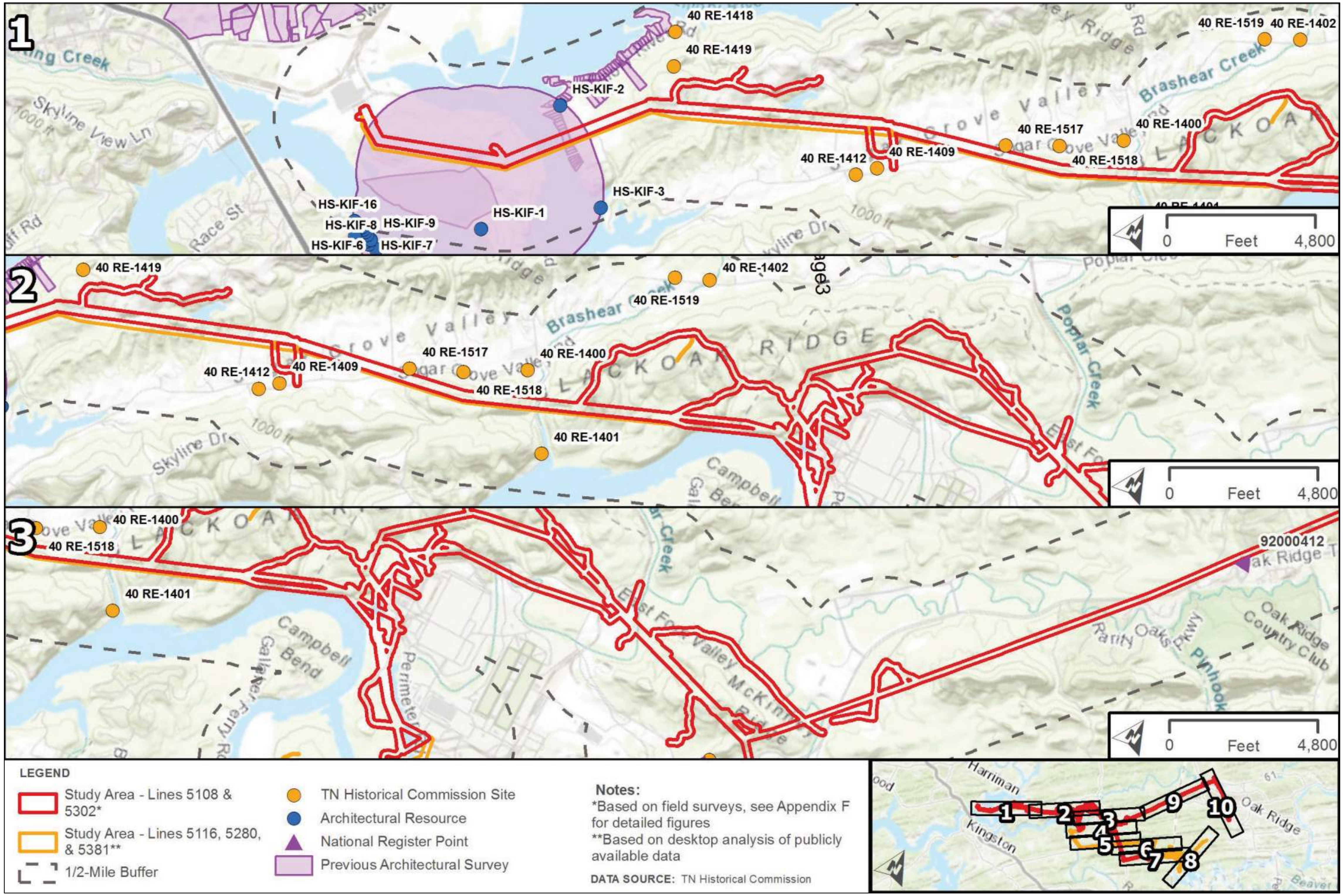

Figure 3.13-3a. Historic Architectural Resources Within 0.5-Mile Buffer of Lines 5116, 5280, and 5381 of the Eastern Transmission Line Corridor

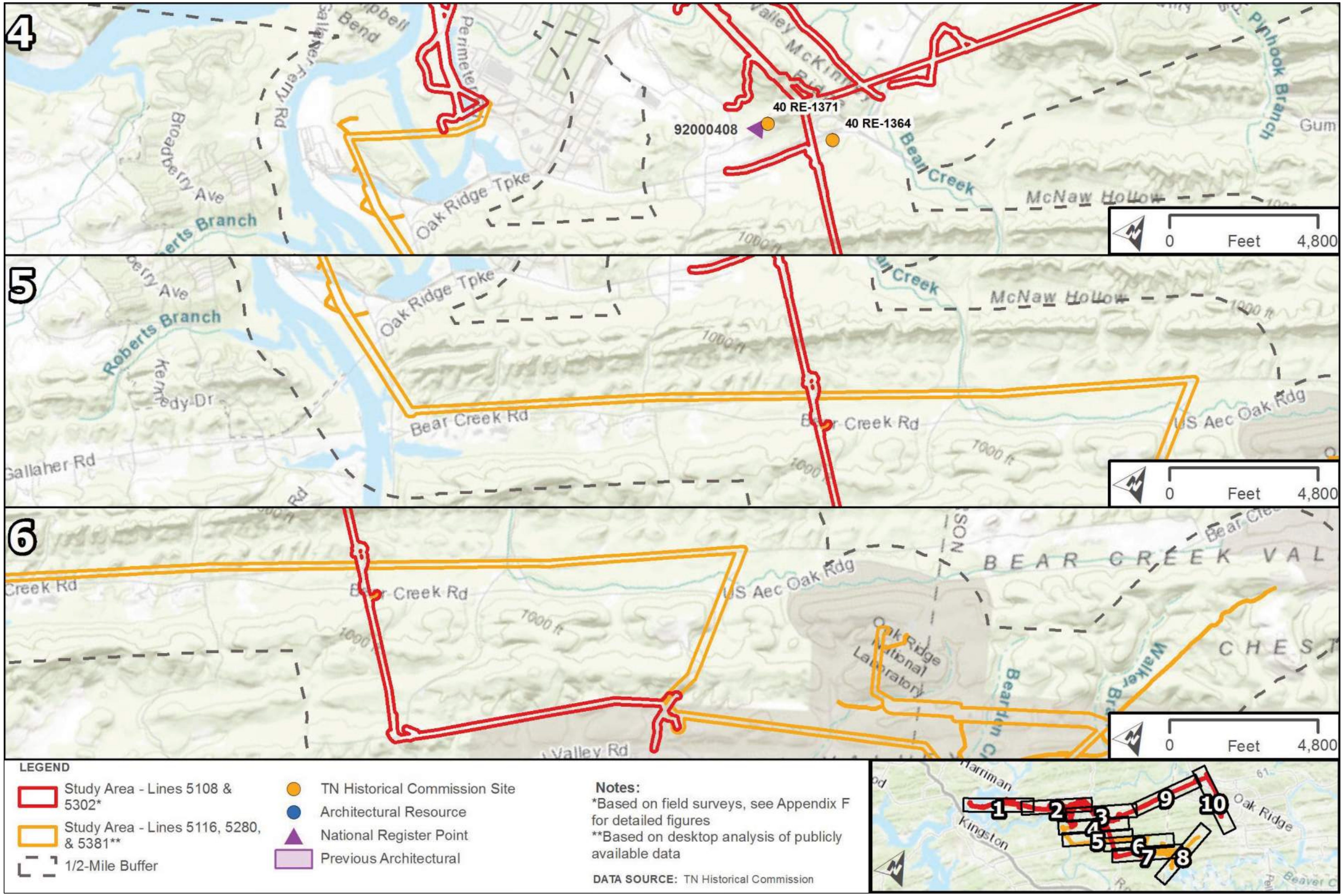

Figure 3.13-3b. Historic Architectural Resources Within 0.5-Mile Buffer of Lines 5116, 5280, and 5381 of the Eastern Transmission Line Corridor

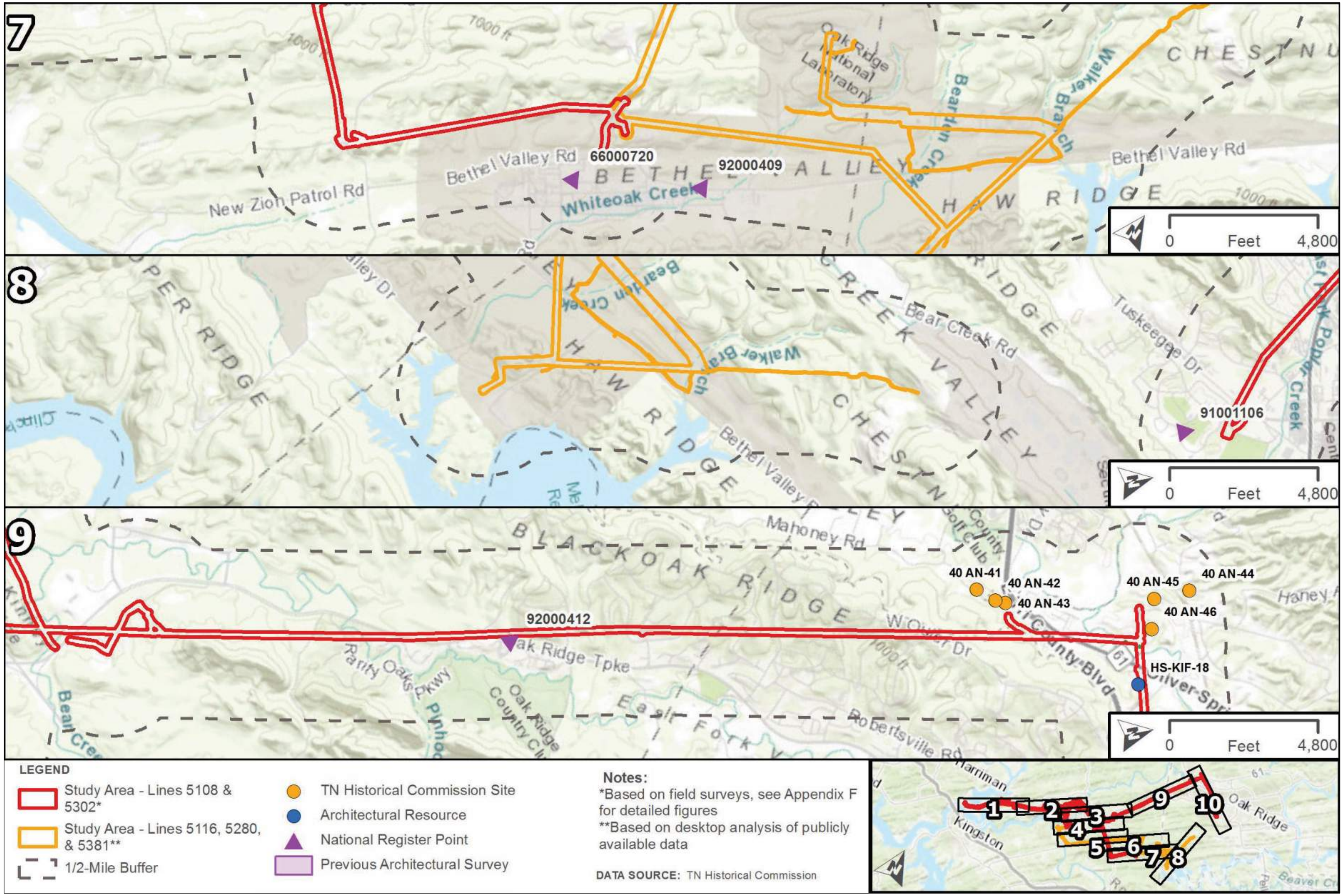

Figure 3.13-3c. Historic Architectural Resources Within 0.5-Mile Buffer of Lines 5116, 5280, and 5381 of the Eastern Transmission Line Corridor

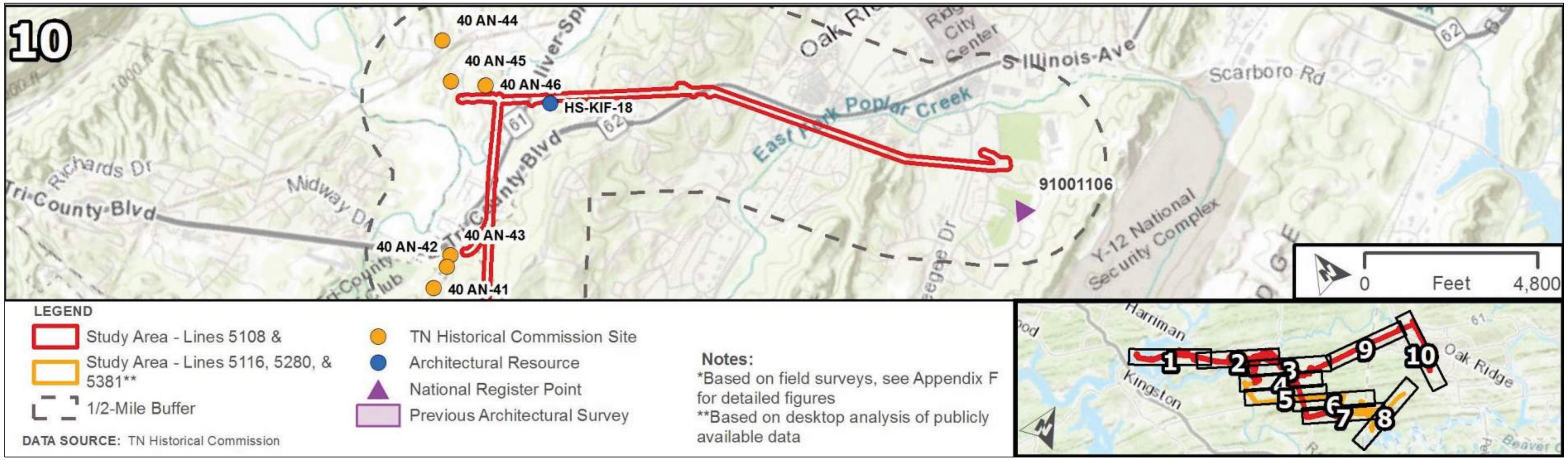

Figure 3.13-3d. Historic Architectural Resources Within 0.5-Mile Buffer of Lines 5116, 5280, and 5381 of the Eastern Transmission Line Corridor

Archaeological Resources

There are 35 previously recorded archaeological sites within 0.5 mile of the transmission line upgrades not already covered in L5108, L5302, and L5382. These sites are summarized in Table 3.13-3 below. Two of these sites are potentially eligible for the NRHP; the NRHP eligibility status of the remainder is unknown. Site 40RE567 is the only previously recorded archaeological site within the proposed right-of-way of the transmission line upgrades.

Table 3.13-3. Previously Recorded Archaeological Sites Within 0.5-Mile Buffer of Eastern Transmission Corridor (Lines5116, 5280, and 5381) under Alternative A

Site Number	NRHP Eligibility Status
40AN228	No Data
40AN229	No Data
40AN230	No Data
40RE89	No Data
40RE90	No Data
40RE91	No Data
40RE110	No Data
40RE123	No Data
40RE125	No Data
40RE135	No Data
40RE138	No Data
40RE139	No Data
40RE140	No Data
40RE202	No Data
40RE232	No Data
40RE233	No Data
40RE488	No Data
40RE492	No Data
40RE493	No Data
40RE501	Determined Potentially Eligible
40RE566	No Data
40RE567	No Data
40RE575	No Data
40RE576	No Data
40RE593	No Data
40RE595	No Data
40RE597	No Data
40RE602	No Data
40RE613	No Data
40RE615	No Data
40RE616	No Data
40RE617	No Data
40RE619	No Data
40RE622	Determined Potentially Eligible
40RE636	No Data

3.13.2.2.5.2 Western Transmission Corridor

Line 5383 – Data from Field Surveys

Architectural Resources

TVA determined no survey for aboveground architectural resources along existing transmission line corridors was necessary given the lack of potential visual impacts associated with the proposed reconductoring and upgrade efforts for the existing transmission lines. When architectural resources were encountered within the transmission line corridors (a total of two resources in the Western Transmission Line Corridor) during the archaeological survey, the project archaeologist coordinated with the architectural historian to record those resources. During the archaeological survey, two architectural resources in Cumberland County (CU-929 [Green Acres Cemetery] and CU-930 [Fredonia Baptist Church Cemetery]) were encountered in the survey area and recorded. CU-929 and CU-930 are recommended not eligible for listing in the NRHP. TVA has found (in consultation with SHPO) that the proposed transmission reconductoring and upgrade activities would not result in the potential for visual effects on above-ground resources outside the project footprint; as such, visual effects are not evaluated further for the proposed offsite transmission upgrades to L5383.

Archaeological Resources

L5383 extends from a substation in unincorporated Crossville on Plateau Road in a southeast direction and terminates north of the Crossville city limits. The line is composed of two segments. Several access roads are proposed along the route in agricultural areas. TVA completed archaeological surveys of two transmission line segments and eight access roads associated with L5383, resulting in the identification of one archaeological site (40CU91) and one isolated find (HDR-IF-001). Site 40CU91 is a scatter of historic artifacts. Site HDR-IF-001 is a Pre-Contact isolated find. TVA has determined that both resources should be considered not eligible for the NRHP and is consulting with the SHPO and federally recognized Indian tribes regarding this finding.

Additionally, four previously recorded sites (40RE620, 40RE228, 40RE572, and 40RE224) were revisited during the cultural resources survey. Subsequent visual inspection, pedestrian survey, and shovel testing failed to yield any evidence of the previously recorded sites.

3.13.2.2.6 -Construction and Operation of a Natural Gas Pipeline

3.13.2.2.6.1 Agency Consultation

As stated in ETNG's Resource Report 4 (ETNG 2022e):

> [ETNG], on behalf of the FERC, initiated Section 106 consultation with various state and local agencies and Native American groups located in or having areas of interest regarding cultural and historic resources in Tennessee.
>
> [ETNG] initiated consultation with the Tennessee SHPO via letter dated December 9, 2021, to provide a methodology for historic architectural resources survey. In a letter dated December 27, 2021, the SHPO concurred with the proposed architectural surveying methodology for both the [ETNG Construction ROW] and the proposed buildings
>
> On April 13, 2022, [ETNG] submitted a letter to the SHPO to notify them of the planned Project and [ETNG's] intent to request authorization to use the FERC pre-filing process and to invite the SHPO to participate in this process. On June

> 7, 2022, [ETNG] submitted a letter to the SHPO to update them on Project developments.
>
> On December 2, 2022, [ETNG] submitted the draft Phase I Survey Report and the Phase II work plan to the SHPO for review.

3.13.2.2.6.2 Native American Consultations

As stated in ETNG's Resource Report 5 (ETNG 2022f):

> [ETNG] initiated communications with 18 federally recognized Native American tribes to provide an opportunity for comments related to traditional cultural or religious properties of significance that may be affected by the Project. On August 26, 2021, [ETNG] submitted hardcopy letters to the tribes, to introduce the Project during the early stage of Project development. [ETNG] also presented the introductory letter to the tribes via email on September 1, 2021. Of the 18 tribal letters sent in August and September 2021, [ETNG] received responses from the Choctaw Nation of Oklahoma, Cherokee Nation, the Chickasaw Nation, the Eastern Shawnee Tribe of Oklahoma, and the Quapaw Tribe of Indians.
>
> On August 11, 2022, FERC initiated consultation with 17 federally recognized Native American tribes, all of whom had been included in the August 2021 correspondence. One tribe, the Absentee Shawnee Tribe of Indians of Oklahoma, was not included in the August 2022 outreach. FERC has received formal responses from the Cherokee Nation, Choctaw Nation of Oklahoma, the Eastern Shawnee Tribe of Oklahoma, and the Quapaw Tribe of Indians.
>
> On December 2, 2022, [ETNG] submitted the draft Phase I Survey Report and the Phase II work plan to 16 federally recognized Native American Tribes for review. The Quapaw Nation previously filed correspondence with FERC stating that the Project is not located within their tribal area of interest; therefore, they did not receive the Phase I Survey Report. (ETNG 2022e).

3.13.2.2.6.3 Area of Potential Effects

The following description from ETNG's Resource Report 4 (ETNG 2022e) defines the APE for historic architectural/industrial properties:

> In December 2021, [ETNG], in consultation with the SHPO, defined the Indirect APE for historic architectural resources. It was determined that the proposed underground facilities along the [ETNG Construction ROW] have a minimal potential to affect historic architectural resources. As such, for the length of the [ETNG Construction ROW], the APE for historic architectural resources will be defined as follows:
>
> - [Pipeline corridor]: Effects within the boundaries of NRHP-listed properties intersected by the Project, and any buildings or structures 50 years of age or older that will be directly impacted by the proposed Project. If such resources are located, the entirety of the parcel on which they are located will be subject to historic architectural resource survey.
>
> For aboveground Project facilities with the potential for visual effects, the APE for historic architectural resources will be defined as follows:

- Compressor stations, meter stations, and crossover sites: The APE will include the Project area plus any areas within one-half mile of the Project area containing historic resources from which the Project facilities will be visible. The viewshed will be defined utilizing GIS-based viewshed analysis and confirmed based on lines of sight in the field.

- Mainline valves: The APE will include the Project area plus any areas within 500 feet of the Project area containing historic resources from which the Project area will be visible.

The archaeological APE is defined as an approximately 122-mile-long pipeline construction ROW and adjoining ATWS, access roads, and aboveground facility workspace and footprints (ETNG 2022e).

3.13.2.2.6.4 Previously Recorded Cultural Resources

ETNG's Resource Report 4, Cultural Resources (2022e), which TVA has independently reviewed, provides the following regarding architectural resources within the APE of the pipeline:

> [Cultural Resources Analysts, Inc. (CRA)] obtained information for previous architectural resources in the APE from the [Tennessee Historical Commission] Viewer website in lieu of in-office research, since the office of the SHPO was not open to researchers due to COVID-19 pandemic restrictions.
>
> The review identified 23 previously recorded historic architectural resources within the 0.5-mile radius study are area. Four resources that are within, or partially within, the 300-foot pipeline survey corridor are listed in the NRHP, including: Officer Farmstead (1000469), Averitt-Herod House (96000411), Hartsville Battlefield (98001247; 40TR51), and Fort Blount-Williamsburg (74001918; 40JK125). Architectural resource JK-376 (Samuel Smith/Smith) within the APE was previously recommended as eligible for listing in the NRHP. It should be noted, however, that the NRHP eligibility of resources indicated in the THC Viewer reflects the opinion of the previous surveyor and does not necessarily reflect concurrence from THC or the status of the property.

The recorded historic architectural resources identified within the half-mile radius of the potential ETNG Construction ROW are summarized in Table 3.13-4 and depicted on figures in Appendix D-7.

Table 3.13-4. Previously Recorded Historic Architectural Resources Within 0.5 Mile of the ETNG Construction ROW

Resource	Historic Name	Common Name	Construction Date	NRHP
1000496	Officer Farmstead		1806-circa 1951	Listed
7400191	Fort Blount-Williamsburg Site		1790s	Listed
96000411	Averitt-Herod House		1834-1866	Listed
98001247	Hartsville Battlefield		1862	Listed
JK-166	Unknown	Unknown		Not Eligible

Resource	Historic Name	Common Name	Construction Date	NRHP
JK-373			1920	Not Eligible
JK-376	**Samuel Smith**	**Smith**	**1867**	**Eligible**
JK-387	William Smith	n/a	1910	Not Eligible
JK-496	Riley Spurlock	Ragland Sisters place	1904	Not Eligible
JK-499	Doug Flatt	Hagy Place	1910	Not Eligible
JK-501	Henry Flatt	Flatt Place	1909	Not Eligible
JK-503	Forest Chaffin	Birdwell House	1912	Not Eligible
JK-504	Aunt Nan Rash House	Williams Residence	1890	Not Eligible
MO-191	Watt Branstetter House	Wilburn Hanahan House	1880	Not Eligible
MO-192	Earl Branstetter House	Joyce Chatman House	1925	Not Eligible
MO-381	Old Dillon House	Juanita Hargis House	1910	Not Eligible
MO-401	Ed Love House	Fate Cox, Sr. House	1905	Not Eligible
OV-354	John Officer	Nilon Neeley	1910	Not Eligible
SH-1136	Strong	Carsey Kemp	1850	Not Eligible
SH-1137	Stone Cemetery	Stone		Not Eligible
SH-1139	Dakes	Pearl Anderson	1920	Not Eligible
SH-1147				Not Eligible
TR-137	Carey House	Kyle House	1932	Unknown

***Bold resource is eligible for listing in the NRHP**
Source: ETNG 2022e

CRA consulted the Tennessee State Archaeological Site Files (Site Files) maintained by the TDOA to determine if previously recorded archaeological resources were located within, or adjacent to, the pipeline and associated structures. Resources located within a 0.5-mile radius of the proposed pipeline and associated structures were recorded during this review. ETNG's Resource Report 4 (ETNG 2022e), which TVA has independently reviewed, provides the following regarding archaeological resources within the APE pipeline:

> The TDOA Site Files identified 39 previously recorded sites that were within or partially within the APE. Six previously recorded sites within or partially within the APE are either listed in the NRHP or have been determined eligible for listing in the NRHP. Sites 40JK125 (NRHP Reference No. 74001918) and 40TR51 (NRHP Reference No. 98001247) are listed on the NRHP, and sites 40JK171, 40PM85, 40PM89, and 40PM90 have been determined eligible for listing in the NRHP. One additional site, 40TR92, located outside of the APE within the 0.5-mile buffer was also recommended as eligible for listing in the NRHP.
>
> Four sites (40TR66, 40PM36, 40PM96, and 40SM12) have also been recommended as potentially eligible. Four sites (40TR66, 40OV1, 40JK125, and 40JK171) within the APE have associated mortuary features. Of these, two are historic cemeteries, one is a precontact cemetery, and one is not well documented but appears to represent a cave with precontact interments. Site location was the only information on the site for three sites previously recorded within the APE.

These sites are summarized in Table 3.13-5.

Table 3.13-5. Previously Recorded Archaeological Sites in the Proposed Pipeline Study Corridor[1]

Site Number	County	Site Type	Mortuary Features	NRHP Status
40JK34	Jackson	Pre-Contact	No	Not Eligible
40JK125	**Jackson**	**Pre-Contact and Historic**	**Yes**	**Listed**
40JK171	**Jackson**	**Pre-Contact and Historic**	**Yes**	**Eligible**
40JK172	Jackson	Pre-Contact	No	Unassessed
40JK174	Jackson	Pre-Contact	No	Not Eligible
40JK173	Jackson	Pre-Contact	No	Not Eligible
40JK273	Jackson	Pre-Contact	No	Unassessed
40MO11	Morgan	No data	No data	No data
40MO12	Morgan	No data	No data	No data
40MO119	Morgan	Pre-Contact	No	Unassessed
40OV1	Overton	Pre-Contact	Yes	Unassessed
40OV14	Overton	Pre-Contact	No	Unassessed
40OV31	Overton	Pre-Contact	No	Not Eligible
40PM35	Putnam	Pre-Contact	No	Not Eligible
40PM36	**Putnam**	**Pre-Contact**	**No**	**Potentially Eligible**
40PM81	Putnam	Pre-Contact	No	Unassessed
40PM82	Putnam	Pre-Contact	No	Unassessed
40PM83	Putnam	Pre-Contact and Historic	No	Unassessed
40PM84	Putnam	Pre-Contact and Historic	No	Unassessed
40PM85	Putnam	Pre-Contact	No	Not Eligible
40PM86	Putnam	Pre-Contact	No	Not Eligible
40PM87	Putnam	Pre-Contact	No	Not Eligible
40PM88	Putnam	Pre-Contact	No	Not Eligible
40PM89	**Putnam**	**Pre-Contact and Historic**	**No**	**Eligible**
40PM90	**Putnam**	**Pre-Contact**	**No**	**Eligible**
40PM96	**Putnam**	**Pre-Contact**	**No**	**Potentially Eligible**
40PM97	Putnam	Pre-Contact	No	Unassessed
40RE539	Roane	Pre-Contact	No	Not Eligible
40SM12	**Smith**	**Pre-Contact**	**No**	**Potentially Eligible**
40SM156	Smith	Pre-Contact	No	Not Eligible
40TR6	Trousdale	No data	No data	No data
40TR44	Trousdale	Pre-Contact	No	Unassessed
40TR45	Trousdale	Pre-Contact	No	Unassessed
40TR46	Trousdale	Pre-Contact	No	Unassessed
40TR47	Trousdale	Pre-Contact	No	Unassessed

Site Number	County	Site Type	Mortuary Features	NRHP Status
40TR51	Trousdale	Pre-Contact	No	Unassessed
40TR53	Trousdale	Pre-Contact	No	Not Eligible
40TR54	Trousdale	Pre-Contact	No	Not Eligible
40TR66	**Trousdale**	**Historic**	**Yes**	**Potentially Eligible**
40TR95	Trousdale	Pre-Contact and Historic	No	Unassessed

***Bold resources are eligible for listing or listed in the NRHP**
[1]The Area of Potential Effect for the ETNG Construction ROW is defined in Section 3.13.2.2.6.3 in this EIS.
Source: ETNG 2022e

According to ETNG's Resource Report 4 (ETNG 2022e):

> Following background research, CRA conducted Phase I field investigations for the [natural gas] project between October 19, 2021, and June 29, 2022. Approximately 4,723.9 total acres were surveyed including 4,467.7 acres of mainline pipeline corridor, 75.3 acres of access roads, 202.1 acres for the Hartsville Compressor Station and non-jurisdictional solar array, and two acres for a Harriman Lateral Crossover site which has been eliminated from the Project (Survey Area). The mainline pipeline survey corridor measured 300 feet wide on average and extends for 122.8 miles. Approximately 9.8 miles of [the ETNG Construction ROW] were not surveyed due to restricted landowner tracts, avoidance of sites that have previously been recommended as eligible or have been listed in the NRHP, or recent previous survey coverage.

Additionally, as stated in ETNG's Resource Report 4 (2022e):

> The archaeological survey included the revisit and reassessment of 29 previously recorded sites and the [documentation] of 133 previously unrecorded sites…Two previously recorded sites (40TR95 and 40PM36) were determined to merge with other previously documented sites in the APE and the two state site numbers were subsequently vacated. Site 40TR95 was combined with site 40TR44, and site 40PM36 was combined with 40PM35.
>
> Two previously recorded precontact sites (40JK174 and 40OV1) were not relocated. The previous site area of 40JK174 was surveyed but yielded no artifacts and no evidence of the site. Site 40OV1 is a previously documented precontact cave site mapped within the APE that was not [re]located during fieldwork. Following consultation with TDOA, the site is presumed to be located outside of the APE. Of the 29 previously recorded sites, 27 were relocated and reassessed within or partially within the mainline study corridor including the combination of sites 40TR95/40TR44 and 40PM46/40PM35, and two were not relocated. The reassessed previously recorded sites include 23 precontact sites, one historic cemetery, and five multicomponent sites.
>
> A total of 133 new sites were recorded during the current survey and consist of 117 precontact, 11 historic, and five multicomponent (precontact and contact components) sites. Of the 133 new sites, 3 were located in the Hartsville Compressor Station survey area, 4 were located exclusively within access road survey corridors, and 126 sites were located within, or partially within, the mainline pipeline survey corridor.

A total of 44 newly recorded and previously recorded sites are considered potentially eligible and additional work is recommended to evaluate their NRHP eligibility. Of these 44 total sites recommended for further work, 34 are precontact, 4 are historic, and 6 are multicomponent. Two additional previously recorded precontact sites (40PM89 and 40PM90), which are discussed below, were avoided during the current survey but are also recommended for agency consultation and further work if they cannot be avoided by construction activities.

In addition to these 44 sites, 4 previously recorded sites (40TR51, 40JK125, 40PM89, and 40PM90) within the APE are [potentially eligible]. These sites were not revisited during the current survey. Sites 40TR51 (the Hartsville Battlefield) and 40JK125 (Fort-Blount Williamsburg) are listed on the NRHP. Sites 40PM89 and 40PM90 were previously recommended as eligible for listing in the NRHP. Evaluation of the portions of these two sites within the current APE have not been conducted at this time and they are considered to be potentially eligible. Further consultation with state agencies is [in process by ETNG] to define a treatment plan for these two resources. [[35]].

The newly and previously recorded sites are summarized in Table 3.13-6. The new and previously recorded cemeteries are listed in Table 3.13-7.

Table 3.13-6. New and Previously Recorded Archaeological Sites in the ETNG Construction ROW

State Resource /Field Site Number	Resource Type	Applicant NRHP Assessment
	ETNG Construction ROW	
	Trousdale County, TN	
40TR6/FS-AB-1	Precontact	Not Eligible
40TR44	Multicomponent	Precontact (Not Eligible); Historic (Unassessed)
40TR53	Precontact	Not Eligible
40TR54	Precontact	Potentially Eligible
40TR66	Historic Cemetery	Existing Cemetery
40TR98/FS-AB-2	Precontact	Not Eligible
40TR99/FS-AB-04, FS-SJ-01	Precontact	Not Eligible
40TR100/FS-DL-20	Precontact	Not Eligible
40TR101/FS-DL-50	Precontact	Not Eligible
40TR103/FS-MD-01/FS-SJ-17	Precontact	Not Eligible
40TR104/FS-MD-02	Precontact	Not Eligible
40TR105/FS-SJ-02	Precontact	Not Eligible
40TR106/FS-SJ-05	Precontact	Not Eligible
40TR107/FS-SJ-06	Precontact	Not Eligible
40TR108/FS-SJ-10	Precontact	Not Eligible

35 Results of final impact determinations, SHPO consultation, and identified minimization, mitigation, and treatment plans will be provided by ETNG when filing their application for Certificate of Public Necessity with FERC. These data will be provided in TVA's final EIS package.

State Resource /Field Site Number	Resource Type	Applicant NRHP Assessment
40TR109/FS-SJ-12	Historic	Not Eligible
40TR110/FS-SJ-16	Precontact	Potentially Eligible
40TR111/FS-SJ-18	Precontact	Not Eligible
40TR112/FS-SJ-45, FS-SJ-46	Precontact	Not Eligible
40TR113/FS-SJ-47	Precontact	Not Eligible
40TR116/FS-SJ-03	Historic	Potentially Eligible
Smith County, TN		
40SM12/FS-MD-11	Precontact	Potentially Eligible
40SM156	Precontact	Potentially Eligible
40SM245/FS-DL-05, FS-SJ-24, FS-SJ-25	Multicomponent	Precontact: (Potentially Eligible); Historic (Not Eligible)
40SM246/FS-DL-6, FS-DL-7	Precontact	Potentially Eligible
40SM247/FS-DL-9, FS-DL-10	Multicomponent	Precontact: (Potentially Eligible); Historic (Not Eligible)
40SM248/FS-DL-12	Historic	Not Eligible
40SM249/FS-DL-13	Precontact	Not Eligible
40SM250/FS-DL-14	Precontact	Potentially Eligible
40SM251/FS-DL-15	Historic	Potentially Eligible
40SM252/FS-DL-17, FS-DM-22	Precontact	Potentially Eligible
40SM253/FS-DL-21	Precontact	Not Eligible
40SM254/FS-DL-22	Precontact	Not Eligible
40SM255/FS-DL-24	Precontact	Not Eligible
40SM256/FS-JR-01	Precontact	Not Eligible
40SM257/FS-MD-04	Precontact	Not Eligible
40SM258/FS-MD-05	Precontact	Not Eligible
40SM259/FS-MD-06	Precontact	Not Eligible
40SM260/FS-SJ-20, FS-SJ-21, FS-SJ-22	Precontact	Not Eligible
40SM261/FS-SJ-26	Precontact	Not Eligible
40SM262/FS-SJ-27	Precontact	Not Eligible
40SM263/FS-SJ-28	Precontact	Not Eligible
40SM264/FS-SJ-29	Precontact	Not Eligible
40SM265/FS-SJ-34, FS-SJ-35	Precontact	Not Eligible
40SM266/FS-SJ-36, FS-SJ-37	Precontact	Not Eligible
40SM267/FS-SJ-39, FS-SJ-40	Precontact	Not Eligible
40SM268/FS-SJ-41	Multicomponent	Not Eligible
40SM269/FS-SJ-51	Precontact	Not Eligible
Jackson County, TN		
40JK34	Precontact	Not Eligible
40JK171	Precontact	Potentially Eligible
40JK172	Precontact	Not Eligible
40JK173	Precontact	Potentially Eligible

State Resource /Field Site Number	Resource Type	Applicant NRHP Assessment
40JK174	Precontact	Not Eligible
40JK273/FS-SJ-68	Multicomponent	Potentially Eligible
40JK275/FS-JR-04	Precontact	Not Eligible
40JK276/FS-JR-12	Precontact	Not Eligible
40JK277-FS-JR-19	Precontact	Not Eligible
40JK282/-FS-DL-27	Precontact	Not Eligible
40JK283/FS-DL-34	Multicomponent	Potentially Eligible
40JK284/FS-DL-36	Precontact	Not Eligible
40JK285/FS_DL-37	Precontact	Not Eligible
40JK287/FS-DL-40	Precontact	Potentially Eligible
40JK288/FS-DL-41/42/43	Multicomponent	Potentially Eligible
40JK289/FS-DL-44, FS-JW-10, FS-JW-09	Precontact	Potentially Eligible
40JK290/FS-DL-47	Historic	Not Eligible
40JK291/FS-DM-01	Historic	Potentially Eligible
40JK292FS-DM-24	Historic	Not Eligible
40JK293/FS-JR-02, FS-JR-03	Precontact	Not Eligible
40JK294/FS-JR-09	Precontact	Potentially Eligible
40JK295/FS-JR-10	Precontact	Not Eligible
40JK296/FS-JR-11	Precontact	Not Eligible
40JK297/FS-JR-13	Precontact	Not Eligible
40JK298/FS-JR-14, FS-JR-37	Multicomponent	Precontact (Potentially Eligible); Historic (Not Eligible)
40JK299/FS-JR-15	Precontact	Not Eligible
40JK300/FS-JR-16	Precontact	Not Eligible
40JK301/FS-JR-17, FS-JR-18	Precontact	Not Eligible
40JK302/FS-JR-38	Precontact	Not Eligible
40JK303/FS-JW-02	Precontact	Not Eligible
40JK304/FS-JW-06	Precontact	Potentially Eligible
40JK305/FS-JW-07	Precontact	Not Eligible
40JK306/FS-JW-11	Precontact	Not Eligible
40JK307/FS-SJ-54	Precontact	Not Eligible
40JK308/FS-SJ-69, FS-SJ-70	Precontact	Not Eligible
40JK309/FS-SJ-71	Precontact	Not Eligible
40JK310/FS-SJ-72	Precontact	Potentially Eligible
40JK311/FS-SJ-73	Precontact	Not Eligible
40JK312FS-SJ-76	Precontact	Not Eligible
40JK313/FS-SJ-79	Precontact	Not Eligible
40JK314/FS-SJ-81	Precontact	Not Eligible
40JK315/FS-SJ-82	Precontact	Not Eligible
40JK316/FS-SJ-83	Precontact	Not Eligible

State Resource /Field Site Number	Resource Type	Applicant NRHP Assessment
40JK317/FS-SJ-85	Precontact	Not Eligible
40JK318/FS-SJ-86	Precontact	Not Eligible
40JK319/FS-SJ-87	Precontact	Not Eligible
FS-SJ-90	Historic	Unassessed
Putnam County, TN		
40PM35	Precontact	Potentially Eligible
40PM81	Precontact	Not Eligible
40PM82	Precontact	Potentially Eligible
40PM83	Multicomponent	Precontact (Potentially Eligible); Historic (Not Eligible)
40PM84	Multicomponent	Not Eligible
40PM85	Precontact	Potentially Eligible
40PM87	Precontact	Potentially Eligible
40PM88	Precontact	Potentially Eligible
40PM96	Precontact	Not Eligible
40PM97	Multicomponent	Not Eligible
40PM148	Precontact	Potentially Eligible
40PM149	Precontact	Not Eligible
40PM150/FS-DL-31	Precontact	Potentially Eligible
40PM151/FS-DL-68, FS-DL-69	Precontact	Not Eligible
40PM152/FS-DM-02, FS-DM-03, FS-DM-25	Precontact	Not Eligible
40PM153/FS-DM-07	Precontact	Potentially Eligible
40PM154/FS-DM-09	Precontact	Potentially Eligible
40PM155/FS-JR-06	Precontact	Potentially Eligible
40PM156/FS-JR-07	Precontact	Not Eligible
40PM157/FS-JR-08	Precontact	Potentially Eligible
40PM158/FS-JR-23	Precontact	Potentially Eligible
40PM159/FS-JR-24	Precontact	Potentially Eligible
40PM160/FS-JR-39	Precontact	Not Eligible
40PM161/FS-JR-40	Precontact	Not Eligible
40PM162/FS-JW-15	Precontact	Not Eligible
40PM163/FS-JW-16	Precontact	Not Eligible
40PM164/FS-DL30	Precontact	Potentially Eligible
40PM165/FS-SJ-60	Precontact	Not Eligible
40PM166/FS-SJ-61	Precontact	Not Eligible
40PM167/FS-SJ-63	Precontact	Not Eligible
40PM168/FS-DL-49	Precontact	Not Eligible
Overton County, TN		
40OV1	Precontact	Unassessed
40OV14/FS-JW-24, FS-DM-13, FS-DL-54	Precontact	Potentially Eligible

State Resource /Field Site Number	Resource Type	Applicant NRHP Assessment
40OV31/FS-DM-05, FS-DM-06	Precontact	Potentially Eligible
40OV173/FS-DL-52	Precontact	Potentially Eligible
40OV174/FS-DL-53	Precontact	Not Eligible
40OV176/FS-DM-11	Precontact	Not Eligible
40OV177/FS-JR-21	Precontact	Not Eligible
40OV178/FS-JR-22	Precontact	Not Eligible
40OV179/FS-JR-25	Precontact	Not Eligible
40OV180/FS-JR-26	Precontact	Not Eligible
40OV181/FS-JR-28	Precontact	Not Eligible
40OV182/FS-JR-29	Precontact	Not Eligible
40OV183/FS-JR-31	Precontact	Not Eligible
40OV184/FS-JR-32	Precontact	Not Eligible
40OV185/FS-JR-33, FS-JR-34	Precontact	Not Eligible
40OV186/FS-JW-19	Precontact	Not Eligible
40OV187/FS-JW20	Precontact	Not Eligible
40OV188/FS-MD-12	Precontact	Not Eligible
Fentress County, TN		
40FN426/FS-JW-26	Precontact	Not Eligible
40FN427/FS-JW-27	Precontact	Not Eligible
40FN425/FS-DM-14	Precontact	Not Eligible
Morgan County, TN		
40MO168/FS-JR-36	Precontact	Potentially Eligible
40MO171/FS-DL-59	Precontact	Not Eligible
40MO172/FS-DL-64	Historic	Not Eligible
40MO173/FS-DM-16	Precontact	Not Eligible
40MO174/FS-DM-18, FS-DM-19	Precontact	Not Eligible
40MO175/FS-DM-20	Precontact	Not Eligible
40MO176/FS-JW-31, FS-JW-32	Precontact	Not Eligible
40MO177/FS-JW-33	Precontact	Not Eligible
FS-SJ-88	Historic	Potentially Eligible
Roane County, TN		
40RE539	Precontact	Not Eligible
	Hartsville Compressor Station	
Trousdale County, TN		
40TR102/FS-DM-26	Precontact	Not Eligible
40TR114/FS-TJ-01	Historic	Not Eligible
40TR115/FS-TJ-02	Precontact	Not Eligible

Table 3.13-7. Previously Recorded Historic Cemeteries in the ETNG Construction ROW

Milepost	Cemetery ID	County	Age	Earliest and Latest Interment	Cemetery Description
3.1	Cemetery 1	Trousdale, TN	Historic	Unknown	Unnamed cemetery
6.9	Cemetery 2	Trousdale, TN	Historic	1894/1930	Reese Cemetery
9.2	Cemetery 3	Trousdale, TN	Historic	1845/1941	Corley-Shaw-Buford Cemetery
16.4	Cemetery 4	Smith, TN	Historic	Unknown	Unnamed cemetery
16.8	Cemetery 5	Smith, TN	Historic	1888/1950	Oldham Cemetery
17.8	Cemetery 6	Smith, TN	Historic	1766/1953	Stone Cemetery
22.5	Cemetery 7	Smith, TN	Historic	1835/1933	West Cemetery
22.7	Cemetery 8	Smith, TN	Historic	1878/1939	Williams Cemetery
28.3	Cemetery 9	Jackson, TN	Historic	1891/1928	Mill Hill Cemetery
32.2	Cemetery 10	Jackson, TN	Historic	1898/1920	Collins Family Cemetery
34.2	Cemetery 11	Jackson, TN	Precontact	N/A	Reinterred precontact mortuary feature; precise location unknown
40.9	Cemetery 12	Jackson, TN	Historic	1940/2021	Flatt-Woolbright Cemetery
41.5	Cemetery 13	Jackson, TN	Modern	2012/2021	Byers Cemetery extension
42.6	Cemetery 14	Jackson, TN	Historic	1885/2022	Young Cemetery
49.3	Cemetery 15	Putnam, TN	Historic	Unknown	Unnamed cemetery
53.0	Cemetery 16	Putnam, TN	Historic	1875/1968	Officers Chapel Cemetery
105.7	Cemetery 17	Morgan, TN	Modern	2017	Unnamed cemetery

Source: ETNG 2022e

3.13.2.3 Alternative B
TVA anticipates that the solar facilities proposed under Alternative B would be located within portions of East Tennessee. As specific sites have not yet been determined for evaluation under this alternative, typical cultural resources effects of solar and storage construction and transmission projects have been listed under Section 3.2 and Section 3.3. A broad overview of archaeological resources, historic structures, and TCPs in the TVA region is presented below.

3.13.2.3.1 Archaeological Resources
Human occupation in the TVA region began at the end of the Ice Age with the Paleo-Indian Period (13,500 – 11,000 years before present, or "B.P."). In the Tennessee Valley, prehistoric archaeological chronology is generally broken into four broad time periods: following the Paleo-Indian Period are the Archaic (11,000 – 3,000 B.P.), Woodland (3,000 – 1,100 B.P.), and Mississippian (1,100 – 500 B.P.) periods. Archaeological sites from all these periods, as well as from the more recent historic period, are numerous throughout the TVA region. They occur on a variety of landforms and in a multitude of environmental contexts. Sites are rarely found on steep slopes, with the exception of rock shelters, which have been used throughout the Pre-contact and historic periods and often contain artifacts and features with value to archaeology and history. Areas affected by construction, such as mining, civil works projects, and highways,

for example, tend to lack significant archaeological resources due to modern ground disturbing activities.

The most reliable information about the locations of archaeological sites in the Tennessee Valley is produced during Phase I archaeological surveys conducted by federal agencies for compliance with Section 106 and Section 110. Numerous surveys have been conducted along reservoir shorelines, within reservoirs, and on power plant reservations. Some TVA transmission line corridors and many highway corridors have also been surveyed. However, large areas remain that have not been surveyed. Outside of TVA reservoirs and power plant reservations, the density of surveys is low and relatively little is known about archaeological site distributions.

The earliest documentation of archaeological research in the region dates back to the 19th century when entities such as the Smithsonian Institute and individuals such as Cyrus Thomas undertook some of the first archaeological excavations in America to document the history of Native Americans (Guthe 1952). TVA was a pioneer in conducting archaeological investigations during the construction of its dams and reservoirs in the 1930s and early 1940s (Olinger and Howard 2009). Since then, TVA has conducted numerous archaeological surveys associated with permitting actions, power plants, and transmission system construction and maintenance. These surveys, as well as other off-reservoir projects, have identified more than 2,000 sites, including over 250 within or in the immediate vicinity of TVA transmission line rights-of-way. A large proportion of these sites have not been evaluated for NRHP eligibility.

The number of sites eligible or potentially eligible for listing on the NRHP in East Tennessee is unknown. While digitization of this data is under way, no consistent database is available for determining the number of archaeological sites within the TVA region. Survey coverage on private land has been inconsistent and is largely project-based rather than focusing on high probability areas, so data is unlikely to be representative of the total population of archaeological sites. Based on a search through TVA’s data and reports of archaeological surveys on reservoirs, TVA estimates that over 11,000 archaeological sites have been recorded on TVA reservoir lands, including submerged lands. Significant archaeological excavations have occurred as a result of TVA projects and federal projects and have yielded impressive information regarding the prehistoric and historic occupation of the Southeastern U.S. Notable recent excavations and related projects in the region include those associated with the Townsend highway expansion; Shiloh Mound on the Tennessee River in Hardin County; the Ravensford site in Swain County, North Carolina; and documentation of prehistoric cave art in Alabama and Tennessee.

3.13.2.3.2 Historic Structures

Historic architectural resources are found throughout the TVA region and can include houses, barns, public buildings, TVA facilities, and historic transmission lines. Many historic structures in the region have been either determined eligible for listing or have been listed in the NRHP. However, historic architectural surveys have been conducted in only a fraction of the land area within the region.

Over 5,000 historic structures have been inventoried in the vicinity of TVA reservoirs and power system facilities. Of those evaluated for NRHP eligibility, at least 85 are included in the NRHP and about 250 are considered eligible or potentially eligible for listing. Four of TVA’s coal-fired plants (John Sevier, Bull Run, Watts Bar, and Shawnee) have been determined eligible for the NRHP; one (Shawnee) is listed in the NRHP. TVA has determined that all other TVA fossil plants are NRHP-ineligible.

3.13.2.3.3 Traditional Cultural Properties

The TVA region is a diverse cultural landscape that held special meaning to its past inhabitants and to their descendants. Some of these places can be considered TCPs. Similarly, a cultural landscape is defined as "a geographic area, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values" (Birnbaum 1994). TVA does not make public sensitive information regarding the location or other information regarding sacred sites or TCPs identified by consulting tribes. Some examples of TCPs within the TVA region include mound sites, segments of the Trail of Tears, and stacked stone features. The Trail of Tears consisted of many routes and sub-routes that were traveled by Native Americans during their removal from their ancestral homelands. Segments of the Trail of Tears cross TVA transmission line corridors at approximately 278 locations (TVA 2018b). Stacked stone features often appear as single or a group of cylindrically stacked limestone. The origin and purpose of these stone features is uncertain, but a resolution passed by the United South and Eastern Tribes, Inc. (USET) in 2007 recommended that all federal agencies involved in the Section 106 process consider stacked stone features that cannot be conclusively linked to a historic origin to be a TCP under NRHP Criterion A (USET 2007).

3.13.3 Environmental Consequences

3.13.3.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate and maintain KIF. TVA would implement all of the planned actions related to the current and future management and storage of CCRs, which have either been reviewed or would be in subsequent NEPA analyses. Under the scope of this EIS, no work would be conducted that would result in loss or disturbance of cultural resources beyond existing conditions. Therefore, no project-related environmental effects to cultural resources would occur under this alternative.

3.13.3.2 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

Due to modifications made to the plant over the years, which have diminished its integrity as an historic architectural property, KIF is ineligible for the NRHP. Furthermore, there are no NRHP-eligible or potentially eligible archaeological sites in the D4 portion of the APE. The proposed activities under the D4 process are not activities with potential for visual effects on other above-ground resources; as such, this proposed action would not affect historic properties.

3.13.3.2.1 Environmental Justice Considerations

Effects to cultural resources that would occur as a result of the Kingston coal facility retirement and D4 activities are not anticipated to have amplified or adverse human health or environmental effects on EJ populations. Any effects would be avoided, minimized, or mitigated through implementation of cultural resources surveys and NHPA consultation with Native American tribes and interested stakeholders, which could include other EJ populations.

3.13.3.3 Alternative A

3.13.3.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on Kingston Reservation

One site that is considered "undetermined" or potentially eligible for inclusion in the NRHP, 40RE626, is located partially within the area affected by proposed on-site transmission line upgrades. Because 40RE45 is located outside the project footprint and TVA has no planned activities that could affect site 40RE626, the proposed action would not adversely affect any archaeological sites listed in, or eligible for listing in, the NRHP. Additionally, because there are no NRHP-listed or-eligible historic architectural properties in the APE, the proposed activity would not affect any above-ground historic properties.

To fulfill its obligations under Section 106 of the NHPA, TVA is consulting with the TN SHPO on specific effects to cultural resources. Cumulative effects to cultural resources are not anticipated as a result of past, /present and RFFAs near the proposed undertaking.

3.13.3.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

There are no archaeological sites within the proposed 3- to 4-MW solar facility location and no historic architectural properties listed in or eligible for listing in the NRHP are located in the viewshed of the proposed solar site. Therefore, this proposed action would not affect historic properties.

3.13.3.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.13.2.1 apply to the proposed 100-MW BESS on the Kingston Reservation. Site 40RE620 is in the footprint of Site 3, but TVA and SHPO agreed in 2019 that Site 40RE620 is ineligible for the NRHP. There are no archaeological sites within Sites 1 and 2 of the proposed solar facility location. Additionally, there are no NRHP-listed or –eligible historic architectural resources within the half-mile buffer around the Kingston Reservation boundary. No cultural resources would be affected by the construction and operation of the 100-MW BESS.

3.13.3.3.4 On-site Transmission Upgrades

The environmental consequences for on-site transmission upgrades on cultural resources are the same as those described in Sections 3.13.2.2 and 3.13.2.3.1. The proposed transmission line upgrades would not affect any cultural resources.

3.13.3.3.5 Off-site Transmission Upgrades

3.13.3.3.5.1 Eastern Transmission Corridor

Lines 5108 and 5302 – Data from Field Surveys

<u>Architectural Resources</u>

During the architectural resources survey 23 historic-age architectural resources were recorded. Only Green Cemetery (RE-1636) is recommended eligible for listing in the NRHP under Criteria Consideration D. Green Cemetery is surrounded by mature vegetation that serves as a visual screen between the grounds and the proposed KIF CC/Aero CT Plant and Switchyard site, minimizing the potential visual impact of the project on the historic property. The project would not affect the integrity of this single historic property in the Architectural Survey Area nor limit its ability to convey its significance. Therefore, TVA recommends a finding of no effects to historic architectural properties.

<u>Archaeological Resources</u>

TVA completed archaeological survey of off-site transmission lines (L5108 andL5302) and identified two archaeological sites (40AN277 and 40AN278). TVA has determined that both sites should be considered not eligible for the NRHP and is consulting with the SHPO and federally recognized Indian tribes regarding this finding Additionally, four previously recorded sites (40RE620, 40RE228, 40RE572, and 40RE224) were revisited during the cultural resources survey. Subsequent visual inspection, pedestrian survey, and shovel testing failed to yield any evidence of the previously recorded sites. Therefore, TVA recommends no further archaeological investigations for the four revisited sites within the existing corridor.

L5116, L5280, and L5381 – Data from Desktop Sources

Architectural Resources

The only previously recorded historic architectural resource near the transmission line upgrades not already covered in L5108, L5302, and L5383 is Bethel Cemetery. This cemetery is listed in the NRHP. The upcoming architectural survey would assess any effects that the transmission line upgrades may have on this resource.

Archaeological Resources

There are 35 previously recorded archaeological sites within 0.5 mile of the Eastern Transmission Corridor for upgrades not already covered in L5108 and L5302. Two of these sites are potentially eligible for the NRHP; the NRHP eligibility status of the remainder is unknown. [TVA will complete archaeological surveys in L5108, L5302, and L5383 and will consult further with the TN SHPO and Native American tribes. The upcoming archaeological survey would verify any effects that the transmission line upgrades may have on any NRHP potentially eligible, eligible, or listed archaeological sites within the archaeological APE of the transmission line upgrades and appropriately mitigate those effects consistent with TVA's obligations under Section 106 of the NHPA.

3.13.3.3.5.2 Western Transmission Corridor

Line 5383 – Data from Field Surveys

Architectural Resources

Two architectural resources in Cumberland County (CU-929 [Green Acres Cemetery] and CU-930 [Fredonia Baptist Church Cemetery]) were encountered and recorded in the survey area. CU-929 and CU-930 are recommended not eligible for listing in the NRHP. TVA has found (in consultation with SHPO) that the proposed transmission reconductoring and upgrade activities would not result in the potential for visual effects on above-ground resources outside the project footprint; as such, visual effects are not evaluated further for the proposed off-site transmission upgrades to L5383.

Archaeological Resources

TVA completed archaeological surveys of two transmission line segments and eight access roads associated with L5383, resulting in the identification of one archaeological site (40CU91) and one isolated find (HDR-IF-001. TVA has determined that both resources should be considered not eligible for the NRHP and is consulting with the SHPO and federally recognized Indian tribes regarding this finding. Additionally, four previously recorded sites (40RE620, 40RE228, 40RE572, and 40RE224) were revisited during the cultural resources survey. Subsequent visual inspection, pedestrian survey, and shovel testing failed to yield any evidence of the previously recorded sites.

3.13.3.3.6 Construction and Operation of a Natural Gas Pipeline

There are 44 newly and previously recorded archaeological sites within the proposed ETNG Construction ROW that are considered potentially NRHP eligible and ETNG has recommended additional cultural survey work to evaluate their NRHP eligibility. Previously recorded precontact sites 40PM89 and 40PM90 are anticipated to be avoided by the current design; and therefore, were not surveyed. However, both sites are recommended for agency consultation and further work if they cannot be avoided by construction activities (ETNG 2022e). Four additional previously recorded sites were not revisited and instead were recommended for additional (Phase II) survey work, two of which are listed on the NRHP (sites 40TR51 and 40JK125) and would require data recovery investigations prior to construction if the sites cannot be avoided. Further consultations are necessary and ongoing for Sites 40PM89 and 40PM90, which were previously recommended as eligible for NRHP listing. Seven additional previously recorded archaeological sites (40TR45, 40TR46, 40TR47, 40PM86, 40MO11, 40MO12, and 40MO119) within the APE were not revisited during the current survey due to restricted access. ETNG would revisit and update each of these sites prior to project construction if these resources cannot be avoided.

For the archaeological sites recommended as not eligible for the NRHP, no further work is being recommended. Four historic sites or components, or portions thereof, remain unassessed for NRHP eligibility. This includes two historic sites with cemeteries (40TR66 and FS-SJ-90) that are unassessed for NRHP eligibility. The rural domestic house component of FS-SJ-90 within the APE is recommended as not eligible for listing in the NRHP. The historic component of previously recorded multicomponent site 40TR44 within the APE is also recommended as not eligible for listing in the NRHP, though the portion immediately outside of it remains unassessed for NRHP eligibility. Lastly, the historic component of multicomponent site 40PM83 remains unassessed for NRHP eligibility. The historic component of site 40PM83 was not assessed for NRHP eligibility during its initial recording and was not relocated during the current survey (ETNG 2022e).

There are 17 cemeteries located within or immediately adjacent to the current APE, including one precontact cemetery within archaeological site 40JK171, 11 historic cemeteries (three of which are within archaeological sites 40TR44, 40TR66, and FS-SJ-90), three cemeteries with historic and modern interments, two modern cemeteries, and one cemetery that is of unknown age (ETNG 2022e).

As required by Section 106, additional studies are planned for sites listed as potentially eligible to fully determine the NRHP eligibility of those sites. Should a site be determined eligible for NRHP listing in consultation with SHPO and Native American tribes, and avoidance is not possible, then mitigation would be required. The specific mitigation plans would be stipulated in a Memorandum of Agreement (MOA) involving FERC, TN SHPO, and any tribes choosing to participate.

To fulfill its obligations under Section 106 of the NHPA, TVA and FERC will each consult with the TN SHPO and federally recognized Native American tribes on their respective actions regarding specific effects to cultural resources within the ETNG Construction ROW if Alternative A proceeds.

3.13.3.3.7 Summary of Alternative A

TVA Actions

There is one recorded archaeological site (40RE45) within the potential CC/Aero CT Plant footprint at the Kingston Reservation. TVA finds that Site 40RE45 is eligible for inclusion in the NRHP, however, the site is located outside of the project footprint and therefore would not be affected. On May 4, 2023, TVA received concurrence from the TN SHPO that although a portion of this site falls within the APE, effects to the site would not be adverse. The letter also stated that Green Cemetery would also be unlikely to be affected from the project. The TN SHPO requested several revisions to the submittal package, however the “office has no objection to the implementation of this project as currently planned”. The letter is provided in Appendix N.

ETNG Actions - Natural Gas Pipeline and Associated Structures

As stated in ETNG's Resource Report (2022e):

> Along the proposed natural gas pipeline, a total of 44 newly recorded and previously recorded sites are considered potentially eligible and additional work is recommended to evaluate their NRHP eligibility…Two additional previously recorded precontact sites (40PM89 and 40PM90)…were avoided during the current survey but are also recommended for agency consultation and further work if they cannot be avoided by construction activities.
>
> In addition to these 44 sites, four previously recorded sites (40TR51, 40JK125, 40PM89, and 40PM90) within the APE are recommended for further work. These sites were not revisited during the current survey. Sites 40TR51 (the Hartsville Battlefield) and 40JK125 (Fort-Blount Williamsburg) are listed on the NRHP. If these sites cannot be avoided by construction activities, then data recovery investigations will be required prior to construction. Sites 40PM89 and 40PM90 were previously recommended as eligible for listing in the NRHP. Evaluation of the portions of these two sites within the current APE, but outside of the previous project area, have not been conducted at this time. Further consultation with state agencies is needed to define a treatment plan for these two resources.
>
> Seven additional previously recorded archaeological sites (40TR45, 40TR46, 40TR47, 40PM86, 40MO11, 40MO12, and 40MO119) within the APE were not revisited during the current survey due to restricted access. Site 40PM86 was previously recommended as not eligible for listing on the NRHP following Phase II investigations. The six remaining sites were not assessed for NRHP eligibility at the time of their initial recording. All seven sites require a revisit and update prior to project construction if they will be impacted by construction activities.
>
> For the archaeological sites recommended as not eligible for the NRHP, no further work is being recommended. Four historic sites or components, or portions thereof, remain unassessed for NRHP eligibility. This includes two historic sites with cemeteries (40TR66 and FS-SJ-90) that are unassessed for NRHP eligibility. The rural domestic house component of FS-SJ-90 within the APE is recommended as not eligible for listing in the NRHP. The historic component of previously recorded multicomponent site 40TR44 within the APE is also recommended as not eligible for listing in the NRHP, though the portion immediately outside of it remains unassessed for NRHP eligibility. Lastly, the historic component of multicomponent site 40PM83 remains unassessed for NRHP eligibility. The historic component of site 40PM83 was not assessed for NRHP eligibility during its initial recording and was not relocated during the current survey.

Additionally, there are 17 cemeteries located within, or immediately adjacent to, the current natural gas pipeline APE. These cemeteries should be avoided through ETNG's design of the route for the pipeline.

3.13.3.3.8 Environmental Justice Considerations

TVA Actions

Effects to cultural resources that would occur as a result of implementation of Alternative A are not anticipated to have amplified effects on EJ populations. These effects would be avoided, minimized, or mitigated through implementation of cultural resources surveys and NHPA consultation with Native American tribes and interested stakeholders, which could include other EJ populations.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Effects to cultural resources that would occur because of implementation of Alternative A are not anticipated to have amplified effects on EJ populations. These effects would be avoided, minimized, or mitigated through implementation of cultural resources surveys and NRHP consultation with SHPO and NHPA consultation with Native American tribes and other interested stakeholders.

3.13.3.4 Alternative B

3.13.3.4.1 Construction and Operations of Solar and Storage Facilities

Under Alternative B, TVA or a third-party developer would construct and operate 1,500 MW of solar and 2,200 MW of four-hour battery storage capacity at multiple locations primarily in the East Tennessee region, which would require 10,950 acres of land for solar installations and 550 to 825 acres of land for 2,200 MW of BESS. Since the exact project locations of the solar and storage facilities are not known at this time, TVA has compiled a list of typical effects associated with the construction and operation of solar facilities within the TVA region. This list was compiled by reviewing the EAs and EISs for various photovoltaic projects, ranging from community-scale to utility-scale, since 2014. A total of 31 projects were included in the review. Of these, approximately three percent have affected historic properties. These effects generally consist of visual effects to historic architectural resources and direct physical effects to archaeological sites. Based on the assumption of seventeen 100-MW solar sites, approximately one site would result in effects to historic properties.

TVA would seek to avoid any potential adverse effects on any NRHP-listed or eligible archaeological sites or historic architectural properties in the affected area. If adverse effects cannot be avoided, TVA would seek, in consultation with the SHPO and federally recognized Indian tribes, ways to avoid or minimize the adverse effects. If unavoidable, adverse visual effects to historic architectural resources could be mitigated through wooded buffers. Adverse direct effects to archaeological sites could be mitigated through Phase III archaeological investigations. Given the large area of the potential solar developments, there is the possibility of multiple TCPs. To fulfill its obligations under Section 106 of the NHPA, TVA would consult with the TN SHPO on specific effects of individual solar projects on historic properties cultural resources if Alternative B is selected by TVA.

There is the potential for cumulative effects to cultural resources associated with the expansion of 10,000 MW of solar facilities as outlined in the 2019 IRP. Cumulative effects would be minimized through siting and avoidance of NRHP-listed or eligible sites, consultation with the SHPO, and mitigation.

3.13.3.4.2 Transmission and Other Components

Under Alternative B, the new transmission line construction would be on and in the immediate vicinity of the solar and storage sites. The transmission line components would be designed to avoid effects to historic properties. Effects to historic properties generally consist of visual effects to historic architectural resources and direct physical effects to archaeological sites. Adverse visual effects to historic architectural resources could be mitigated through wooded buffers. TVA would seek to avoid any potential adverse effects on any NRHP-listed or eligible archaeological sites or historic architectural properties in the affected area. If adverse effects cannot be avoided, TVA would seek, in consultation with SHPO and federally recognized Indian tribes, ways to avoid or minimize the adverse effects. Adverse direct physical effects to archaeological sites could be mitigated through Phase III archaeological investigations. To fulfill its obligations under Section 106 of the NHPA, TVA would consult with the TN SHPO on specific effects to cultural resources if Alternative B proceeds.

There is the potential for cumulative effects to cultural resources associated with the expansion of 10,000 MW of solar facilities and their associated transmission lines as outlined in the 2019 IRP (TVA 2019a). Cumulative effects would be minimized through siting and avoidance of NRHP-listed or eligible sites, consultation with the SHPO, and mitigation.

3.13.3.4.3 Environmental Justice Considerations

Effects to cultural resources that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to have amplified effects on EJ populations. These effects would be avoided, minimized, or mitigated through implementation of cultural resources survey and NHPA consultation with Native American tribes and interested stakeholders, which could include other EJ populations. EJ impacts would be more fully evaluated for individual solar facilities under Alternative B and associated transmission activities To determine amplified effects for a given solar facility, detailed EJ analyses would occur for each solar facility and transmission line activity under future NEPA reviews.

3.14 Solid and Hazardous Waste

3.14.1 Regulatory Framework

In general, hazardous materials include substances that, because of their quantity, concentration, or physical, chemical, or infectious characteristics, may present substantial danger to public health or the environment when released into the environment. Hazardous materials are regulated under a variety of federal laws including OSHA standards, EPCRA, the RCRA, the Comprehensive Environmental Response, Compensation and Liability Act of 1980, and the Toxic Substances Control Act.

RCRA regulations define what constitutes a hazardous waste and establishes a “cradle to grave” system for management and disposal of hazardous wastes. Subtitle C of RCRA includes separate, less stringent regulations for certain potentially hazardous wastes. Used oil, for example, may be regulated as hazardous waste if it is disposed of, but it is separately regulated if it is recycled. Specific requirements are provided under RCRA for generators, transporters, processors, and burners of used oil that are recycled. Universal wastes are a subset of hazardous wastes that are widely generated. Universal wastes include batteries, lamps and high intensity lights, and mercury thermostats. Universal wastes may be managed in accordance with the RCRA requirements for hazardous wastes or by special, less stringent provisions.

Solid waste consists of a broad range of materials that include refuse, sanitary wastes, contaminated environmental media, scrap metals, nonhazardous wastewater treatment plant sludge, nonhazardous air pollution control wastes, various nonhazardous industrial waste, and other materials (solid, liquid, or contained gaseous substances). Solid waste is regulated by the USEPA and RCRA Subtitle D. Each state is required to ensure the federal regulations for solid waste are met and may implement more stringent requirements.

Special waste is a solid waste, other than a hazardous waste, that requires special handling and management to protect public health or the environment. In some states, special wastes may include sludges, bulky wastes, pesticide wastes, industrial wastes, combustion wastes, friable asbestos, and certain hazardous wastes exempted from RCRA Subtitle C requirements. Any of these wastes, if generated, would be disposed of as required by state and federal regulations. In Tennessee, requirements for solid wastes are focused on solid waste processing and disposal under Rule 0400-11-.01.

3.14.2 Affected Environment

3.14.2.1 Kingston Reservation (No Action and D4 Activities)

3.14.2.1.1 Solid Waste

The primary solid wastes that result from the operation of KIF are CCRs in the form of ash and gypsum. KIF currently produces two coal ash related CCR streams, fly ash and bottom ash, which are byproducts from coal combustion. Fly ash comprises approximately 80 percent and bottom ash comprises the remaining 20 percent of these CCR streams. Currently, fly ash is handled dry and is pneumatically conveyed to silos. Bottom ash is directed to a dewatering process facility to dewater the solids and clarify the bottom ash sluice water. Both dry ash by-products are trucked to the on-site Phase 1 Landfill. TVA has historically managed storage of CCR materials generated at KIF in a combination of on-site landfills, dry stacks, wet stacks, ash ponds, and impoundments. The gypsum produced by Flue Gas Desulfurization (FGD) is also disposed at the on-site landfill.

Fly ash and boiler slag make up the noncombustible particles or components in coal. Both fly ash and bottom ash are composed primarily of silica, aluminum oxide, and iron oxide. These waste streams also contain a variety of heavy metals at limited concentrations, including arsenic, cadmium, chromium, copper, lead, mercury, and selenium. In Tennessee, CCRs are regulated as special wastes that require special approval for the wastes to be disposed of at a landfill specifically permitted to receive those types of wastes (Class I or II disposal facility).

3.14.2.1.2 Hazardous Waste

Hazardous, non-radiological wastes typically produced by common facility operations include paint and paint solids, paint thinners, discarded out-of-date chemicals, parts washer liquids, sand blast grit, and chemical waste from cleaning operations. The amount of these wastes generated varies with the size and type of facility. Wastes regulated under TSCA that are typically encountered at TVA sites include PCBs, historically used in insulating fluids in electrical equipment.

KIF is considered a RCRA conditionally exempt small quantity generator of hazardous waste by TDEC. From 2020 to 2022, KIF generated between 59,882 and 119,113 tons of coal ash (fly ash and bottom ash) per year and between 62,202 and 112,191 tons of gypsum per year (TDEC 2023a).

3.14.2.1.3 Universal Waste

Universal wastes are a subset of hazardous wastes that are widely generated and can include batteries, pesticides, lamps and high intensity lights, and mercury thermostats. Universal wastes may be managed in accordance with the RCRA requirements for hazardous wastes or by special, less stringent provisions. KIF is considered a small quantity handler of universal waste that includes batteries, lamps/bulbs, and mercury-containing equipment.

3.14.2.2 Alternative A

3.14.2.2.1 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

Following construction of the proposed CC/Aero CT Plant, all nine KIF units would be retired and decommissioned by 2027. The retired coal facilities would transition to the D4 process as described in Table 2.1-1. The existing switchyard would be maintained for use in future operations associated with the proposed CC/Aero CT facility. All buildings and structures within the proposed demolition boundary (Figure 2.1-2) would be demolished to three feet below final grade via mechanical deconstruction and/or explosives and then backfilled using concrete and masonry from the demolished facilities in addition to fill.

All buried utilities within the project boundary would be cut and capped and abandoned in place if they do not interfere with other ongoing projects that overlap the project footprint. All hollow pipe utilities would be decommissioned and sealed with a mechanical cap or plug. The D4 site would be restored to grade to provide proper drainage.

3.14.2.2.2 Construction and Operation of a CC/Aero CT Plant and Switchyard on Kingston Reservation

The proposed CC/Aero CT Plant site is located on the Kingston Reservation (Section 3.14.2.1) at the Landfill Phase 2 expansion area, described as Option C and shown on Figure 2.1-4. The site is approximately 55 acres and has been permitted for landfill expansion but has not been constructed or received waste. The selected site has been largely cleared of vegetation and grading activities have been completed in some areas. TVA has historically used the area as a laydown yard and staging area for equipment and has constructed a network of unpaved access roads throughout the site.

The site is not likely to contain or produce solid or hazardous waste, although any excavated materials may need to be tested for waste characterization if intended for off-site disposal or land application.

3.14.2.2.3 Construction and Operation of a 3 to –4-MW Solar Facility on Kingston Reservation

The proposed 3 to –4-MW solar facility would be located on the footprint of the current coal storage yard on the Kingston Reservation, as identified in Figure 2.1-5. The affected environment at this location would be consistent with that of the Kingston Reservation, as described in Section 3.14.2.1.

3.14.2.2.4 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential areas of the Kingston Reservation, as identified in Figure 2.1-5. The preferred site, Battery Option 1, is part of the D4 boundary and would have comparable waste streams and processes as those described for the Kingston Reservation in Section 3.14.2.1. The Battery Option 2 and Option 3 sites are located primarily on forested land that would be cleared prior to construction and installation of the BESS components. Tree clearing activities would generate typical silvicultural debris and small volumes of solid waste. Tree clearing and construction activities would be performed following the appropriate BMPs and relevant local, state, and federal permit requirements.

3.14.2.2.5 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT

Plant facilities and switchyard. Therefore, the affected environment for on-site transmission upgrades is described in Section 3.14.2.1.

3.14.2.2.6 Off-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines, five of which are within the vicinity of the Kingston Reservation and one in Crossville (L5108, L5116, L5280, L5302, L5381, and L5383). Descriptions of these improvements can be found in Section 2.1.3.5. Transmission lines L5108, L5116, L5280, L5302, L5381 extend from the current Kingston Reservation travelling eastbound and terminating in the city of Oak Ridge. The route is largely agricultural and cleared forest land with smaller areas of developed space and open water. There is minor variability in elevation across the transmission line corridor.

Transmission line L5383 extends in a southeast direction from a substation in unincorporated Crossville on Plateau Road, terminating north of the Crossville city limits. Land use near the route is largely agricultural with small areas of cleared forest land and developed space.

Based on a review of the TDEC Division of Remediation database (TDEC 2022e), permitted Tennessee landfill sites, solid waste processors, transfer or convenience centers, and UST database and the USEPA ECHO database (USEPA 2022a), the following sites were identified within 0.5 mile of proposed transmission corridor upgrades:

- The ORNL is located adjacent to the Bethel Valley – end reconductor. The ORNL was listed in the TDEC UST database for two active USTs and 54 permanently closed USTs. No leaks or violations were listed in association with the USTs.
- Neighborhood Market (a filling station) located 0.12 miles south-southwest of the transmission corridor, UST Facility ID #2010044, was listed in the TDEC UST database for three active USTs. No leaks or violations were listed in association with the USTs.
- Kroger Fuel Center GA-690 (a filling station) located 0.11 miles east of the transmission corridor, UST Facility ID #2010220, was listed in the TDEC UST database for three active USTs. No leaks or violations were listed in association with the USTs.
- M and S Quik Mart (a filling station) located 0.15 miles east of the transmission corridor, UST Facility ID #2010015, was listed in the TDEC UST database for three active USTs. No leaks or violations were listed in association with the USTs.
- Central Service Complex (a public works fleet filling station) located 0.25 miles northeast of the transmission corridor, UST Facility ID #2010205, was listed in the TDEC UST database for two active USTs. No leaks or violations were listed in association with the USTs.
- Circle K Store no. 4703620 (a filling station) located 0.50 miles south of the transmission corridor, UST Facility ID #4180180, was listed in the TDEC UST database for three active USTs. No leaks or violations were listed in association with the USTs.
- Mountain Mini Mart (a filling station) located 0.47 miles south of the transmission corridor, UST Facility ID #4180123, was listed in the TDEC UST database for three temporarily out-of-use USTs. In 1994 a release was detected from piping failure but the case has since been closed.
- Hittman Transport Services Inc. (RCRA Active Transporter) located 0.47 miles south of the transmission corridor. No violations have been recorded for the facility.

- United States Department of Energy (USDOE) – NNSA DBA Office of Secure Transportation Agent OP Eastern Command, located adjacent to the transmission corridor. No violations have been recorded for the facility.
- URS Safety Management Solutions LLC (RCRA Active Transporter) located 0.29 miles south of transmission corridor. No violations have been recorded for the facility.
- USDOE East Tennessee Technology Park (RCRA Active Large Quantity Generator and Active Transporter) located adjacent to the transmission corridor. No violations have been recorded for the facility.
- Impact Services, Inc. (RCRA Active Very Small Quantity Generator) located adjacent to the transmission corridor. No violations have been recorded for the facility.
- Philotechnics, LTD (RCRA Active Transporter) located 0.49 miles west of transmission corridor. No violations have been recorded for the facility.
- Oak Ridge Sewage Treatment Plant located 0.45 miles east of transmission corridor. Several violations of the CWA have been recorded for the facility for exceedances of constituents in effluent discharge.
- Turnkey Technical Services, LLC (RCRA Active Transporter) located 0.35 miles west of transmission corridor. No violations have been recorded for the facility.
- Interstate Venture, Inc. (RCRA Active Transporter) located 0.35 miles west of transmission corridor. No violations have been recorded for the facility.
- Clinton Engineer Works (DOR Site ID #01593) located adjacent to the transmission corridor at the Bethel Valley – end Reconductor was listed on the TDEC Remediation database, but the site status has been closed.

Based on the lack of violations or leaks, the above sites are not considered a concern for Alternative A. Potential effects related to solid and hazardous waste of transmission line upgrade construction and operation were considered. Any potential effects to solid and hazardous waste from the construction and improvement actions of transmission lines would be minor and temporary. Thus, further analysis of transmission lines and their effect on solid and hazardous waste resources was not deemed necessary.

3.14.2.2.7 Construction and Operation of a Natural Gas Pipeline

Based on TVA’s review of the TDEC Division of Remediation database (TDEC 2022e), permitted Tennessee landfill sites, solid waste processors, transfer or convenience centers, and Underground Storage Tank (UST) database and the USEPA ECHO database (USEPA 2022a), the following sites were identified within 0.5 mile of the proposed ETNG Construction ROW:

- TVA KIF Plant, located along the ETNG Construction ROW, was listed in the Tennessee permitted landfill database as a Class II landfill. No violations were listed in association with the landfill. KIF had three violations of the CWA between January 2019 and September 2020 and multiple violations of the CAA that were considered “high priority” since June 2019 for sulfur dioxide.
- Cumberland Utility District of Roane and Morgan counties Waste Treatment Plant, located within 0.25 miles of ETNG Construction ROW at 3201 Harriman Hwy, Harriman, TN 37748. The facility has several recent violations of the CWA for aluminum concentration exceedances in effluent discharge.

- ETNG, LLC Wartburg Station #3110, located adjacent to the ETNG Construction ROW (0.1 miles south) at 142 Clayton Howard Road, Wartburg, TN 37887. The facility is listed as a RCRA large quantity generator and had a 40 CFR 279.C violation identified September 8, 2021 for Used Oil Generators.
- Wartburg Sewage Treatment Plant, located adjacent to the ETNG Construction ROW (0.16 miles north) along Hwy 27 in Wartburg TN, 37887. The facility is listed as having several violations of their NPDES permit since at least 2019 for levels of cyanide, pH, dissolved oxygen, nitrogen, as well as e. coli, chronic chr_ceriodaphnia, and chronic chr_pimephales.
- Twin K Enterprises, LLC, located at 3612 Morgan County Hwy in Wartburg TN, 37887 (0.35 miles from proposed pipeline). Ready-mix concrete manufacturer. No violations have been recorded.
- East Tennessee Natural Gas Co. Station 3107, located at 3400 Stamps-Shady Grove Rd, Monterey TN, 38574 (on proposed pipeline). No CWA, CAA, or RCRA violations have been recorded for this facility.
- Lewis Farm Quarry, located at 280 Lewis Lane Monterey, TN 38574 (adjacent to the proposed pipeline). No CWA violations have been recorded for this facility.
- Crab Orchard Stone Monterey Quarry located near Stamps-Shady Grove Rd Monterey TN, 38574 (approximately 0.37 miles south of proposed pipeline). No CWA violations have been recorded for this facility.
- Billy Walker Property, quarry located on Thorn Gap Road in Cookeville, TN 38506 (adjacent to proposed pipeline). No CWA violations have been recorded for this facility since at least 2019.
- Smyrna Ready Mix Concrete, LLC doing business as (DBA) Cookeville Plant #35 located at 114 West Turkey Creek Road Cookeville TN, 38506 (adjacent to the proposed pipeline). Between 2019 and 2020 several CWA violations were recorded for this facility for late or missing Discharge Monitoring Reports.
- Smith Lumber Company located at 4482 South Grundy Quarles Hwy Bloomington Springs TN, 38545 (0.37 miles south of proposed pipeline). No CWA violations have been recorded for this facility.
- East Tennessee Natural Gas, LLC DBA Compressor Station 3105-Gainseboro located at 3460 Granville Hwy Gainesboro TN, 38562 (adjacent to the proposed pipeline). No CWA or RCRA violations have been recorded for this facility.
- East Tennessee Natural Gas, LLC DBA Dixon Springs Compressor Station 31 located at 120 J.D. Hood Lane – Station 3104 Hartsville TN, 37074 (adjacent to the proposed pipeline). No CAA or RCRA violations have been recorded for this facility.
- V&C Manufacturing & Warehouse, Inc. located at 100 Trousdale Way Hartsville TN, 37074 (0.2 miles south of proposed pipeline). In December 2021 several RCRA violations were recorded for this facility, which is a large-quantity generator. During a follow-up inspection, no violations or compliance issues were found.
- Hartsville Sewage Treatment Plant located at 53 Water Plant Rd Hartsville TN, 37074 (0.2 miles south of proposed pipeline). Several CWA violations have been recorded for this facility between 2019 and 2022.

- West Trousdale Substation Located at S.R. 10/25 & Hwy 231 in Castalian Springs TN, 31031 (0.25 miles southwest of proposed pipeline). No CWA violations have been recorded for this facility.
- Castalian Springs Dollar General located at 6100 Hwy 231 South Castalian Springs TN, 37071 (0.4 miles southwest of proposed pipeline). No CWA violations have been recording for this facility.
- Fast Track Market #6 (a filling station) located 0.09 miles west of the proposed pipeline, UST Facility ID #2650064, was listed in the TDEC UST database for two active USTs and one permanently closed UST. No leaks or violations were listed in association with the USTs.
- Quality Oil Co. (a filling station) located 0.08 miles west-southwest of the proposed pipeline, UST Facility ID #2650025, was listed in the TDEC UST database for three active USTs. No leaks or violations were listed in association with the USTs.
- Main Stop (a filling station) located 0.50 miles north of the proposed pipeline, UST Facility ID #2650014, was listed in the TDEC UST database for three active USTs. In 2008 a drip beneath one of the dispensers and a vapor complaint were reported but the case has been closed.
- Holladay Express (a filling station) located 0.27 miles north of the proposed pipeline, UST Facility ID #4250071, was listed in the TDEC UST database for one active UST and two temporarily out-of-use USTs. In 1998 a spill was reported but the case has been closed.
- Swafford's IGA (a filling station) located 0.44 miles north of the proposed pipeline, UST Facility ID #4250083, was listed in the TDEC UST database for four active USTs. No leaks or violations were listed in association with the USTs.
- Looper Tire Co. (a filling station) located 0.45 miles south of the proposed pipeline, UST Facility ID #4710121, was listed in the TDEC UST database for two active USTs and three permanently closed USTs. No leaks or violations were listed in association with the USTs.
- Roy's Market (a filling station) located 0.34 miles north of the proposed pipeline, UST Facility ID #4710218, was listed in the TDEC UST database for four active USTs. No leaks or violations were listed in association with the USTs.
- K and K Market (a filling station) located 0.32 miles south of the proposed pipeline, UST Facility ID #4440044, was listed in the TDEC UST database for three active USTs and three permanently closed USTs. No leaks or violations were listed in association with the USTs.
- Hartsville Food Mart (a filling station) located 0.15 miles north of the proposed pipeline, UST Facility ID #5850254, was listed in the TDEC UST database for two active USTs. A release was suspected in 2015 due to inconclusive inventory reports but the case was closed.
- Starmart no. 102 (a filling station) located 0.37 miles southwest of the proposed pipeline, UST Facility ID #5850019, was listed in the TDEC UST database for two active USTs and five permanently closed USTs. A release in 1998 was found to have off-site impacts. The case has since been closed.

- Brake Point (a filling station) located 0.38 miles southwest of the proposed pipeline, UST Facility ID #5850028, was listed in the TDEC UST database for five temporarily out-of-use USTs and three permanently closed USTs. No leaks or violations were listed in association with the USTs.

Based on the lack of violations or leaks, the above sites are not considered a concern for Alternative A.

ETNG conducted a comparable review of publicly available information to identify, to the extent feasible, potentially hazardous waste within 0.25-miles of the proposed pipeline. Databases reviewed by ETNG include active RCRA sites; Waste Treaters, Storers, and Disposers; Toxic Release Inventory Sites, Superfund Sites, TDEC landfills, and TDEC Remediation sites. A list of identified sites is presented in Resource Report 8 (ETNG 2022i) and provided below in Table 3.14-1.

Table 3.14-1. Environmental Sites within 0.25 Mile of the Proposed ETNG Pipeline (Source: ETNG 2022i)

Milepost	County, State	Site Name	Distance to Project (feet)	Facility Type
5.1	Trousdale, TN	TDOT Trousdale County Garage	165	Closed Remediation Site
9.3	Trousdale, TN	V&C Manufacturing and Warehousing	585	Large Quantity Generator
10.8	Trousdale, TN	East Tennessee Dixon Springs Compressor Station	Adjacent	Small Quantity Generator
34.0	Jackson, TN	East Tennessee Granville Compressor Station	Adjacent	Very Small Quantity Generator
59.6	Putnam, TN	East Tennessee Monterey Compressor Station	Adjacent	Large Quantity Generator
68.1	Overton, TN	Reed Drums	233	Closed Remediation Site
80.5	Fentress, TN	East Tennessee Clarkrange Compressor Station	Adjacent	Very Small Quantity Generator
104.9	Morgan, TN	TDOT Morgan County Garage	1,250	Closed Remediation Site
106.9	Morgan, TN	East Tennessee Wartburg Compressor Station	Adjacent	Large Quantity Generator

As stated in ETNG's Resource Report 8 (ETNG 2022i):

> There are no active spills or compliance issues at the sites listed in Table 3.14-1. [ETNG] does not anticipate potential concerns associated with encountering hazardous materials during construction and operation of the [pipeline] Project. Should hazardous materials be encountered during construction, [ETNG] will implement [the] Waste Management Plan located in Appendix 1C of Resource Report 1 (ETNG 2022b) and will dispose of and/or mitigate for the hazardous materials in accordance with applicable regulations.

3.14.2.3 Alternative B

3.14.2.3.1 East Tennessee TVA Power Service Area

The affected environment of solid and hazardous waste in the East Tennessee region is based on general information in the IRP (TVA 2019b). Coal-fueled generating plants produce large quantities of ash and other coal combustion solid wastes. Industries within East Tennessee also produce solid and hazardous waste that is tracked through various federal and state databases. The locations of proposed solar and storage facilities are not known; prior to development into a solar or storage facility, Phase I environmental site assessments would be conducted to identify potential records of environmental concern, including solid and hazardous wastes.

3.14.3 Environmental Consequences

3.14.3.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate KIF. TVA would implement all planned actions related to the current and future management and storage of CCRs at the fossil plants, which have either been reviewed or would be in subsequent NEPA analyses. As a result, existing solid and hazardous waste management would not change from continuing operations under this alternative. The production and disposal of hazardous and universal wastes are not expected to change under the No Action Alternative.

3.14.3.2 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

For all alternatives, the KIF plant would be retired, decommissioned, decontaminated, and deconstructed. The plant would be demolished to a depth of three feet below final grade. Demolition and construction debris would be generated at the KIF Plant during the demolition of the metal buildings, footings, asphalt, etc. The facilities would be inspected for regulated materials (asbestos, lead paint, PCBs, etc.) and would be properly abated prior to demolition. These wastes, if generated, would be disposed as required by state and federal regulations. Remaining demolition debris would be disposed off-site. The solid and hazardous wastes listed below may be generated during demolition:

- Asbestos-containing materials (ACM)
- Mercury in equipment switches and gauges
- Lead-containing materials including paint, coatings, roof vents, circuit boards, batteries, and cathode ray tubes
- Electronic wastes
- PCBs in electrical equipment and light ballasts
- Materials such as glaze, caulk, building siding, roofing materials, electric cable, cable trays
- Other construction wastes (e.g., concrete, scrap metal)
- Universal waste (fluorescent light bulbs, batteries, etc.)
- Off spec/surplus chemicals contained in aboveground storage tanks
- Containerized petroleum products or chemicals
- Refrigerants and ozone depleting substances
- Tritium exit signs
- Radioactive sources from equipment
- Various oils and fuels
- Antifreeze

- Batteries in bulk and associated fixtures including deep cycle series uninterruptible power supply batteries and lead batteries from emergency lighting
- Street lighting
- Off spec consumer commodities
- Creosote (in railroad ties) and
- Technology Enhanced Naturally Occurring Radioactive Materials

A regulated material survey would be completed prior to demolition to estimate the materials and quantities of wastes expected to be generated. Additionally, all areas with stains or containing hazardous materials would be addressed, as appropriate, prior to demolition. All generated wastes would be handled in accordance with the TVA BMP procedures and local, state, and federal guidelines.

Direct effects would be minor due to the limited potential for hazardous waste to be discharged and/or released into the environment during D4 activities. Some wastes such as hazardous wastes, PCBs, ACMs, lead-based paints, and universal wastes, which require special removal, handling, or disposal, would be evaluated prior to demolition. These materials would be disposed of at a facility permitted to handle these waste streams. Non-hazardous or special waste would need to be transported to a landfill or other approved disposal facility.

Possible temporary effects to the local environment are those that could result from the release of fugitive dust during demolition and while removing transporting material to the landfill. If other projects in the area result in minor releases of fugitive dust or hazardous material, this may result in minor cumulative effects. Project and cumulative effects would be minimized through mitigation measures, including dust suppression and environmental controls. Due to the temporary nature of the operations and use of permitted disposal facilities, along with trained and experienced contractors and personnel, environmental effects from waste handling and disposal are not anticipated. Degradation over time of the remaining structures and material that is incorporated into those remaining structures may cause minor indirect environmental effects.

3.14.3.2.1 Environmental Justice Considerations

Demolition and construction wastes would be disposed off-site, as required by state and federal regulations. Off-site waste facilities have the potential to be located in EJ areas, per the history of the siting of these type facilities and the general assumptions that are made in evaluating EJ effects. As such, EJ populations may experience amplified effects as compared to non-EJ populations depending on the location of waste facilities.

3.14.3.3 Alternative A

3.14.3.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on Kingston Reservation

Under Alternative A, the proposed construction activities would result in a potential increase in generation of hazardous waste. Various hazardous wastes, such as waste paints, coating and adhesive wastes, and spent solvents, could be produced during construction. These wastes would be temporarily stored in properly managed hazardous waste storage areas on-site. Appropriate spill prevention, containment, and disposal requirements for hazardous wastes would be implemented to protect construction and plant workers, the public, and the environment. A permitted hazardous waste disposal facility would be used for ultimate disposal of the wastes. Once construction is completed, the generation of hazardous waste during operations would be similar to the current waste generation rates.

Any reportable spills related to Alternative A would be addressed in accordance with the requirements outlined in the site spill plans. Designated contractor and subcontractor personnel would be responsible for daily inspection; cleanup; and proper labeling, storage, and disposal of all refuse and debris produced. Disposal containers, such as dumpsters or roll-off containers, would be obtained from a proper waste disposal contractor.

Construction of the CC/Aero CT Plant would generate typical construction debris and small volumes of solid waste:

- Paper, wood, glass, and plastics would be generated from packing materials, waste lumber, insulation, and empty nonhazardous chemical containers.
- Scrap metal would result from welding, cutting, framing, and finishing operations, electrical wiring, disposal of packing materials, and empty nonhazardous chemical containers.

Construction and waste debris would be placed in roll-offs and disposed of at a permitted off-site construction and demolition landfill. TVA would manage all solid wastes in accordance with applicable state regulations and TVA BMP procedures.

During construction, TVA would rely on the use of portlets and holding tanks at the construction trailer site. Waste would be pumped using an approved/licensed pump and haul vendor and sent to POTW. Once operational, the site facilities would connect to the existing online sewer system.

If CCR management projects in the area result in solid waste or hazardous material, this may result in minor cumulative effects. Cumulative effects would be minor as TVA would manage all hazardous and solid wastes in accordance with applicable federal and state regulations and TVA BMP procedures.

3.14.3.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

Construction of solar sites typically produce petroleum-based oils and fuels and generation of liquid and solid wastes in the form of used oil, construction debris, packing materials, and general construction wasted. During construction of the proposed solar facility, materials are typically stored on-site in storage tanks, vessels, or other appropriate containers specifically designed for the characteristics of these materials. The storage facilities would include secondary containment in case of tank or vessel failure. Construction and decommissioning-related materials stored on-site would primarily be liquids such as used oil, nitrogen, diesel fuel, gasoline, hydraulic fluid, and other lubricants associated with construction equipment. Safety Data Sheets for all applicable materials present on-site would be made readily available to on-site personnel.

Fueling of some construction vehicles typically occurs in the construction area. Other mobile equipment would return to the on-site laydown areas for refueling. Special procedures would be identified to minimize the potential for fuel spills, and spill control kits would be carried on all refueling vehicles for activities such as refueling, vehicle or equipment maintenance procedures, waste removal, and tank clean-out. A fuel truck may be stored on-site for the duration of construction.

During operation, bulk chemicals would be stored in storage tanks; other chemicals would be stored in returnable delivery containers. Chemical storage areas would be designed to contain leaks and spills. The transport, storage, handling, and use of chemicals would be conducted in accordance with applicable laws, ordinances, regulations, and standards. While the various transformers would contain oil, there would be no separate oil or hydraulic fluid stored on-site related to transformers.

Construction of solar sites also generates construction debris and general trash, including pallets and flattened cardboard module boxes. Universal wastes and unusable materials would be handled, stored, and managed in accordance with Tennessee Universal Waste requirements. Waste collection and disposal would be conducted in accordance with applicable regulatory requirements to minimize health and safety effects. To the extent possible, waste would be recycled. Materials that cannot be recycled would be disposed of at an approved facility to be determined by the designated contractor(s). No waste oil would be disposed of on the solar or storage facility sites.

If necessary, TVA, the facility developer, or the construction contractor, would obtain a hazardous waste generator identification number from the state prior to generating any hazardous waste. Any spills related to Alternative A would be reported to the state regulator as required by regulations. A sampling and cleanup report would be prepared for the project site and sent to the state regulator to document each spill and clean up as required.

Photovoltaic panels and other components of the solar sites have an estimated operational lifespan of up to 35 years and would eventually need to be replaced or decommissioned. The materials would be managed as potentially hazardous solid waste and may require characterization prior to recycling or disposal. According to the USEPA and TDEC, solar panels and other photovoltaic components are not considered universal waste and may not be managed as universal waste. Therefore, if disposed of, the end-of-life management of photovoltaic components from the solar sites would require toxicity characteristic leaching procedure testing to determine if they are characteristic hazardous waste.

Although opportunities for recycling solar panels and lithium-ion batteries have been limited, some solar panel and battery manufacturers are developing panel-specific recycling programs or forming long-term recycling partnerships with developers. Therefore, opportunities for solar panel and battery recycling are expected to increase in the future.

Cumulative effects may occur with the additional 10,000 MW of solar facilities planned under the 2019 TVA IRP. Cumulative effects to solid and hazardous wastes would be minor as facilities would be constructed and managed in accordance with established procedures and applicable regulations.

3.14.3.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential areas of the Kingston Reservation, as identified in Figure 2.1-5. The Battery Option 1 site is part of the KIF D4 footprint and the potential environmental consequences for the D4 site preparation, prior to construction of the battery facility, on for solid and hazardous waste are the same as described in Section 3.14.2.1. The potential environmental consequences of the construction and operation of the Battery Option 1 site, if selected, would be comparable to those described in Section 3.14.2.1.

The Battery Option 2 and 3 sites are located primarily on forested land and are not located within the D4 boundary identified in Figure 2.1-5. Tree clearing activities would generate typical timber clearing debris and small volumes of solid waste. Tree clearing and construction activities would be performed following the appropriate BMPs and relevant local, state, and federal permit requirements. The potential environmental consequences of the construction and operation of a 100-MW battery storage site at Battery Option 2 or Battery Option 3 would be similar to those described in Section 3.14.3.3.2 and Section 3.14.3.3.3.

3.14.3.3.4 On-site Transmission

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT Plant facilities and switchyard. Therefore, the environmental consequences for on-site transmission upgrades on solid and hazardous waste is described in Section 3.14.2.2.1.

3.14.3.3.5 Off-site Transmission

Under Alternative A, TVA would make improvements to existing transmission lines, two within the vicinity of the Kingston Reservation (L5108 and L5302) and one in Crossville (L5383). Descriptions of these improvements can be found in Section 2.1.3.2.3. Upgrades may include uprating, reconductoring, or rebuilding transmission lines as well as replacing terminal equipment, bus work, or jumpers. Off-site upgrades may be needed such that 161-kV transmission lines may need to be reconductored or rebuilt. If future studies indicate improvements are required to the regional transmission system to maintain system stability and integrity, additional site-specific reviews would be completed.

Transmission lines L5108 and L5302 extend eastward from the current Kingston Reservation and terminate in the city of Oak Ridge. The route is largely agricultural and cleared forest land with smaller areas of developed space and open water. There is slight variability in elevation across the transmission line corridor. Several access roads are proposed largely along routes that have already been cleared. Construction of these access roads is not likely to produce solid or hazardous waste.

Transmission line L5383 extends in a southeast direction from a substation in unincorporated Crossville on Plateau Road, terminating north of the Crossville city limits. Land use near the route is largely agricultural with small areas of cleared forest land and developed space. Several access roads are proposed along the route in agricultural areas. Construction of these access roads is not likely to produce solid or hazardous waste, although any excavated material from commercial / agricultural areas may require waste characterization for disposal / land application.

Development of new permanent access roads to support upgrades to the existing transmission lines may be needed. Depending on access needs, existing access roads may require modifications, such as brush clearing or tree trimming, to allow for passage of equipment and bucket trucks. Tree removal is not anticipated and if required would be a negligible amount. Modifications would generally be limited to existing access road areas, and, if needed, tree trimming to allow a vertical clearance of up to 12 feet. Minor ground disturbance is expected in these areas, but if the ground is disturbed, the access road area would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed. Areas such as pasture, agricultural fields, or lawns would be returned to their former condition.

Effects to the environment associated with the transmission line corridor upgrades and the measures to address those effects are the same as the general construction and site work as described in Section 3.14.2.2.1.

3.14.3.3.6 Construction and Operation of a Natural Gas Pipeline

Construction of the new gas pipeline would generate typical construction debris and small volumes of solid waste. No areas of soil contamination have been identified within the proposed ETNG Construction ROW. Soil contamination may result from at least two sources: hazardous material or fuel spills during construction and/or spills in pre-existing contaminated areas that are encountered during construction. To minimize potential environmental impacts, ETNG would develop and implement plans and specific procedures for the pipeline project which could include, but are not limited to the following:

- Dust Control Plan;
- Horizontal Directional Drill Monitoring, Inadvertent Return Response, and Contingency Plan;
- Waste Management Plan;
- Blasting Plans (as necessary);
- Karst Plans (as necessary);
- Existing pipe removal and disposal procedures; and
- Site-specific residential construction plans (as necessary).

If contaminated or suspect soils are encountered during construction, ETNG would adhere to measures which include, but are not limited to, the following activities: taking immediate steps, if feasible, to isolate the contamination; stopping work activities in the immediate vicinity of the site; making the appropriate internal and external notifications; determining appropriate sampling requirements; and coordinating for disposal of contaminated media, if necessary (based on analytical results). ETNG would dispose of all waste in accordance with the Waste Management Plan. With respect to erosion and sedimentation control, ETNG's Resource Report 1 (ETNG 2022b), which TVA has independently reviewed, provides:

> In addition, [ETNG] has developed an Erosion and Sediment Control Plan, which will incorporate the requirements of FERC's Plan (FERC 2013a) and FERC's Procedures (FERC 2013b), and will include:
>
> - erosion and sediment control [BMPs];
> - spill prevention measures; and
> - applicable federal and state permit conditions.
>
> [ETNG's Erosion and Sediment Control Plan] is provided in Appendix 1C [of Resource Report 1 (ETNG 2022b)]. Requested deviations to the current FERC Procedures are detailed in Table 2.3-8 of Resource Report 2 (ETNG 2022c). [ETNG] is not requesting deviations to FERC's Plan at this time. In the event that additional deviations from FERC's Plan or FERC's Procedures are identified, [ETNG] will provide information regarding those requested deviations in the Project Application.

ETNG is also conducting a detailed analysis of potential solid and hazardous waste effects as part of the Environmental Report to be submitted with their certificate application that would be filed with FERC for the proposed pipeline. If present, the gradient of the project could result in runoff into the trench dug for the pipeline and workspace areas. Should contaminated media (i.e., soil or groundwater) be encountered during construction, routine procedures would be followed to ensure work was stopped, access to the site was limited, and contaminated soil was contained and collected for sampling. Depending on the results of the analysis, a route variation to avoid the site would be considered or a site-specific plan for completing construction within the contaminated area would be prepared in accordance with applicable environmental regulations and in coordination with the appropriate agency(ies). Any soil verified as contaminated would not be placed back into the trench unless approved by the appropriate agency(ies). Decontamination could involve removing select regulated materials in a safe and practical manner in such a way that the pipeline is left in a status that does not present a hazard or risk to the environment or personnel (ETNG 2022a, 2022b, 2022i).

Fueling of some construction vehicles typically occurs in the construction area. Other mobile equipment would return to the on-site laydown areas for refueling. An appropriate Spill Prevention Counter Measure and Control (SPCC) plan would be implemented by ETNG to minimize the potential of a spill during construction and operation of the pipeline. Special procedures would be identified to minimize the potential for fuel spills, and spill control kits would be carried on all refueling vehicles for activities such as refueling, vehicle or equipment maintenance procedures, waste removal, and tank clean-out. A fuel truck may be stored on-site for the duration of construction. Safety Data Sheets for all applicable materials present on-site would be made readily available to on-site personnel (ETNG 2022a, 2022b, 2022i).

Construction-related wastes may include skids, construction debris, timber mats, and used ECD materials and would be removed and disposed off-site at an approved facility. No construction material would be buried in the ROW. All used lubricants and cleanup materials would be containerized and disposed of at an approved facility. All sandblasting materials would be contained and disposed of properly. Shipping manifests would be maintained that verify the proper labeling and shipping of all wastes to authorized off-site facilities. Once construction of the pipeline is completed, solid and hazardous wastes should not be generated (ETNG 2022a, 2022b, 2022i).

In areas where the 3100 pipeline is still in place but no longer in use due to pipeline upgrades, portions of the 3100 line that were previously abandoned in place and are not in use would be removed as part of this project. In these areas, the pipeline that is no longer in use would be excavated from the trench in a manner that would minimize disturbance to the pipe and coating to the extent practicable. The pipeline coating would be tested to ensure proper disposal locations for the pipeline are chosen. The pipe would either be transported to a staging area for later disposal or loaded directly onto a truck and carried off-site for disposal. Once the pipe has been removed, the trench would be backfilled and rough graded to prepare for the new pipe trench (ETNG 2022a, 2022b, 2022i).

Shallow and/or hard bedrock can restrict excavation and may require special mechanical means or possibly blasting to achieve required design depths. Approximately 2,132 acres, or 72 percent, of the soils within the transmission and access road corridors contain soils with the potential for shallow bedrock (ETNG 2022a, 2022b, 2022i).

To prevent incorporation of rock into the topsoil, ETNG would segregate topsoil at excavations and dispose of excess rock fragments in an approved manner so as not to incorporate rock fragments into topsoil layers. Rock encountered during excavation would be removed using conventional excavation with a backhoe, ripping with a bulldozer followed by backhoe excavation, or hammering with a pointed backhoe attachment or a pneumatic rock hammer followed by backhoe excavation. If un-rippable subsurface rock is encountered, blasting for ditch excavation would be necessary (ETNG 2022a, 2022b, 2022i).

TVA has independently reviewed and concurs with the waste-related findings in Resource Reports 1, 2, and 8 (ETNG 2022a, 2022b, 2022i).

If RFFAs in the area result in solid waste or hazardous material, this may result in cumulative effects. Cumulative effects would be minor as applicable federal and state regulations would be followed.

3.14.3.3.7 Summary of Alternative A

TVA Actions

Demolition and construction debris would be generated during the demolition of the metal buildings, footings, asphalt, etc. Direct effects would be minor due to the limited potential for hazardous waste to be discharged and/or released into the environment during demolition activities. The proposed CC/Aero CT Plant site is approximately 55 acres and has been permitted for landfill expansion but has not been constructed or received waste. The selected site has been largely cleared of vegetation and grading activities have been completed in some areas. TVA has historically used the area as a laydown yard and staging area for equipment. The site is not likely to contain or produce solid or hazardous waste, although any excavated materials may need to be tested for waste characterization if intended for off-site disposal or land application.

The proposed 3- to 4-MW solar facility would be located on the footprint of the current coal storage yard on the Kingston Reservation as identified in Figure 2.1-5. The affected environment at this location is similar to the affected environment description f for the Kingston Reservation.

The proposed 100-MW battery storage facility would be located on one of three potential areas of the Kingston Reservation, as identified in Figure 2.1-5. The preferred site, Battery Option 1, is part of the D4 boundary and would have comparable waste streams and processes as those described for the Kingston Reservation in Section 3.14.1. The Battery Option 2 and Option 3 sites are located primarily on forested land that would be cleared prior to construction and installation of the BESS components. Tree clearing activities would generate typical silvicultural debris and small volumes of solid waste. Tree clearing and construction activities would be performed following the appropriate BMPs and relevant local, state, and federal permit requirements.

Construction of the CC/Aero CT Plant would generate typical construction debris and small volumes of solid waste. TVA would manage all solid wastes in accordance with applicable state regulations and TVA BMP procedures. During construction, TVA would rely on the use of portlets and holding tanks at the construction trailer site. Once operational, the site facilities would connect to the existing online sewer system.

If CCR management projects in the area result in solid waste or hazardous material, this may result in minor cumulative effects. TVA would manage all hazardous and solid wastes in accordance with applicable federal and state regulations and TVA BMP procedures.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Under Alternative A, proposed pipeline construction activities would result in the generation of waste; however, it is not expected to result in generation of hazardous waste. If elevated levels of hazardous waste are generated, an appropriate spill prevention, containment, and disposal measures for hazardous wastes would be implemented to avoid or minimize impacts to construction workers, the public, and the environment. Any reportable spills related to the Project would be addressed in accordance with the requirements outlined in site spill plans. Waste created (hazardous or otherwise) would be handled and disposed of per the Waste Management Plan located in Appendix 1C of Resource Report 1 (ETNG 2022b) and in accordance with applicable regulations. Any hazardous waste generated would be collected and disposed of at A permitted hazardous waste disposal facility. In addition, the pipeline and associated structures would be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards, as set forth in 49 CFR Part 192.

Based on TVA's review of the TDEC Division of Remediation database (TDEC 2022e), permitted Tennessee landfill sites, solid waste processors, transfer or convenience centers, and UST database and the USEPA ECHO database (USEPA 2022a), 28 sites were identified within 0.5 mile of the TVA-assessed Study Area, inclusive of the ETNG Construction ROW. However, based on evidence of the absence of violations or leaks, these sites are not considered a concern for Alternative A.

3.14.3.3.8 Environmental Justice Considerations

TVA Actions

Waste-related effects that would occur as a result of the proposed CC/Aero CT Plant would be temporary and mitigated, with some effects occurring on the TVA-owned Kingston reservation, where no residential populations exist.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Waste-related effects would occur as a result of the proposed natural gas pipeline lateral; these effects would be temporary and mitigated for construction-related effects, and minor and permanent for operations-related effects. A portion of these waste-related effects would occur on the TVA-owned Kingston Reservation, where no residential populations exist.

Waste-related effects due to the pipeline activities would also occur outside of the TVA-owned reservation or at selected waste facilities in the area. These effects, while still minor, have the potential to be located in EJ areas, per the history of the siting of these type facilities; thus, EJ populations may experience amplified effects. Although TVA has assessed these impacts to be minor and temporary, and potentially amplified to identified EJ populations, ETNG is still evaluating effects of its proposed project, and TVA may update its conclusions in TVA's final EIS based on ETNG's findings.

3.14.3.4 Alternative B

3.14.3.4.1 Construction and Operations of Solar and Storage Facilities

Construction and operations of solar and solar storage facilities would be comparable to Alternative A, see Section 3.14.3.3.2 and Section 3.14.3.3.3.

3.14.3.4.2 Transmission and Other Components

Under Alternative B, TVA would construct solar sites in undetermined locations within portions of East Tennessee. These new facilities would also require construction of new transmission line corridors or upgrades to existing transmission lines, depending on site-specific location and construction details. The effects on the environment for the transmission corridors associated with Alternative B and the measures to address those effects would be similar to those described for Alternative A in Section 3.14.3.2.1.

3.14.3.4.3 Environmental Justice Considerations

Waste-related effects that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to have amplified effects on EJ populations for Alternative B. These effects would be temporary, mitigated, and generally limited to the immediate project site and transmission line corridors. To further verify the absence of amplified effects for a given solar facility, detailed EJ analyses would occur for each solar facility and transmission line activity under future NEPA reviews.

3.15 Safety

3.15.1 Regulatory Framework

Workplace health and safety regulations are designed to eliminate personal injuries and illnesses from occurring in the workplace. These laws may include both Federal and state statutes. U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) is the main agency responsible for protecting the health and safety of workers in the workplaces. OSHA regulations are in Title 29 CFR Part 1910 (29 CFR 1919), OSHA Standards. A related regulation, 29 CFR 1926, contains health and safety requirements specific to the construction industry. The Tennessee Department of Labor and Workforce Development has adopted Federal OSHA standards contained in 29 CFR Parts 1910 and 1926 pursuant to Tennessee Code Annotated section 50-3-201.

3.15.2 Affected Environment

The routine operations and maintenance activities conducted at TVA facilities, on TVA-owned land, or within TVA transmission ROWs reflect a safety-conscious culture. Activities performed are consistent with OSHA, state standards and requirements, and specific TVA guidance. TVA personnel (including TVA authorized contractors) are conscientious about health and safety having addressed and managed operations to reduce or eliminate occupational hazards through implementation of safety practices, training, and control measures.

TVA has a safety program in place to prevent worker injuries and accidents. The various prevention programs include but are not limited to the following:

- Operations and Maintenance Plans
- Hazard Communication
- Housekeeping
- Project Safety Plans
- Competent Person
- Ground Disturbance
- Lifting Operations
- Energy Isolation (Lockout/Tag out)
- Cutting, Burning, Welding and other “Hot Work”
- Incident Reporting and Investigations
- Personal Protective Equipment
- Hearing Conservation
- Employee Training
- Contractor Evaluation and Acceptance
- Emergency Spill/Release Plans
- Emergency Response Plan

The implementation of proper engineering and equipment design and administrative controls, such as employee training and compliance with regulatory requirements related to Health and Safety, help ensure that the risks associated with work at TVA facilities remain low.

3.15.2.1 Kingston Reservation (No Action and D4 Activities)

No residential properties are located within the Kingston Reservation. Since the land proposed to be occupied by the proposed project area is not used by, or accessible to, the general public, there are no current public health and safety issues.

Public emergency services in the vicinity of the Kingston Reservation include law enforcement services, fire protection services, urgent care clinics, and a hospital in the City of Harriman. The Roane County Emergency Management Agency has the responsibility and authority to coordinate with state and local agencies in the event of a release of hazardous materials (Tennessee Emergency Management Agency [TEMA] 2022).

The Roane Medical Center, located in Harriman, approximately 3.4 miles (9 minutes) northwest of the Kingston Reservation, is the closest medical provider.

Law enforcement services in the City of Harriman are provided by the Harriman Police Department in Harriman, approximately four miles (11 minutes) from the Kingston Reservation. Law enforcement services in the city of Kingston are provided by the Kingston Police Department, approximately five miles (12 minutes) from the Kingston Reservation. Roane County law enforcement services are provided by the Roane County Sheriff's Office in Kingston, approximately four miles (11 minutes) from the Kingston Reservation.

Fire protection services in Harriman are provided by the Harriman Fire Department, located approximately four miles (11 minutes) from the Kingston Reservation. Fire protection services in Kingston are provided by the Kingston Fire Department, located approximately four miles (10 minutes) from the Kingston Reservation.

3.15.2.2 Alternative A

3.15.2.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Public emergency services in the vicinity of the proposed CC/Aero CT Plant are the same as the Kingston Reservation and are generally described in Section 3.15.2.1.

3.15.2.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.15.2.1 apply to the proposed 3- to 4-MW solar facility location on the Kingston Reservation.

3.15.2.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.15.2.1 apply to the proposed 100-MW BESS on the Kingston Reservation.

3.15.2.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT facilities and switchyard. TVA would also install new transmission lines for the proposed battery station. Therefore, the affected environment for on-site transmission upgrades is described in Section 3.15.2.1.

3.15.2.2.5 Off-site Transmission Upgrades

3.15.2.2.5.1 Eastern Transmission Corridor

The Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) is within Roane and Anderson counties. The emergency services would vary at different points along the Eastern Transmission Corridor. Fire protection services would be provided by the Roane County or Anderson County Fire Departments, and law enforcement services would be provided by the Roane County or Anderson County Police Departments.

3.15.2.2.5.2 Western Transmission Corridor

The Western Transmission Corridor (L5383) is within Cumberland County. Emergency services would vary at different points along the Western Transmission Corridor. Fire protection services would be provided by the Cumberland County Fire Department, and law enforcement services would be provided by the Cumberland County Police Department.

3.15.2.2.6 Construction and Operation of a Natural Gas Pipeline

Transportation of natural gas by pipeline involves risk to the public due to the potential for accidental release of natural gas. The greatest hazard is a fire that may result in the event of a major pipeline rupture or leak.

ETNG's Resource Report 11 (ETNG 2022l), which TVA has independently reviewed, provides the following:

> Methane, the primary component of natural gas, is colorless, odorless, and tasteless. It is not toxic but is classified as an asphyxiant by inhalation. If breathed in high concentration, oxygen deficiency can result in serious injury or death. Methane is a flammable gas with an ignition temperature of 1,000 degrees […] Unconfined mixtures of methane in air away from a point source are generally not explosive or a significant health hazard. However, a flammable concentration within an enclosed space or point source in the presence of an ignition source can result in a fire or explosion. […]
>
> The pipeline and aboveground facilities associated with the [pipeline] must be designed, constructed, operated, and maintained in accordance with the DOT Minimum Federal Safety Standards, as set forth in 49 CFR Part 192. The regulations are intended to ensure adequate protection for the public and to prevent natural gas facility accidents and failures. The DOT specifies material selection and qualification, minimum design requirements, and protection from internal, external, and atmospheric corrosion. The [pipeline] will not involve a new or recommissioned liquefied natural gas facility.
>
> Under 49 CFR §192.615, each pipeline operator must also establish an emergency plan that provides written procedures to minimize the hazards from a gas pipeline emergency. [ETNG] will implement procedures in its Emergency Plan to enable the public and officials to recognize and report a natural gas emergency. The DOT requires that each operator establish and maintain a liaison with appropriate fire, police, and public officials to learn the resources and responsibilities of each organization that may respond to a natural gas pipeline emergency, and to coordinate mutual assistance. The operator must also establish a continuing education program to enable customers, the public, government officials, and those engaged in excavation activities to recognize a gas pipeline emergency and report it to the appropriate public officials.
>
> […]

> [ETNG] is committed to safety, protecting the environment, preventing accidents/incidents, and maintaining the highest standards for its pipeline operation and maintenance. [ETNG] will accomplish this goal through routine preventative maintenance, pipeline patrols, solid emergency response plans and a strong pipeline Integrity Management Program. [ETNG] will establish and maintain strict operating and maintenance policies and procedures that will be audited periodically by the PHMSA and are in compliance with 49 CFR Part 192.
>
> Trained and qualified pipeline personnel will operate and maintain the pipeline in accordance with 49 CFR Part 192, Subpart N. The training program will ensure all personnel possess the knowledge and competency necessary to efficiently operate and maintain the pipeline in a manner that protects the environment, the public and the health and safety of all employees (ETNG 2022l).

ETNG's safety measures and programs are provided in greater detail in ETNG's Resource Report 11 (ETNG 2022l).

Public emergency services in the area of the proposed 122 miles of pipeline include urgent care clinics, hospitals, law enforcement services, and fire protection services. The Roane, Morgan, Fentress, Overton, Putnam, Jackson, Smith, and Trousdale County Emergency Management Agencies have the responsibility and authority to coordinate with state and local agencies in the event of a release of hazardous materials (TEMA 2022). The Roane Medical Center in Harriman is the closest medical provider, located approximately three miles southwest of the corridor.

Law enforcement services are provided by the Harriman Police Department in Harriman located approximately four miles northwest of the corridor; Trousdale County Sheriff's Department, one mile north of the pipeline in its western portion; or Algood Police Department, two miles south of the pipeline in its central portion.

Fire protection services are provided by the Harriman Fire Department located approximately four miles northwest of the corridor; Hartsville Fire Department, one mile north of the pipeline in its western portion; or the Algood Fire Department, two miles south of the pipeline in its central portion.

These are the closest emergency services to a specific point on the corridor. Distances and travel times would vary at different points on the corridor.

3.15.2.3 Alternative B

3.15.2.3.1 East Tennessee TVA Power Service Area

TVA anticipates that the solar and storage facilities proposed under Alternative B would be located within portions of the East Tennessee region. During construction, workers would have an increased safety risk typical for other construction activities. Particular caution would be taken when handling solar panels due to the potential for electric shock. The standard practice is for contractors to establish and maintain health and safety plans in compliance with OSHA regulations. See Section 2.3.1 for more details on standard BMPs.

3.15.3 Environmental Consequences

3.15.3.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate and maintain the KIF plant and adhere to all applicable safety standards. No project-related impacts on public health and safety would result.

3.15.3.2 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

TVA's Standard Programs and Processes related to safety would be strictly adhered to during implementation of all the action alternatives. The safety programs and processes are designed to identify actions required for the control of hazards in all activities, operations, and programs. They also establish responsibilities for implementing Section 19 of the Occupational Safety and Health Act of 1970. TVA and its contractors are required to comply with OSHA regulations and follow a Site-Specific Safety & Health Plan.

Potential public health and safety hazards could result from increased traffic on roadways as a result of D4 alternatives. Residential and other human use areas along roadways used by construction traffic to access the site would experience increased commercial and industrial traffic. Awareness of these residences and establishment of traffic procedures to minimize potential safety concerns would be addressed in the health and safety plans followed by construction contractor(s).

Under both action alternatives, TVA would retire, decommission, decontaminate, and deconstruct the KIF plant. Primary operational measures that would be discontinued due to the plant retirement include coal pile management, withdrawals of raw water from the Clinch/Emory River for cooling purposes at the coal plant, and thermal discharges back into the Clinch/Emory River. The combustion of coal for the production of power would cease as, would generation of wastes associated with such power production, thereby reducing any risks resulting from proximity to coal combustion for workers on-site.

During D4 activities, workers would have an increased safety risk. However, because D4 work has known hazards, the standard practice is for contractors to establish and maintain health and safety plans in compliance with OSHA regulations. Health and safety plans emphasize BMPs for site safety management to minimize potential risks to workers. Examples of BMPs include employee safety orientations; establishment of work procedures and programs for site activities; use of equipment guards, emergency shutdown procedures, lockout procedures, site housekeeping, and personal protective equipment; regular safety inspections; and plans and procedures to identify and resolve hazards. Asbestos-containing materials in building structures and systems would be remediated as necessary to be protective of environment and worker health and safety, but full abatement would not occur until demolition activities are initiated.

TVA's SPCC Specialist would update Kingston's existing SPCC Plan throughout construction. The purpose of the SPCC Plan is to minimize the potential of a spill during the drainage and disposal of oil and fluids and to instruct on-site workers on how to contain and clean up any potential spills. Decontamination would involve removing select regulated materials in a safe and practical manner in such a way that the plant is left in a status that does not present a hazard or risk to the environment or personnel. Limited decontamination work undertaken at the fossil plant may include abatement and disposal of regulated materials, which includes but is not limited to PCB equipment, asbestos, hazardous waste, and solid waste. The demolition perimeter would remain securely fenced during demolition and decontamination, and access gates would normally remain locked. General public health and safety would not be at risk in the event of an accidental spill on-site. Emergency response would be provided by the local, regional, and state law enforcement, fire, and emergency responders.

Since explosive demolition would be conducted under tight security, the danger to the public from this activity would likely be very low. Explosives would be managed under the direction of a state licensed blaster. Security would be a very important component of this event to eliminate as much as possible any threats to public health or safety. Once explosives arrive on-site, 24-hour security would be provided to monitor the explosives. Detailed security plans would be developed and coordinated with area emergency response agencies. Security details, including any information about the transport and storage of explosives, would be limited to authorized personnel only. Site security on the day of the event would be strictly enforced, and trespassing would not be tolerated. Notifications to the public would be issued prior to the use of explosives for demolition. Health and safety hazards could result from premature detonation or premature collapse of structures during demolition if explosives are used. These risks are reduced if mechanical demolition is utilized, though precautions are still implemented. Overall, impacts to public health and safety in association with implementation of the D4 activities would be considered temporary and minor.

During demolition and materials removal, truck traffic of other projects on the Kingston Reservation and CCR management activities would add to the traffic. This could result in cumulative safety impacts as a result of the cumulative traffic impacts from nearby projects. Impacts would be anticipated to be temporary and minor and would affect primarily the truck drivers and construction personnel. Controls would be needed to ensure truck traffic is coordinated and safe. With proper planning, adherence to OSHA regulations, health and safety plans, and implementation of BMPs, cumulative impacts from the project in relation to public health and safety would not occur.

3.15.3.2.1 Environmental Justice Considerations

Safety-related effects that would occur as a result of KIF retirement and D4 activities are not anticipated to have amplified effects on EJ populations in the Kingston Reservation EJ study area. Effects would be temporary, minor, and mitigated. Moreover, the effects are anticipated to be limited to the TVA-owned Kingston reservation or immediate vicinity, where EJ populations are not present. Therefore, adverse effects are not anticipated on EJ-populations.

3.15.3.3 Alternative A

3.15.3.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Under Alternative A, TVA would retire the KIF, demolish the units, and construct and operate a CC/Aero CT Plant on the Kingston Reservation among additional upgrades as described in Section 2.1.3. During construction, workers would have an increased safety risk. See Section 2.3.1 for additional details on standard BMPs.

The CC/Aero CT Plant would require minor and temporary movement of fuel gas and oil. Two 1,000,000-gallon oil tanks with fuel oil would be stored on-site. A total on-site oil storage capacity of 1,000,000 gallons and greater would require a Facility Response Plan in addition to an SPCC Plan. The FRP must be approved by USEPA prior to reaching 1,000,000 gallons of on-site oil storage. TVA's SPCC Specialist would update Kingston's existing SPCC Plan throughout construction. Limited contamination work undertaken at the fossil plants may include abatement and disposal of regulated materials, which may include but are not limited to PCB equipment, asbestos, hazardous waste, and solid waste. The perimeter of each grouping of project elements would remain securely fenced during construction and operation, and access gates would normally remain locked. Security fencing around site boundary would be installed during construction. Once the plant is operational, permanent security fencing would be installed. General public health and safety would not be at risk in the event of an accidental spill on-site. Emergency response would be provided by the local, regional, and state law enforcement, fire, and emergency responders.

During construction of the CC/Aero CT Plant, truck traffic of other projects on the Kingston Reservation and CCR Management activities would add to the traffic. This could result in cumulative safety impacts as a result of the other traffic impacts from nearby projects. Impacts would be anticipated to be temporary and minor and would affect primarily the truck drivers and construction personnel. Controls would be needed to ensure truck traffic is coordinated and safe.

The public health and safety impacts of air quality from coal plant operations would be reduced, as the CC/Aero CT Plant would produce less emissions than the KIF plant. The CC/Aero CT Plant would also use an SCR system located within the HRSG for additional NOx reduction. As 19.5 percent aqueous ammonia would be used rather than anhydrous (gaseous) ammonia used by the coal plant, the new site would have an aqueous ammonia storage facility and truck unloading but would not need the sitewide anhydrous ammonia alert system. See the Air Quality Section for more information.

3.15.3.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

During construction, workers would have an increased safety risk typical for other construction activities. Particular caution would be exercised when handling solar panels due to the potential for electric shock. The standard practice is for contractors to establish and maintain health and safety plans in compliance with OSHA regulations. See Section 2.3.1 for more details on standard BMPs.

Once solar panels are installed and in operation, they are considered to be very safe for humans and wildlife. Solar projects do not cause EMF levels such that there would be impacts on nearby residents. Sites are typically designed and operated using standard industry practices with sufficient setbacks to reduce or eliminate EMF exposure to adjacent property owners; strength of EMF is typically measured in milli-gauss. While long-term exposure to levels above 4 milli-gauss is identified as a concern (Cleveland 2017), the EMF generated by the solar facilities and associated transmission lines are typically less than 4 milli-gauss.

The perimeter of each grouping of solar arrays, as well as substations and BESS, would remain securely fenced during construction and operation, and access gates would normally remain locked. Security fencing around site boundary would be installed during construction. Once the facility is operational, permanent security fencing would be installed.

3.15.3.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

Except for decontamination work at the fossil plant, the proposed BESS would have similar impacts to safety and impose as required similar minimization measures as those described in Section 3.15.3.3.2. During construction, workers would have an increased safety risk. See Section 2.3.1 for additional details on standard BMPs. Overall, public health and safety impacts are anticipated to be temporary and minor.

3.15.3.3.4 On-site Transmission Upgrades

Transmission lines, like all other types of electrical wiring, generate both electric and magnetic fields (EMFs). The voltage on the conductors of a transmission line generates an electric field that occupies the space between the conductors and other conducting objects such as the ground, transmission line structures, or vegetation. A magnetic field is generated by the current (i.e., the movement of electrons) in the conductors. The strength of the magnetic field depends on the current, the design of the line, and the distance from the line. Most of this energy is dissipated on the ROW, and the residual very low amount is reduced to background levels near the ROW or energized equipment. A new transmission line for the battery station is proposed under Alternative A; therefore, safety hazards related to electrical equipment are relevant under this alternative as well as those anticipated from proximity to the existing on-site and nearby transmission lines and planned transmission upgrades described in Section 2.1.3.5.1.

Magnetic fields can induce currents in conducting objects. Electric fields can create static charges in ungrounded, conducting materials. The strength of the induced current or charge under a transmission line varies with: (1) the strength of the electric or magnetic field, (2) the size and shape of the conducting object, and (3) whether the conducting object is grounded. Induced currents and charges can cause shocks under certain conditions by making contact with objects in an electric or magnetic field. The existing off-site transmission lines have been designed to minimize the potential for such shocks. This is done, in part, by maintaining sufficient clearance between the conductors and objects on the ground. Stationary conducting objects, such as metal fences, pipelines, and highway guardrails that are near enough to the transmission line to develop a charge, would be grounded by TVA to prevent them from being a source of shocks.

Transmission line construction and operation require a high level of safety risk management due to the dangers present when working near high-voltage equipment. Overall, impacts to public health and safety in association with the transmission system components on the Kingston Reservation would be considered temporary and minor. With proper planning, adherence to OSHA regulations, health and safety plans, and implementation of BMPs, cumulative impacts from the project in relation to public health and safety would not occur.

3.15.3.3.5 Off-site Transmission Upgrades

Safety hazards and precautions for off-site transmission line upgrades proposed for the Eastern Transmission (L5108, L5116, L5280, L5302, and L5381) and Western Transmission (L5383) corridors are the same as those described for on-site transmission line upgrades in Section 3.15.3.3.4.

3.15.3.3.6 Construction and Operation of a Natural Gas Pipeline

The construction and operation of a new CC/Aero CT Plant would require construction of approximately 122 miles of new natural gas pipeline and gas system infrastructure.

While pipelines are the safest form of energy transportation, the transportation of natural gas by pipeline does involve minimal incremental risk to the public due to the potential for accidental release of natural gas. FERC will review the construction of ETNG's pipeline application and require the construction of the pipeline in accordance with DOT safety standards, and the PHMSA will provide ongoing regulation of construction, operation, and maintenance through routine inspections and enforcement of pipeline safety laws and regulations.

Construction of the pipeline may result in a temporary increased demand on public services. Potential temporary impacts on services may include traffic-related incidents, medical emergencies, and issuances of permits for vehicles subject to load and width restrictions. During construction, workers would have an increased safety risk. However, because construction work has known hazards, the standard practice is for contractors to establish and maintain health and safety plans in compliance with OSHA regulations.

Natural gas transmission pipeline incidents are rare and their consequences vary. For the 10-year period from 2012 through 2021, 1,155 incidents were reported by natural gas transmission pipeline operators in the United States. In 2021, there were 99 pipeline incidents that resulted in four injuries and four fatalities (USDOT 2022). Using the annual average for incidents (114) from 2012 through 2021 and the average miles of gas transmission pipelines (319,372) from 2012 through 2021 obtained from the USDOT Pipeline and Hazardous Materials Safety Administration (USDOT 2022), there was one incident for each 2,802 miles of pipeline per year on average.

General public health and safety would not be at risk in the event of an accidental spill anywhere along the corridor. Emergency response would be provided by the local, regional, and state law enforcement, fire, and emergency responders. Overall, effects to public health and safety in association with construction and operation of the gas pipeline lateral would be minor.

Preventive, emergency, patrolling, and safety measures relating to the pipeline are provided in ETNG's Resource Report 11 (ETNG 2022l), which TVA has independently reviewed. Some of these measures include:

> Preventive measures begin with the design and construction of [ETNG]'s facilities. These measures include design specifications, selection of suitable construction materials, development and selection of welding procedures, pipe coatings and cathodic protection systems, as set forth in 49 CFR §192.935. Additionally, manufacturing controls are used to promote high-quality installation of the pipeline and to limit operating stress. During the installation phase, all welders and radiographic technicians performing work on the facilities must take and pass a qualification test. Qualified oversight inspection staff is used to monitor the installation of the facilities.
>
> A cathodic protection system will be installed on the new pipeline, as required by 49 CFR Part 192, to protect the integrity of the pipeline from corrosion, thereby extending its operating life and providing protection from pipeline failures for [ETNG] personnel and the general public. […] The functional capability of cathodic protection systems is inspected frequently to ensure proper operating conditions for corrosion mitigation.
>
> The cathodic protection system design will be prepared based upon soil resistivity measurements obtained at multiple locations on the interconnecting piping. All relevant regulations and standards, including DOT, National Association of Corrosion Engineers, and American Society for Testing and Materials will be taken into consideration while preparing this design.
>
> [ETNG] pipeline facilities will be built to meet or exceed the DOT safety standards. Since the pipeline is buried a minimum of three feet underground, it is relatively immune from direct lightning strikes or other weather-related hazards. Specific site conditions, including earthquakes, are considered in the design of the pipeline. The magnitude of earthquakes in the southeast is relatively low and the ground vibration is unlikely to be a hazard for a modern welded-steel pipeline.

> [ETNG]'S pipeline will be equipped with remote control shutoff valves as required by the DOT regulations. This allows the shutoff valves to be operated remotely by [ETNG]'s gas control center in the event of an emergency, usually evidenced by a sudden loss of pressure on the pipeline. Remotely closing the shutoff valve allows the section of pipeline to be isolated from the rest of the pipeline system.
>
> […]
>
> [ETNG] will employ an array of patrol methods to conduct comprehensive and effective patrols, as required by federal law. Aerial, driving, or foot patrols will be used to physically inspect the pipeline facilities. [ETNG] will have line field service crews that perform the ground-based patrols and facility inspections. When performing patrols, technicians will observe surface conditions on and adjacent to the pipeline ROW for indications of leaks, construction activity, and other factors affecting safety and operation. Conditions identified during patrols will be entered into [ETNG]'s work management system and remedial actions taken. Preventative maintenance checks shall be performed on the pipeline at a set frequency and will comply with Part 192 of the safety regulations.

As further stated in ETNG's Resource Report 11 (ETNG 2022l):

> The pipeline will be patrolled in accordance with the requirements of 49 CFR §192.705 and personnel well qualified to perform both emergency and routine maintenance on interstate pipeline facilities will handle emergencies and maintenance related to:
>
> - Erosion and wash-outs along the ROW;
> - Settling, undermining or degradation of repaired ditch line in streets or parking lots:
> - Performance of water control devices such as diversions;
> - Condition of banks at stream and river crossings;
> - Third-party activity along the pipeline ROW;
> - Evidence of subsidence, surface cracks or depressions which could indicate sinkhole formation; and
> - Any other conditions that could endanger the pipeline.
>
> [ETNG] will also monitor the pipeline 24 hours a day, seven days a week, from its Control Center that is located in Houston, Texas, and will be staffed continuously by qualified pipeline operators. Operators will monitor all aspects of the pipeline including system pressures, temperatures, flows, and valve positions (open or closed). A secondary Pipeline Control Center will be available in cases of an emergency in Nashville, Tennessee. This high-tech computer control center monitors the flow of gas throughout Enbridge's interstate transmission pipeline system. The center collects data from all of these pipelines to ensure they are operating within their design parameters. The Gas Control Center monitors and reacts to equipment anomalies and, when necessary, dispatches employees who live and work along the pipeline to respond. As an added safety measure, remote control equipment is

> installed along the pipeline system, enabling remote operation of the pipeline valves from the Gas Control Center
>
> The pipeline will be monitored for leaks continuously using the data acquisition system. Operators will use pressures, flows and rate of change alarms to monitor for leaks or other abnormal operating conditions. In the unlikely case that a shutdown of the pipeline system is needed, the [ETNG] pipeline system [would] be equipped with remotely controlled sectionalizing block valves to isolate the affected pipeline segment.
>
> [ETNG] employs field services crews to perform Part 192 required operations, maintenance and inspection tasks along the 122-mile-long pipeline. All personnel [would] have the proper training and qualifications, as required by Part 192 of the safety regulations.

During construction of the pipeline, truck traffic of other projects in the area could add to the overall traffic, which could result in cumulative safety impacts. Impacts are anticipated to be temporary and minor and would primarily affect the truck drivers and construction personnel. Controls would be needed to ensure truck traffic is coordinated and safe. With proper planning, adherence to OSHA regulations, health and safety plans, and implementation of BMPs, cumulative impacts from the project in relation to public health and safety would not occur.

3.15.3.3.7 Summary of Alternative A

TVA Actions

During construction of the CC/Aero CT Plant, solar facility, BESS, and proposed transmission line, workers would have an increased safety risk that would be mitigated through BMPs and site-specific health and safety plans; however, there would remain minor safety risks from increased traffic during construction. General public health and safety would not be at risk in the event of an accidental spill on-site due to precautionary measures. Atmospheric emissions would be reduced as a result of coal generation replacement.

ETNG Actions - Natural Gas Pipeline and Associated Structures

During construction of the pipeline, workers would have an increased safety risk that would be mitigated through BMPs and site-specific health and safety plans; however, there would remain minor safety risks from increased traffic during construction. General public health and safety would not be at risk in the event of an accidental spill on-site due to precautionary measures. The greatest hazard during pipeline construction and operation is a fire that may result in the event of a major pipeline rupture or leak. A number of precautionary systems and response measures would be in place to mitigate this risk to workers and the public.

3.15.3.3.8 Environmental Justice Considerations

TVA Actions

Safety-related effects such as increased traffic near high traffic construction areas could result in negative safety effects for people living near the Kingston Reservation.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Safety-related effects such as increased traffic near high traffic construction areas could result in negative safety effects for people living near the pipeline. In areas where pipeline activities intersect with EJ populations, amplified safety effects may occur to these communities.

3.15.3.4 Alternative B

3.15.3.4.1 Construction and Operation of Solar and Storage Facilities

Under Alternative B, TVA, or a third-party developer, would construct and operate 1,500 MW of solar and 2,200 MW of BESS at various sites within portions of East Tennessee. The proposed construction and operation of multiple BESS at multiple sites would have similar impacts to safety and impose, as required, similar minimization measures as those described in Section 3.15.3.3.2. During construction, workers would have an increased safety risk. See Section 2.3.1 for additional details on standard BMPs.

The construction of Alternative B combined with the planned RFFA of 10,000 MW in solar facilities could result in cumulative safety impacts as a result of the cumulative traffic impacts from nearby projects. Effects would be anticipated to be temporary and minor and would affect primarily the truck drivers and construction personnel. Controls would be needed to ensure truck traffic is coordinated and safe. With proper planning, adherence to OSHA regulations, health and safety plans, and implementation of BMPs, cumulative effects from the project in relation to public health and safety would not occur.

3.15.3.4.2 Transmission and Other Components

The extent of transmission lines necessary under Alternative B is not yet known. Transmission line impacts to safety would be comparable to those discussed in Section 3.15.2.2.5 and Section 3.15.2.2.6.

3.15.3.4.3 Environmental Justice Considerations

Safety-related effects that would occur as a result of the proposed solar facilities and transmission line activities would be anticipated to be temporary, minor and mitigated, and limited to the immediate project sites and transmission line corridors. While adverse safety related effects are not anticipated, effects on EJ populations would be more fully evaluated for individual solar and storage facilities under future NEPA reviews.

3.16 Socioeconomics

Social, economic, and sociocultural characteristics of potentially affected populations are assessed in this section using the 2010 Census, 2020 Census, and the 2020 ACS. State-level USCB data are included for comparison purposes. These data were obtained utilizing USCB Explore Census Data (USCB 2022b) and ESRI Demographics (ESRI 2022). Where appropriate, additional data from USCB and other federal and state agencies are employed.

The area considered for socioeconomic analysis varies relative to the alternative and corresponds to the extent of impacts anticipated for that alternative (Figure 3.16-1). The area considered for the Kingston Reservation is the approximated geographic area from which the labor market is derived. The Kingston labor market area consists of the counties where the facility is located and all adjacent counties, including the off-site transmission corridors. For the ETNG Construction ROW associated with Alternative A, the extent of effects, including labor market effects, is expected to be more limited than those associated with the natural gas plants and solar and storage facilities but more encompassing than the area considered for EJ effects; thus, a three-mile radius of the pipeline was assessed for the socioeconomic analysis (hereafter referred to as the TVA Expanded Socioeconomic Study Area). To better represent the data, census tract data, given as Census Tract number (e.g., CT 9702) by county, are utilized to characterize the ETNG Construction ROW. Because census tract boundaries may have changed between the 2010 decennial census and the 2020, population change data are presented at the county level rather than the census tract level, making population change the one exception.

For Alternative B, the area from which potentially affected populations are identified is the East Tennessee region of the TVA PSA (Figure 3.4-2), as assessed by the census data associated with each county in the region. This area is hereafter referred to as the Alternative B Socioeconomic Study Area.

In evaluating beneficial and adverse effects to socioeconomics in relation to the natural gas pipeline associated with Alternative A, TVA incorporated the ETNG socioeconomic findings (ETNG 2022f). Detailed information regarding the affected environment of socioeconomics in relation to the ETNG Ridgeline Expansion Project are presented in Resource Report 5 (ETNG 2022f).

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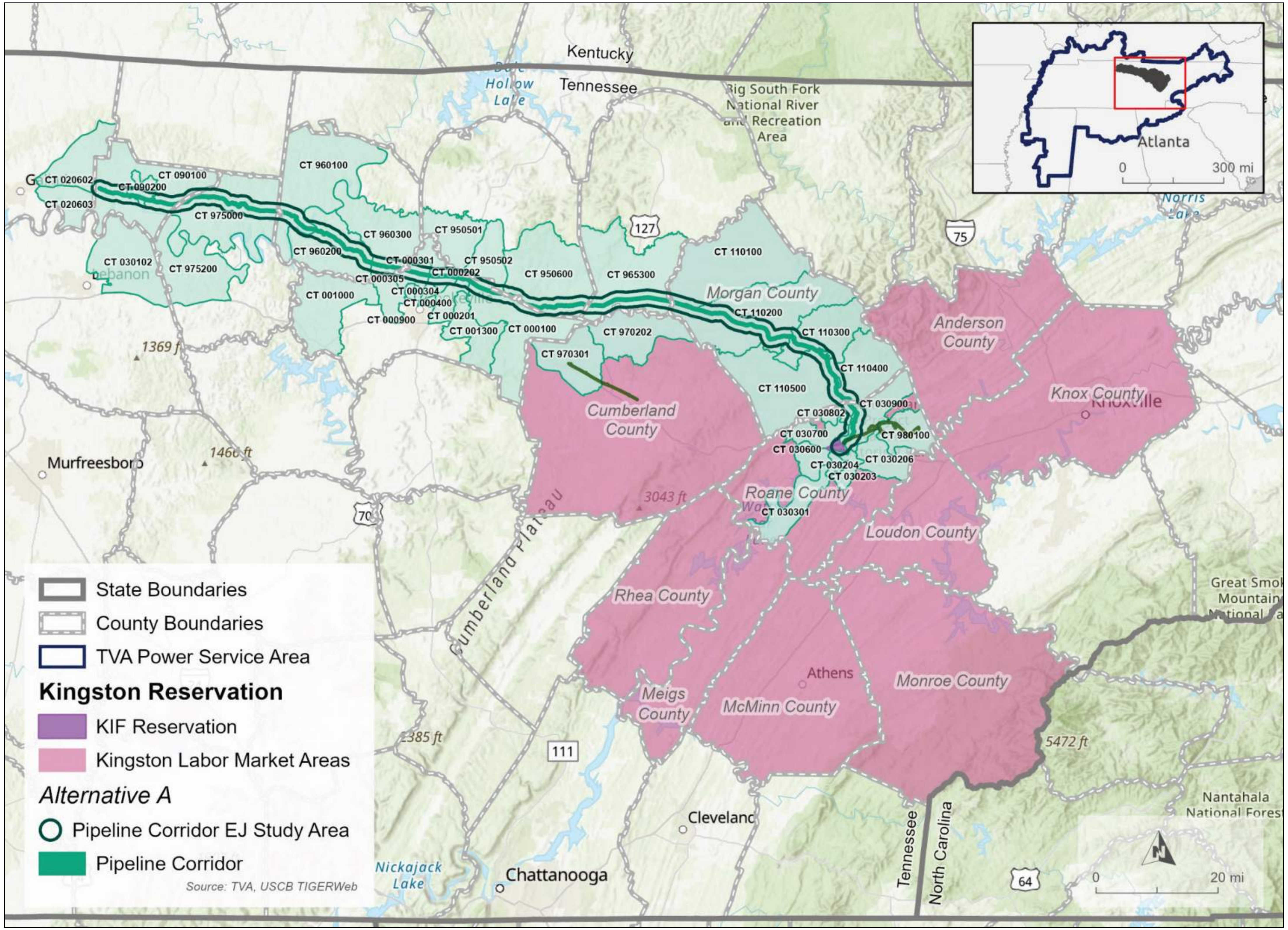

Figure 3.16-1. Kingston Reservation and Alternative A and B Socioeconomic Study Areas

3.16.1 Affected Environment

3.16.1.1 Kingston Reservation (No Action and D4 Activities)

The Kingston labor market area includes Roane County, where the facility is located, and Anderson, Cumberland, Knox, Loudon, McMinn, Meigs, Monroe, Morgan, and Rhea counties. The Kingston labor market area is largely rural but does include Knoxville, the third largest city in Tennessee with a 2020 population of 190,740. Other cities located in surrounding counties are much smaller with next largest populations being in Oak Ridge at 31,402 (Roane County) and Farragut at 23,506 (Knox County). All other counties' largest cities range in population from approximately 1,000 to 15,000. Kingston's 2020 population was 5,953. The Kingston labor market area also encompasses the on-site and off-site transmission corridors associated with Alternative A.

3.16.1.1.1 Demographics and Housing

Population data for the affected counties and associated states are provided in Table 3.16-1, based on the 2010 Census and the 2020 Census. As shown, from 2010 to 2020, population growth in six of the 10 counties was less than the growth for the state. Two of the 10 affected counties recorded population losses over that period, including Roane County, where the Kingston Reservation is located. Morgan County also recorded a population loss. Of the affected counties, three counties, Knox, Loudon, and McMinn counties, recorded population gains of more than 10 percent during that period.

Table 3.16-1. Population Change for the Kingston Labor Market Area

Geography	2010 Census	2020 Census	% Change
Tennessee	*6,346,105*	*6,910,840*	*8.9*
Roane County (Kingston)	54,181	53,404	-1.4
Anderson County	75,129	77,123	2.7
Cumberland County	56,053	61,145	9.1
Knox County	432,226	478,971	10.8
Loudon County	48,556	54,886	13.0
McMinn County	52,266	53,276	13.3
Meigs County	11,753	12,758	8.6
Monroe County	44,519	46,250	3.9
Morgan County	21,987	21,035	-4.3
Rhea County	31,809	32,870	3.3

Sources: 2010 Census; 2020 Census

Other demographic characteristics of the 10 affected counties, as compared with the state, are summarized in Table 3.16-2, based on the 2020 ACS. The populations of affected counties were generally more aged than the state population with the only exception being in Knox County, where the larger City of Knoxville is present, and the population is younger than in Tennessee. Roane County, Anderson County, and Knox County were the only counties with higher percentages of people who were high school graduates or higher than the state.

Table 3.16-2. Demographic Characteristics for the Kingston Labor Market Area

Geography	% of Population 65 Years and Over	Median Age	% High School or Higher*	% of Occupied Housing Units, Renter Occupied	Median Year Housing Units Built
Tennessee	*16.4*	*38.8*	*88.2*	*33.5*	*1984*
Roane County (Kingston)	22.7	47.3	89.8	24.4	1978
Anderson County	19.9	41.3	88.6	32.4	1976
Cumberland County	30.8	51.8	87.1	20.9	1993
Knox County	15.8	37.4	91.9	35.0	1983
Loudon County	26.3	47.8	87.0	20.7	1991
McMinn County	19.8	42.4	85.0	25.7	1982
Meigs County	21.5	45.9	84.0	20.1	1992
Monroe County	21.2	44.1	84.6	26.0	1991
Morgan County	18.0	41.5	81.5	17.6	1984
Rhea County	18.2	40.0	82.5	26.3	1987

*Of Population over 25 Years and includes High School Equivalency
Source: 2020 ACS

According to the 2020 ACS, all affected counties except Knox County had lower percentages of renter-occupied housing units than their respective state. In six of the affected counties, including Roane County, housing units were generally older than across the state.

3.16.1.1.2 Regional Economy, Employment, and Income

Kingston Reservation directly employs a range of positions such as general laborers, steamfitters, machinists, electricians, analysts, administrators, and supervisors. The Kingston Reservation average annual salary is approximately 100 percent higher than the 2020 average annual wages per employee in affected counties, based on the Quarterly Census of Employment and Wages from the U.S. Bureau of Labor Statistics (USBLS; USBLS 2022). Kingston Reservation also employs contractors for both short- and long-term operations labor support and contracts with coal and limestone mining operations and transportation companies that support additional employment and account for significant contributions to the area economy.

Kingston Reservation also has indirect and induced effects on the local economy. Indirect effects result from changes in sales, income, or employment within the Kingston Reservation region, and induced effects occur through the recirculation of money received through direct and indirect income sources and the subsequent creation of additional jobs and economic activities.

TVA makes payments in lieu of taxes, also called tax equivalent payments, to states where TVA sells electricity or owns power system assets. The payments total five percent of gross proceeds from the sale of power in the prior fiscal year, with some exclusions. Tennessee Code Annotated Title 67, Chapter 9, Part 1 (T.C.A. §67-9-102) directs how the funds are apportioned within the state and mandates that an individual county's portion of the total payment is determined by its proportion of population, total land area, and TVA-owned land in the county. In addition to tax equivalent payments, there is also a provision that allows for "impact payments" to local communities as a result of large TVA projects. These impact payments are made in addition to the normal tax equivalent payments made by the state. Impact payments acknowledge that large projects have impacts to traffic volumes, the number of students, infrastructure, and other regional resources.

Table 3.16-3 summarizes 2020 ACS data on employment and income for the affected counties. Except for Knox County, all other affected counties had lower percentages of people in the labor force than the state. All affected counties had unemployment rates above that of the associated state. Based on the Quarterly Census of Employment and Wages from USBLS, the annual average total employment in Roane County was estimated to be 19,171 in 2020 (USBLS 2022). Direct employment at Kingston Reservation comprises a small percentage of this total. Based on the 2020 ACS, per capita income in three of the affected counties, including Roane County, was higher than that of their respective state.

Table 3.16-3. Employment and Income Characteristics for the Kingston Reservation Labor Market Area

Geography	% of 16+ Civilian Population in Labor Force	Unemployment Rate	% Employed in Education Services, Healthcare, and Social Services	% Employed in Manufacturing	Per Capita Income
Tennessee	*61.1*	*5.3*	*22.6*	*12.9*	*$30,869*
Roane County (Kingston)	54.5	6.0	22.9	9.7	$32,067
Anderson County	55.3	5.5	22.4	10.5	$28,633
Cumberland County	45.8	6.2	17.9	15.9	$26,910
Knox County	64.3	4.2	25.0	7.9	$34,338
Loudon County	54.3	3.6	16.2	18.8	$34,158
McMinn County	54.1	6.2	20.1	24.4	$25,637
Meigs County	51.4	8.9	18.8	25.6	$24,299
Monroe County	51.2	6.9	21.8	25.3	$25,179
Morgan County	43.4	7.7	22.1	11.1	$20,258
Rhea County	54.1	8.8	17.8	17.8	$23,634

Source: 2020 ACS

Pertinent civilian employment characteristics for the affected counties are also shown on Table 3.16-3. Manufacturing, education services, and healthcare generally lead the industries for employment. Though not shown on Table 3.16-3, construction also employs larger percentages of people in the Kingston labor market area, accounting from generally five to 15 percent of employment. Roane County and three other affected counties, however, have lower percentages of civilians employed in manufacturing as compared to the state percentage.

3.16.1.2 Alternative A

3.16.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The proposed CC/Aero CT Plant site would be located within the Kingston Reservation. Therefore, the affected environment for socioeconomics is as described for the Kingston labor market area in Section 3.16.1.1.

3.16.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located within the Kingston Reservation. Therefore, the affected environment for socioeconomics is as described for the Kingston labor market area in Section 3.16.1.1.

3.16.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW battery site and new transmission corridor would be located within the Kingston Reservation. Therefore, the affected environment for socioeconomics is as described for the Kingston labor market area in Section 3.16.1.1.

3.16.1.2.4 On-site Transmission Upgrades

The proposed on-site transmission connections and corridors would be located within the Kingston Reservation and, therefore, in the Kingston Reservation labor market area. The affected environment for socioeconomics is as described for the Kingston labor market area in Section 3.16.1.1.

3.16.1.2.5 Off-site Transmission Upgrades

The off-site transmission upgrades proposed for the Eastern Transmission (L5108, L5116, L5280, L5302, and L5381) and Western Transmission (L5383) corridors would be located within the Kingston Reservation labor market area. Therefore, the affected environment for socioeconomics is as described for the Kingston labor market area in Section 3.16.1.1.

3.16.1.2.6 Construction and Operation of a Natural Gas Pipeline

Census tracts within the TVA Expanded Socioeconomic Study Area include or touch 40 census tracts within portions of Cumberland, Fentress, Jackson, Morgan, Overton, Putnam, Roane, Smith, Sumner, Trousdale, and Wilson counties.

While the study area overlaps CT 9801, this census tract is entirely encompassed by the Y-12 National Security Complex, which has no residential population. As all census values were zero, CT 9801 was not included in the CT total or the analyses so not to skew results.

3.16.1.2.6.1 Demographics and Housing

Population data for the TVA Expanded Socioeconomic Study Area and Tennessee are provided in Table 3.16-4, based on the 2010 Census and the 2020 ACS. As shown, from 2010 to 2020, five of the counties recorded population growth greater than the state rate with four of those counties being in double digits. Three counties recorded population losses over that period.

Table 3.16-4. Population Change in the TVA Expanded Socioeconomic Study Area

Geography	2010 Census	2020 ACS	% Change
Tennessee	*6,346,105*	*6,910,840*	*5.7*
Cumberland County	56,053	61,145	9.1
Fentress County	17,959	18,489	3.0
Jackson County	11,638	11,617	-0.2
Morgan County	21,987	21,035	-4.3
Overton County	22,083	22,511	1.9
Putnam County	72,321	79,854	10.4
Roane County	54,181	53,404	-1.4

Geography	2010 Census	2020 ACS	% Change
Smith County	19,166	19,904	3.9
Sumner County	160,645	196,281	*22.2*
Trousdale County	7,870	11,615	47.6
Wilson County	113,993	*147,737*	*29.5*

Sources: 2010 Census; 2020 ACS

Other demographic characteristics of the affected census tracts, as compared to Tennessee, are summarized in Table 3.16-5, based on the 2020 ACS. Generally, median age within the census tracts was higher than that of the state. In 26 of the affected census tracts, there were lower percentages of people who were high school graduates or higher than the state. All but two of the 14 census tracts with higher percentages of high school graduates or higher compared to the state are located in Putnam and Roane counties.

According to the 2020 ACS, six of the affected census tracts had higher percentages of renter-occupied housing units than the state, with four of those being in Putnam County. In 13 of the 36 census tracts, housing units were older than across the respective state.

Table 3.16-5. Demographic Characteristics in the TVA Expanded Socioeconomic Study Area

Geography	% of Population 65 Years and Over	Median Age	% High School or Higher*	% of Occupied Housing Units Renter Occupied	Median Year Housing Units Built
Tennessee	*16.4*	*38.8*	*88.2*	*33.5*	*1984*
Cumberland County					
CT 9702.02	26.6	41.4	83.8	10.7	1999
CT 9703.01	28.8	48.3	84.8	17.0	1994
Fentress County					
CT 9653 (Pipeline)	19.6	38.0	88.2	11.7	1997
Jackson County					
CT 9601 (Pipeline)	24.6	48.7	78.5	18.2	1984
CT 9602 (Pipeline)	23.8	45.5	85.0	14.2	1983
CT 9603(Pipeline)	20.1	45.0	81.6	22.9	1989
Morgan County					
CT 1101 (Pipeline)	21.9	46.0	79.9	14.0	1987
CT 1102 (Pipeline)	19.7	46.4	87.5	10.2	1989
CT 1103 (Pipeline)	12.5	36.2	74.9	29.4	1982
CT 1104 (Pipeline)	21.6	41.0	85.3	27.3	1984
CT 1105 (Pipeline)	18.7	45.8	83.7	8.0	1984
Overton County					
CT 9505.01	17.0	38.3	89.5	17.1	1986
CT 9505.02 (Pipeline)	12.3	36.6	89.6	13.2	1986

Geography	% of Population 65 Years and Over	Median Age	% High School or Higher*	% of Occupied Housing Units Renter Occupied	Median Year Housing Units Built
CT 9506 (Pipeline)	15.1	40.9	66.0	19.3	1991
Putnam County					
CT 1 (Pipeline)	18.5	40.0	82.7	34.2	1985
CT 2.01 (Pipeline)	20.2	33.8	83.3	42.7	1991
CT 2.02 (Pipeline)	24.2	47.2	91.1	13.5	1996
CT 3.01 (Pipeline)	21.3	48.1	91.8	10.2	1989
CT 3.03	17.3	39.8	79.6	45.1	1979
CT 3.04	4.8	24.5	80.4	78.9	1985
CT 3.05	7.0	31.7	91.6	52.9	1992
CT 4	21.3	40.6	97.2	45.4	1983
CT 9	14.2	42.7	89.8	22.6	1992
CT 10	19.8	39.9	82.9	9.1	1986
CT 13	24.0	49.6	89.0	15.0	1990
Roane County					
CT 302.03	21.8	46.7	94.3	23.8	1983
CT 302.04	24.8	49.2	88.6	39.4	1961
CT 302.06	20.5	47.3	94.3	18.7	1988
CT 303.01	25.4	45.1	93.5	19.4	1993
CT 306	27.7	50.9	86.8	28.0	1981
CT 307 (Pipeline)	23.6	50.4	89.1	24.7	1966
CT 308.02	18.5	33.9	95.8	32.4	1972
CT 309 (Pipeline)	28.1	48.1	86.0	22.7	1980
Smith County					
CT 9750 (Pipeline)	16.5	47.3	86.7	15.4	1977
CT 9752	16.9	38.7	85.9	25.2	1991
Sumner County					
CT 206.02	17.3	43.2	85.9	10.6	1977
CT 206.03	23.1	48.2	86.5	8.1	1988
Trousdale County					
CT 901 (Pipeline)	12.8	34.2	84.9	20.2	1986
CT 902 (Pipeline)	14.7	32.8	85.3	37.8	1977
Wilson County					
CT 301.02	14.1	40.9	87.8	14.3	1991

*Of Population over 25 Years and includes High School Equivalency
Source: 2020 ACS

3.16.1.2.6.2 Employment and Income

Table 3.16-6 summarizes 2020 ACS data on employment and income for the TVA Expanded Socioeconomic Study Area. Twenty-nine affected census tracts had lower percentages of people in the labor force than Tennessee. Nineteen of the 40 affected census tracts had unemployment rates above that of the state. Based on the 2020 ACS, except for 11 census tracts, per capita income across the study area was generally lower than that of their respective state.

Table 3.16-6. Employment and Income Characteristics in the TVA Expanded Socioeconomic Study Area

Geography	% of 16+ Civilian Population in Labor Force	Unemployment Rate	% Employed in Education Services, Healthcare, and Social Services	% Employed in Manufacturing	Per Capita Income
Tennessee	*61.1*	*5.3*	*22.6*	*12.9*	*$30,869*
Cumberland County					
CT 9702.02	62.3	0.8	24.4	25.9	$30,967
CT 9703.01	46.1	4.2	32.5	9.3	$25,822
Fentress County					
CT 9653 (Pipeline)	55.0	5.9	26.5	18.3	$19,021
Jackson County					
CT 9601 (Pipeline)	40.4	9.2	28.9	16.8	$20,841
CT 9602 (Pipeline)	56.5	5.4	22.4	15.6	$20,528
CT 9603 (Pipeline)	54.7	9.9	19.4	15.3	$22,209
Morgan County					
CT 1101 (Pipeline)	50.4	5.5	15.2	16.7	$19,815
CT 1102 (Pipeline)	43.5	7.4	20.1	11.7	$25,569
CT 1103 (Pipeline)	25.8	3.7	29.7	6.3	$13,437
CT 1104 (Pipeline)	56.7	11.3	34.4	16.4	$22,446
CT 1105 (Pipeline)	53.9	8.7	23.8	10.2	$23,920
Overton County					
CT 9505.01	62.4	7.5	20.4	11.2	$23,403
CT 9505.02 (Pipeline)	75.6	0.8	31.8	17.4	$26,231
CT 9506 (Pipeline)	50.4	2.6	20.1	12.9	$24,186
Putnam County					
CT 1 (Pipeline)	55.6	2.3	20.3	17.4	$20,676
CT 2.01 (Pipeline)	60.0	2.8	21.0	16.6	$24,231
CT 2.02 (Pipeline)	48.2	1.8	26.6	14.4	$30,416
CT 3.01 (Pipeline)	60.3	5.4	26.4	11.2	$27,300
CT 3.03	53.6	3.6	45.0	5.0	$23,637
CT 3.04	60.9	4.1	26.4	13.2	$14,721

Geography	% of 16+ Civilian Population in Labor Force	Unemployment Rate	% Employed in Education Services, Healthcare, and Social Services	% Employed in Manufacturing	Per Capita Income
CT 3.05	81.0	1.8	27.6	9.6	$25,999
CT 4	58.9	5.4	21.3	15.2	$32,046
CT 9	67.6	3.8	9.7	21.3	$27,599
CT 10	51.9	7.6	15.8	14.3	$24,618
CT 13	54.0	2.8	26.5	11.1	$30,371
Roane County					
CT 302.03	63.3	5.6	25.9	10.4	$36,753
CT 302.04	51.3	10.5	36.3	7.2	$30,561
CT 302.06	64.2	6.0	18.3	12.0	$42,910
CT 303.01	50.4	7.9	18.2	4.4	$37,370
CT 306	55.3	6.4	19.4	12.8	$25,421
CT 307 (Pipeline)	55.5	3.0	9.7	10.9	$31,647
CT 308.02	57.4	4.6	15.4	10.4	$32,501
CT 309 (Pipeline)	54.9	3.3	15.7	8.4	$30,854
Smith County					
CT 9750 (Pipeline)	56.4	1.5	20.3	20.3	$33,346
CT 9752	55.5	6.7	17.8	15.0	$27,875
Sumner County					
CT 206.02	65.1	1.3	21.1	11.2	$32,726
CT 206.03	66.1	4.3	21.1	10.4	$33,278
Trousdale County					
CT 901 (Pipeline)	51.9	6.0	12.5	12.3	$23,044
CT 902 (Pipeline)	62.2	1.4	4.7	10.2	$26,640
Wilson County					
CT 301.02	71.1	4.6	14.3	14.2	$31,969

Source: 2020 ACS

Pertinent civilian employment characteristics for the affected census tracts are also shown on Table 3.16-6. In the TVA Expanded Socioeconomic Study Area, manufacturing, education services, and healthcare generally lead the industries for employment. Though not shown on Table 3.16-6, construction also employs larger percentages of people in the TVA Expanded Socioeconomic Study Area with construction accounting for generally five to 15 percent of employment.

3.16.1.3 Alternative B

3.16.1.3.1 East Tennessee TVA Power Service Area

The Alternative B Socioeconomic Study Area consists of the East Tennessee region, as based on regions in the TVA PSA defined by the TVA Economic Development team (TVA 2022e; Figure 3.4-2). It is separated into its 49 associated counties for evaluation purposes.

3.16.1.3.1.1 Demographics and Housing

Population data for the 49 counties in East Tennessee are provided in Table 3.16-7 in comparison with Tennessee as a whole, based on the 2010 Census and the 2020 Census. As shown, from 2010 to 2020, population growth in 36 of the 49 counties was less than the growth for the state. Fourteen of the counties recorded population losses over that period. Those counties include Campbell, Carter, Claiborne, Clay, Grundy, Hancock, Hawkins, Jackson, Johnson, Morgan, Picket, Roane, Scott, and Unicoi.

Table 3.16-7. Population Change in the Alternative B Socioeconomic Study Area

Geography	2010 Census	2020 Census	% Change
Tennessee	*6,346,105*	*6,910,840*	*8.9*
Anderson County	75,129	77,123	2.7
Bledsoe County	12,876	14,913	15.8
Blount County	123,010	135,280	10.0
Bradley County	98,963	108,620	9.8
Campbell County	40,716	39,272	-3.5
Cannon County	13,801	14,506	5.1
Carter County	57,424	56,356	-1.9
Claiborne County	32,213	32,043	-0.5
Clay County	7,861	7,581	-3.6
Cocke County	35,662	35,999	0.9
Cumberland County	56,053	61,145	9.1
DeKalb County	18,723	20,080	7.2
Fentress County	17,959	18,489	3.0
Grainger County	22,657	23,527	3.8
Greene County	68,831	70,152	1.9
Grundy County	13,703	13,529	-1.3
Hamblen County	62,544	64,499	3.1
Hamilton County	336,463	366,207	8.8
Hancock County	6,819	6,662	-2.3
Hawkins County	56,833	56,721	-0.2
Jackson County	11,638	11,617	-0.2
Jefferson County	51,407	54,683	6.4
Johnson County	18,244	17,948	-1.6
Knox County	432,226	478,971	10.8
Loudon County	48,556	54,886	13.0
McMinn County	22,248	25,216	13.3
Macon County	28,237	28,837	2.1
Marion County	80,956	100,974	24.7
Meigs County	11,753	12,758	8.6
Monroe County	44,519	46,250	3.9
Morgan County	21,987	21,035	-4.3
Overton County	22,083	22,511	1.9

Geography	2010 Census	2020 Census	% Change
Pickett County	5,077	5,001	-1.5
Polk County	16,825	17,544	4.3
Putnam County	72,321	79,854	10.4
Rhea County	31,809	32,870	3.3
Roane County	54,181	53,404	-1.4
Scott County	22,228	21,850	-1.7
Sequatchie County	14,112	15,826	12.1
Sevier County	89,889	98,380	9.4
Smith County	19,166	19,904	3.9
Sullivan County	156,823	158,163	0.9
Trousdale County	7,870	11,615	47.6
Unicoi County	18,313	17,928	-2.1
Union County	19,109	19,802	3.6
Van Buren County	5,548	6,168	11.2
Warren County	39,839	40,953	2.8
Washington County	122,979	133,001	8.1
White County	25,841	27,351	5.8

Sources: 2010 Census; 2020 Census

Other demographic characteristics of East Tennessee, as compared with the state, are summarized in Table 3.16-8 based on the 2019 ACS. In all but three (Knox, Putnam, and Trousdale Counties) of the 49 counties, the populations in the study area were more aged than the state. Except in five counties (Blount, Hamilton, Knox, Roane, and Washington counties), there were lower percentages of people who were high school graduates or higher than across the state.

According to the 2020 ACS, the counties in East Tennessee generally had lower percentages of renter-occupied housing units than across the state. In approximately half of the counties, housing units were newer than across the state, while the other half were older.

Table 3.16-8. Demographic Characteristics of the Alternative B Socioeconomic Study Area

Geography	% of Population 65 Years and Over	Median Age**	% High School or Higher*	% of Occupied Housing Units, Renter Occupied	Median Year Housing Units Built**
Tennessee	*16.4*	*38.8*	*88.2*	*33.5*	*1984*
Anderson County	19.9	43.1	88.6	32.4	1976
Bledsoe County	18.2	43.2	78.4	23.4	1992
Blount County	20.2	43.9	89.4	23.4	1987
Bradley County	17.1	39.7	87.1	33.2	1985
Campbell County	20.5	44.1	79.2	33.6	1982
Cannon County	18.0	41.0	84.1	23.2	1985

Geography	% of Population 65 Years and Over	Median Age**	% High School or Higher*	% of Occupied Housing Units, Renter Occupied	Median Year Housing Units Built**
Carter County	21.7	45.7	85.1	28.0	1978
Claiborne County	19.6	42.7	80.4	29.1	1984
Clay County	24.0	47.0	80.7	22.1	1985
Cocke County	21.3	45.3	81.8	30.4	1985
Cumberland County	30.8	51.8	87.1	20.9	1993
DeKalb County	18.8	42.6	79.5	31.7	1982
Fentress County	21.4	45.5	80.7	24.0	1989
Grainger County	20.7	46.2	80.1	23.6	1988
Greene County	21.9	45.0	84.5	24.2	1981
Grundy County	20.8	43.5	78.2	21.4	1983
Hamblen County	18.1	40.7	83.0	33.2	1978
Hamilton County	17.6	39.7	90.3	35.9	1978
Hancock County	21.1	44.5	81.1	22.5	1983
Hawkins County	20.9	45.2	86.8	23.5	1984
Jackson County	22.5	47.4	80.5	19.5	1985
Jefferson County	19.9	44.2	86.2	24.3	1989
Johnson County	22.8	46.1	80.6	24.5	1982
Knox County	15.8	37.4	91.9	35.0	1983
Loudon County	26.3	47.8	87.0	20.7	1991
Macon County	15.7	38.4	81.6	26.6	1989
Marion County	19.4	43.2	81.0	24.8	1985
McMinn County	19.8	42.4	85.0	25.7	1982
Meigs County	21.5	45.9	84.0	20.1	1992
Monroe County	21.2	44.1	84.6	26.0	1991
Morgan County	18.0	41.5	81.5	17.6	1984
Overton County	20.4	43.2	80.4	22.0	1980
Pickett County	27.3	50.7	79.3	19.2	1987
Polk County	21.0	46.3	81.6	25.6	1987
Putnam County	16.7	36.7	88.2	38.1	1988
Rhea County	18.2	40.0	82.5	26.3	1987
Roane County	22.7	47.3	89.8	24.4	1978
Scott County	16.8	39.4	78.5	28.7	1989
Sequatchie County	20.7	44.4	83.2	23.6	1997
Sevier County	19.6	42.9	86.5	28.9	1993
Smith County	16.6	40.6	85.9	24.3	1982
Sullivan County	21.9	45.3	87.5	27.9	1975

Geography	% of Population 65 Years and Over	Median Age**	% High School or Higher*	% of Occupied Housing Units, Renter Occupied	Median Year Housing Units Built**
Trousdale County	13.3	33.9	85.0	25.5	1984
Unicoi County	23.7	47.4	85.6	27.5	1976
Union County	18.1	42.5	78.3	24.7	1992
Van Buren County	23.1	46.5	78.9	20.0	1983
Warren County	17.4	40.1	81.9	29.7	1978
Washington County	18.2	40.1	89.6	35.9	1984
White County	20.2	43.3	81.1	22.5	1985

*Of Population over 25 Years and includes High School Equivalency
**For the PSA regions, the "medians" given are averages of the medians across the associated counties.
Source: 2020 ACS

3.16.1.3.1.2 Employment and Income

Table 3.16-9 summarizes 2020 ACS data on employment and income for the Alternative B Socioeconomic Study Area. All but four of the 49 counties had lower percentages of people in the labor force and approximately half had higher rates of unemployment than across the state. Based on the 2020 ACS, per capita income was lower than that of the state in 45 of the 49 counties.

Table 3.16-9. Employment and Income Characteristics of the Alternative B Socioeconomic Study Area

Geography	% of 16+ Civ. Pop. in Labor Force	Unemployment. Rate	% Employed in Educ. Services., Healthcare, and Social Services	% Employed in Manufacturing	Per Capita Income
Tennessee	*61.1*	*5.3*	*22.6*	*12.9*	*$30,869*
Anderson County	55.3	5.5	22.4	10.5	$28,633
Bledsoe County	49.9	7.5	13.8	15.4	$23,120
Blount County	59.7	4.8	22.9	13.7	$31,231
Bradley County	61.2	5.4	21.5	20.5	$26,743
Campbell County	53.8	10.2	22.6	15.4	$24,670
Cannon County	55.7	3.0	21.2	19.7	$26,971
Carter County	52.0	5.9	28.4	13.0	$24,631
Claiborne County	51.3	7.2	30.2	19.8	$22.562
Clay County	46.0	5.3	25.3	16.1	$20,395
Cocke County	52.1	8.6	19.4	19.3	$22,282
Cumberland County	45.8	6.2	17.9	15.9	$26,910
DeKalb County	52.2	4.9	20.3	26.7	$25,135
Fentress County	50.2	6.3	26.8	13.1	$20,295
Grainger County	53.9	5.2	19.1	18.2	$23,937
Greene County	51.8	5.0	25.6	22.0	$25,319

Geography	% of 16+ Civ. Pop. in Labor Force	Unemployment. Rate	% Employed in Educ. Services., Healthcare, and Social Services	% Employed in Manufacturing	Per Capita Income
Grundy County	53.9	8.0	22.7	21.2	$20,702
Hamblen County	56.9	7.7	19.2	25.3	$23,722
Hamilton County	62.5	4.6	22.8	13.0	$34,707
Hancock County	44.4	12.0	33.4	19.6	$24,237
Hawkins County	50.8	7.6	25.1	23.0	$25,438
Jackson County	50.9	7.6	21.2	19.7	$21,148
Jefferson County	56.6	6.2	19.4	12.6	$25,857
Johnson County	39.2	3.0	18.8	18.3	$22,955
Knox County	64.3	4.2	25.0	7.9	$34,338
Loudon County	54.3	3.6	16.2	18.8	$34,158
Macon County	60.3	4.4	17.3	17.2	$22,881
Marion County	55.5	5.2	17.8	21.2	$25,717
McMinn County	54.1	6.2	20.1	24.4	$25,637
Meigs County	51.4	8.9	18.8	25.6	$24,299
Monroe County	51.2	6.9	21.8	25.3	$25,179
Morgan County	43.4	7.7	22.1	11.1	$20,258
Overton County	55.3	3.6	20.7	16.5	$22,864
Pickett County	47.1	4.8	23.2	15.7	$26,925
Polk County	56.1	6.3	25.1	19.9	$28,059
Putnam County	59.4	5.9	24.4	14.7	$25,208
Rhea County	54.1	8.8	17.8	17.8	$23,634
Roane County	54.5	6.0	22.9	9.7	$32,067
Scott County	51.2	8.2	24.7	20.5	$19,970
Sequatchie County	51.6	4.7	19.7	14.3	$22,931
Sevier County	61.6	4.8	13.5	7.5	$26,919
Smith County	58.6	3.7	19.9	18.5	$28,134
Sullivan County	55.0	6.5	23.0	14.9	$28,790
Trousdale County	54.6	4.6	12.3	10.6	$24,036
Unicoi County	53.0	6.1	22.5	18.5	$23,817
Union County	52.4	6.7	20.7	13.7	$24,268
Van Buren County	52.4	5.0	18.8	25.2	$22,051
Warren County	56.8	3.8	19.1	22.9	$23,143
Washington County	59.3	4.8	29.2	12.4	$29,850
White County	52.7	4.9	17.3	22.1	$23,820

Source: 2020 ACS

Pertinent civilian employment characteristics for East Tennessee are also shown on Table 3.16-9. Manufacturing, education services, and healthcare generally lead the industries for employment. Though not shown on Table 3.16-9, construction also employs larger percentages of people in East Tennessee with construction accounting for generally five to 15 percent of employment in most counties.

3.16.2 Environmental Consequences

3.16.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate and maintain the KIF coal units as part of the TVA generation portfolio. TVA would implement all the planned actions related to the current and future management and storage of CCRs at the coal plant, which have either been reviewed or would be in subsequent NEPA analysis. Employment at the Kingston Reservation would continue to be an option in the labor market area, and contracts associated with the Kingston Reservation operations and any plant modifications and indirect and induced economic activities would continue to support the regional economy. However, the repairs and maintenance necessary to maintain reliability, while providing local employment opportunities, may have a minor adverse effect on ratepayers.

3.16.2.2 Retirement, Decommissioning, Decontamination, and Deconstruction of Kingston Reservation Plant

The coal facilities at Kingston Reservation would be retired by the end of 2027 and would transition to the D4 process detailed in Table 2.1-1. While the demolition of the Kingston coal reservation would result in job loss, the D4 activities would partially offset employment loss in Roane County for the approximately three- to five-year period. Routine plant deliveries would also be discontinued. All previously approved CCR projects would continue to be implemented.

TVA tax equivalent payments to Tennessee would not change with Kingston coal facility retirement and D4 activities. As TVA would maintain ownership of the Kingston Reservation property for the foreseeable future, allocations to Roane County, per T.C.A. §67-9-101, would not decrease as a result of plant closures. However, TVA, at its sole discretion, determines which counties are impacted the most significantly by the project in communication with the state. The state of Tennessee would then pay the impact payments out of a portion of the tax equivalent payments that TVA makes to the state. Thus, there could be a minor economic benefit to Roane County as a result of the Kingston coal facility retirement.

With the retirement of the coal units at the Kingston Reservation, contracts associated with coal operations and indirect and induced economic activities would also be reduced, canceled, or cease in a phased process. The people currently employed by the Kingston Reservation may become temporarily unemployed with the Kingston Reservation coal facility retirement. While this decrease in employment represents a small percentage of total employment as estimated for 2020 in Roane County (USBLS 2022), minor direct adverse economic effects to the area would result. TVA would continue to identify employment opportunities across the TVA region for all interested employees. Given the prominence of several other employment options in the Kingston Reservation vicinity, including manufacturing, educational services, health care, and construction, current Kingston Reservation employees may potentially find alternative employment in these other industries. Kingston employees and any associated family members may also temporarily relocate for work, and these changes may affect familial and community relations in the Kingston Reservation labor market area.

Mining of coal and limestone for use at the Kingston Reservation and the transportation of these products to the Kingston Reservation provides additional regional employment. The retirement of the Kingston Reservation coal facilities may result in indirect employment effects to the nearby mining, trucking, and barge industries. Unless the coal and limestone mines find alternative markets for the tonnage currently purchased by the Kingston Reservation, minor indirect adverse economic effects to the affected counties and the region from which these Kingston Reservation products are purchased would occur from closure of this facility. Due to potential unemployment, reemployment in different industries, and relocations, these changes may also affect familial and community relations in the region from which these Kingston Reservation products are purchased.

Construction of projects in vicinity to the Kingston Reservation plant, such as the CCR management activities, could create short-term, beneficial cumulative effects to socioeconomics in the area.

3.16.2.2.1 Environmental Justice Considerations

Due to the loss of direct and indirect employment associated with Kingston Reservation, competition for employment in other fields in the labor market area, such as manufacturing, educational services, health care, and construction, may increase. Such trends could lead EJ populations and other populations to relocate for work or follow recent depopulation trends, as seen in Roane County where the Kingston Reservation is located, and permanently relocate to different locations in Tennessee or beyond. These changes may affect familial and community relations among EJ and other populations in the Kingston Reservation labor market area. These effects have the potential to be amplified on EJ populations that already face socioeconomic stressors, particularly for those populations in Morgan County CT 1104 BG 1 and Roane County CT 305 BG 3 where unemployment is already elevated.

3.16.2.3 Alternative A

3.16.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

Under Alternative A, the Kingston Reservation coal facilities would be retired and demolished, as described in Section 3.16.2.2. The existing switchyard at Kingston Reservation would be maintained for use in future operations associated with the proposed CC/Aero CT facility. Employment at the plant would be reduced. All previously studied CCR projects would continue to be implemented. The proposed CC/Aero CT facility would be constructed on the Kingston Reservation in Roane County.

While Kingston Reservation coal closures would decrease employment in the Kingston labor market area for the long-term, construction of the CC/Aero CT facility associated with Alternative A would temporarily increase employment in the area. Construction of the CC/Aero CT Plant would take approximately three years and would provide up to 600 jobs at peak. The number of employees for the operation of the new CC/Aero CT Plant would be reduced from the number of employees required to operate the KIF. However, these temporary and permanent employment opportunities would help partially offset some employment losses associated with KIF coal facility retirement. Construction of projects in the vicinity of the proposed CC/Aero CT facility, such as the CCR management activities, could create short-term, beneficial cumulative effects to socioeconomics in the area.

3.16.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located within the Kingston Reservation. Therefore, the effects for socioeconomics are as described for the Kingston labor market area in Section 3.16.2.3.1.

3.16.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation
The proposed 100-MW battery site and new transmission corridor would be located within the Kingston Reservation. Therefore, the effects for socioeconomics are as described for the Kingston labor market area in Section 3.16.2.3.1.

3.16.2.3.4 On-site Transmission Upgrades
Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission connections to the proposed CC/Aero CT facilities and switchyard, and new permanent access roads to support upgrades to the existing transmission lines will be needed as a result. Therefore, the environmental consequences for on-site transmission upgrades on socioeconomics are the same as those described for the Kingston labor market area in Section 3.16.2.3.

3.16.2.3.5 Off-site Transmission Upgrades
The off-site transmission upgrades proposed for the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381) and Western Transmission Corridor (L5383) corridors under Alternative A will require construction of new permanent access roads to support upgrades to the existing transmission lines. The proposed upgrade activities and construction of new access roads are expected to result in a minor temporary increase in employment. While the Kingston Reservation coal closures would decrease employment in the Kingston Reservation labor market area for the long-term, activities associated with the off-site transmission upgrades under Alternative A could result in a minor temporary increase in employment in the area.

3.16.2.3.6 Construction and Operations of Natural Gas Pipeline
The new CC/Aero CT facility would require construction of approximately 122 miles of new natural gas pipeline (up to 30-inch-diameter) and associated gas system infrastructure in Fentress, Jackson, Morgan, Overton, Putnam, Roane, Smith, and Trousdale counties. The pipeline would be built largely within or adjacent to existing pipeline ROW. Due to proximity to Cumberland and Sumner counties, the TVA Expanded Socioeconomic Study Area also includes those two counties.

While the Kingston Reservation coal closures would decrease employment in the Kingston Reservation labor market area for the long-term, construction of the natural gas pipeline associated with Alternative A would partially offset employment loss in the area. Ongoing employment in relation to operation of the gas system infrastructure would allow for a slight increase in employment options in the TVA Expanded Socioeconomic Study Area. These temporary and permanent employment increases would help offset some employment losses associated with the Kingston Reservation coal facility retirement.

According to the ETNG draft Resource Report 5, Socioeconomics (ETNG 2022f), displacement of residences or businesses would be minimized due to the placement of the pipeline primarily along existing pipeline ROW; ETNG “continues to [more fully] evaluate whether and extent to which any residents or commercial businesses would be impacted by the [pipeline].”

Further, ETNG states within this same Resource Report:

> Construction will temporarily increase the population in the Project area to a very limited degree. It is estimated that the Project will directly employ approximately 2,500 workers within the eight-county region. It is estimated that approximately 521 people would be indirectly employed during the construction of Project across the state. Once the pipelines and the compressor station are completed, the workforce numbers will taper off toward the completion of the construction period. [ETNG]

> anticipates its contractors will hire a substantial number of specialized construction workers with the requisite experience for the installation of natural gas facilities. These hires will include surveyors, welders, equipment operators, and general laborers. It is anticipated that some of the construction workers are expected to be local hires. The local supply of construction workers needed for the Project is expected to be derived from workers employed in the construction industry in the affected counties of Tennessee. Construction personnel that may be hired from outside the Project area include supervisory personnel and inspectors. These individuals will temporarily relocate to the Project vicinity, if necessary. The number of personnel required at each proposed activity location will vary greatly, depending on the activity. If a larger than anticipated percentage of non-local workers is required to meet peak workforce requirements, sufficient workers should be available in the labor pool in the surrounding counties and states.
>
> Even if the entire construction workforce for the Project comes from outside the Project counties, this would represent minor, short-term increases in the population of the local communities surrounding the Project areas. [ETNG] anticipates hiring one additional permanent position employees; therefore, no long-term or permanent impacts to population are expected.

Because long-term relocation of construction personnel is not anticipated, ETNG indicates that housing effects would be related to area hotels and short-term rentals in study area communities. These effects would result in minor short-term positive effects on the rental industry through increased demand (ETNG 2022f).

ETNG anticipates effects to socioeconomics related to three other areas of consideration: economy and tax revenues, public service, and transportation and traffic (ETNG 2022f). Additional money would be spent locally on purchase or rental of equipment, supplies, and materials. Construction would also result in increased state and local sales tax revenues associated with these materials as well as for services. Effects to public services are anticipated to be primarily linked to transportation and traffic effects; "potential temporary impacts on services may include traffic-related incidents, medical emergencies, or other incidents." Construction of the project would result in minor, short-term effects on transportation systems in the associated communities due to road crossings, equipment and material deliveries, and construction workers commuting.

TVA has independently reviewed and concurs with the socioeconomic-related findings in Resource Report 5 (ETNG 2022f).

3.16.2.3.7 Summary of Alternative A

TVA Actions

Construction and operation of the CC/Aero CT facility, 3- to 4-MW Solar Facility, 100-MW BESS, and on-site transmission upgrades (all on Kingston Reservation); and off-site transmission upgrades would primarily result in effects to socioeconomics through short-term employment in the study area, which would in turn, result in short-term positive effects for local economies and tax revenues. Construction activities, however, would create minor, short-term effects on transportation systems in the associated communities.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Construction and operation of the proposed natural gas pipeline and associated structures would primarily result in effects to socioeconomics through short-term employment in the study area, which would in turn, result in short-term positive effects for local economies and tax revenues. Construction activities, however, would create minor, short-term effects on transportation systems in the associated communities. ETNG is continuing to more fully evaluate whether and any residents or commercial businesses would be displaced by the pipeline.

3.16.2.3.8 Environmental Justice Considerations

Approximately half (22 of 50) of the census block groups in the natural gas pipeline EJ study area have been identified as EJ-qualifying populations while approximately one fourth (eight of 34) of the census block groups in the off-site transmission upgrades corridors EJ study area have been identified as EJ-qualifying populations. All of these block groups are located within their respective socioeconomics study areas as well.

While displacements of or the extent of any displacements has not yet been determined as a result of construction of the natural gas pipeline, this has the potential to result in amplified effects for EJ-qualifying populations should any be displaced.

While not anticipated to have significant adverse impacts on EJ-qualifying populations, there may be negative effects to current and prospective renters and guests of rental homes and establishments through reduced rental inventory and/or increased prices during the period of construction associated with Alternative A. This has the potential to result in amplified effects for EJ-qualifying low-income populations, especially in EJ-qualifying census block groups with higher percentages of renter-occupied housing units than the associated county. Except for Jackson County, all counties in the Alternative A study area have EJ-qualifying block groups demonstrating higher percentages of renter-occupied housing units than that of its respective county.

3.16.2.4 Alternative B

3.16.2.4.1 Construction and Operation of Solar and Storage Facilities

TVA anticipates that a large portion of the solar facilities proposed under Alternative B would be located within portions of the East Tennessee region. While specific sites have not yet been determined for evaluation under this alternative, typical socioeconomic effects associated with solar facilities include temporary beneficial effects to local population numbers; temporary and permanent beneficial effects to local employment; temporary indirect beneficial effects to the local economy; and long-term beneficial effects to the local tax base. Cumulative effects would also occur if Alternative B was combined with the 10,000 MW expansion of solar planned in the 2019 TVA IRP, as typical temporary benefits of construction employment would increase.

3.16.2.4.2 Transmission and Other Components

Construction of the on-site transmission upgrades associated with the proposed solar and storage facilities under Alternative B are anticipated to result in a slight temporary increase in employment in the area and negligible beneficial effects.

3.17 Noise

Noise is unwanted or unwelcome sound that is usually caused by human activity and added to the natural acoustic setting of a locale. It is further defined as sound that disrupts normal activities and diminishes the quality of the environment. Community response to noise is dependent on the intensity of the sound source, its duration, the proximity of noise-sensitive land uses, and the time of day the noise occurs.

Sound is measured in units of decibels (dB) on a logarithmic scale. Because not all noise frequencies are perceptible to the human ear, A-scale weighting decibels (dBA), which filter out sound in frequencies above and below human hearing, are typically used in noise assessments. A noise level change of three dBA or less is barely perceptible to average human hearing, while a five dBA change in noise level is clearly noticeable. The noise level associated with a 10 dBA change is perceived as being twice as loud, whereas the noise level associated with a 20 dBA change is perceived to be four times as loud and may represent a “dramatic change” in loudness.

Frequency is measured in Hertz (Hz), which is the number of cycles per second. The typical human ear can hear frequencies ranging from approximately 20 to 20,000 Hz. Normally, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the low and high frequencies. As such, the A-weighted scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighted scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighted scale has been applied is expressed in dBA.

Sound in the environment is constantly fluctuating, for example, when a car drives by, a dog barks, or a plane passes overhead. Although an instantaneous sound level measured in dBA may indicate the level of noise experienced by an observer at that point in time, environmental noise levels vary continuously. Most ambient environmental noise includes a mixture of noise from some identifiable sources plus a relatively steady background noise where no particular source is identifiable. A single descriptor called the equivalent sound level (L_{eq}) is used to describe sound that is constant or changing in level. The L_{eq} is the average sound level for a specific time period.

The day-night sound level (Ldn) is the 24-hour equivalent sound level, which incorporates a 10-dBA correction penalty for the hours between 10 p.m. and 7 a.m. to account for the increased sensitivity of people to sounds that occur at night. Typical background day-night noise levels for rural areas are anticipated to range between an Ldn of 35 and 50 dB, whereas higher-density residential and urban areas background noise levels range from 43 dB to 72 dB (USEPA 1974). Background noise levels greater than 65 dBA can interfere with normal conversation, watching television, using a telephone, listening to the radio, and sleeping. Common indoor and outdoor noise levels from various noise sources are listed in Table 3.17-1.

Table 3.17-1. Common Indoor and Outdoor Noise Levels

Common Outdoor Noises	Sound Pressure Levels (dB)	Common Indoor Noises
	110	Rock Band at 5 meters (16.4 feet)
Jet Flyover at 300 meters (984.3 feet)		
	100	
		Inside Subway Train (New York)
Gas Lawn Mower at 1 meter (3.3 feet)		
	90	
		Food Blender at 1 meter (3.3 feet)
Diesel Truck at 15 meters (49.2 feet)		Garbage Disposal at 1 meter (3.3 feet)
	80	
		Shouting at 1 meter (3.3 feet)
Gas Lawn Mower at 30 meters (98.4 feet)	70	Vacuum Cleaner at 3 meters (9.8 feet)
Commercial Area		Normal Speech at 1 meter (3.3 feet)
	60	
		Large Business Office
	50	Dishwasher Next Room
Quiet Urban Daytime		
	40	Small Theater, Large Conference Room
Quiet Urban Nighttime Quiet Suburban Nighttime		Library
	30	
		Bedroom at Night
Quiet Rural Nighttime		Concert Hall (Background)
	20	
		Broadcast and Recording Studio
	10	
		Threshold of Hearing
	0	

Source: AASHTO 1993

The Noise Control Act of 1972, along with its subsequent amendments (Quiet Communities Act of 1978, 42 USC 4901-4918), delegates authority to the states to regulate environmental noise and directs government agencies to comply with local community noise statutes and regulations. Many local noise ordinances are qualitative, such as prohibiting excessive noise or noise that results in a public nuisance. Because of the subjective nature of such ordinances, they are often difficult to enforce. Some local communities have noise ordinances that set allowable maximum noise levels for various activities.

The USEPA 1974 guidelines recommend that Ldn not exceed 55 dBA for outdoor residential areas. The U.S. Department of Housing and Urban Development (HUD) considers an Ldn of 65 dBA or less to be compatible with residential areas (HUD 1985). For traffic-related noise, the Federal Highway Administration (FHWA) has set a threshold of 67 dBA as the sound level at which noise abatement should be considered. Transportation noise primarily includes noise from truck traffic. Three primary factors influence highway noise generation: traffic volume, traffic speed, and vehicle type. Generally, heavier traffic volumes, higher speeds, and greater numbers of trucks increase the sound level of highway traffic noise. Other factors that affect the sound level of traffic noise include a change in engine speed and power, such as at traffic lights, hills, and intersecting roads and pavement type. Highway traffic noise is not usually a serious problem for people who live more than 500 feet from heavily traveled freeways or more than 100 to 200 feet from lightly traveled roads (FHWA 2011). Due to the nature of the decibel scale and the attenuating effects of noise with distance, a doubling of traffic would result in a 3 dBA increase in noise levels, which in and of itself would not normally be a perceivable noise increase.

FERC's sound level requirement states that the sound attributable to a new compressor station not exceed a day-night average Ldn of 55 dBAs at any nearby noise sensitive areas (NSAs), unless such NSAs are established after facility construction. Examples of NSAs include schools, hospitals, and residences. Also, a sound level of 55 dBA (Ldn) can be used as a benchmark sound guideline for assessing the noise impact of temporary or intermittent noise such as site construction noise. No noise standards in the state of Tennessee or relevant counties that are applicable to construction or operation have been identified to date. Smith County, which is crossed by the ETNG Construction ROW in Alternative A, prohibits "obnoxious noise and vibration;" however, no specific criteria were found (ETNG 2022j). The expected level of construction noise is dependent upon the nature and duration of each project. Construction activities for most large-scale projects would be expected to result in increased noise levels as a result of the operation of construction equipment on-site and the movement of construction-related vehicles (i.e., worker trips and material and equipment trips) on the surrounding roadways. Noise levels associated with construction activities would increase ambient noise levels adjacent to the construction site and along roadways used by construction-related vehicles. Construction noise is generally temporary and intermittent in nature, as it generally only occurs on weekdays during daylight hours, which minimizes the impact to sensitive receptors.

3.17.1 Affected Environment

3.17.1.1 Kingston Reservation (No Action and D4 Activities)

The existing KIF plant is situated on approximately 1,250 acres of the 2,254-acre Kingston Reservation, which is located in a rural area on the shores of the Clinch and Emory Rivers. Noise generating sources in the vicinity of the Kingston Reservation include boat traffic, routine vehicle operations at the project site, and the existing coal facility. Sensitive noise receptors in the vicinity of the proposed project area includes mostly residences with some commercial areas. A TVA Wetland Viewing Area is located approximately 1.5 miles north of the Kingston Reservation. Several residences are located approximately 0.5 miles to the south across the Clinch River just north of I-40. The city of Harriman comprises of a mix of commercial, retail, and residential use and is located approximately three miles northwest of the Kingston Reservation. The total number of noise receptors within 0.5 mile of Kingston Reservation and their classifications can be seen in Table 3.17-2 and Figure 3.17-1.

Table 3.17-2. Kingston Reservation Noise Receptors

Noise Receptor Type	Number with 0.5 mile of Kingston Reservation
Cemetery	1
Church	0
Commercial	31

Noise Receptor Type	Number with 0.5 mile of Kingston Reservation
Industrial	0
Recreation	0
Residential	247
Total	**278**

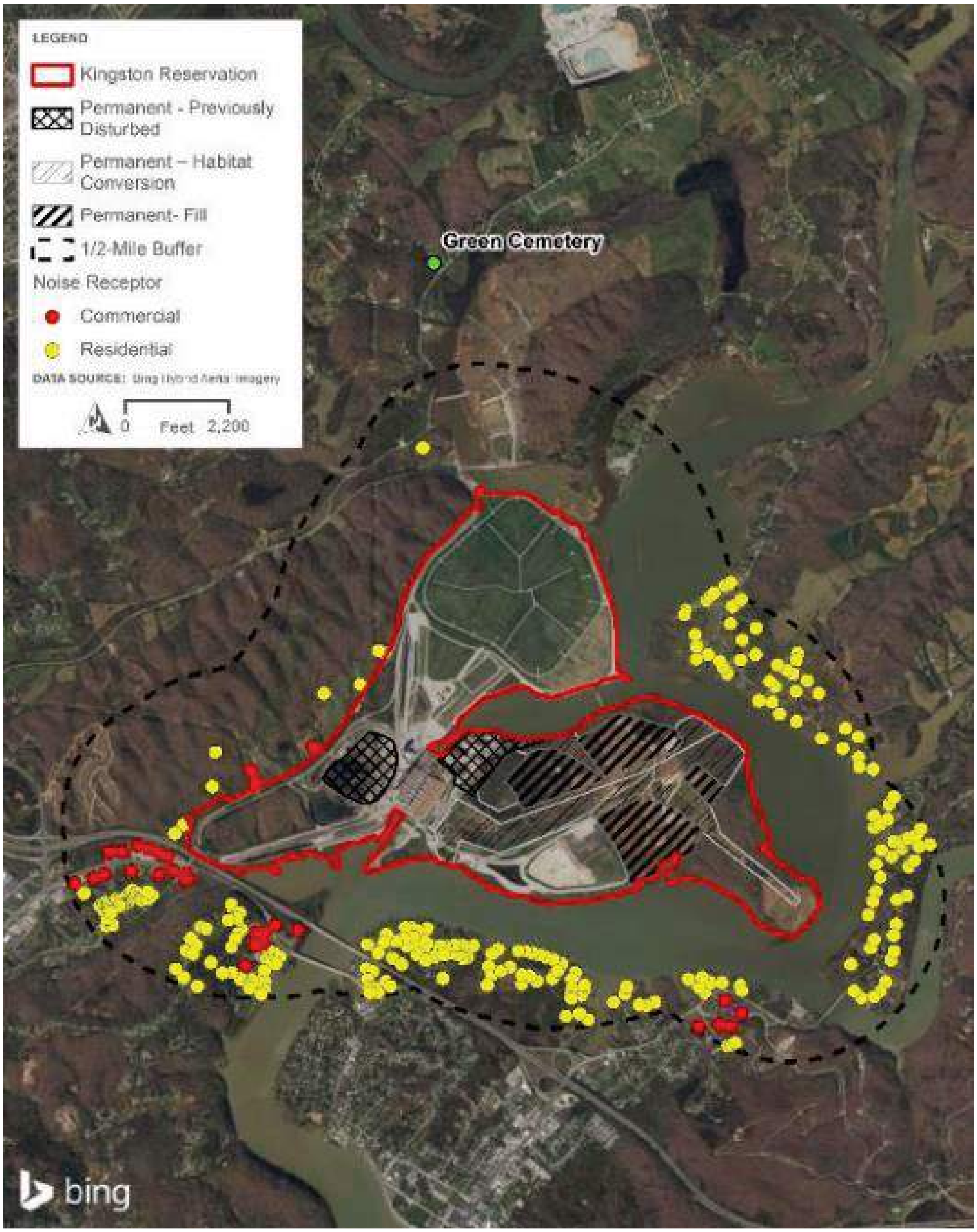

Figure 3.17-1. Noise Receptors within 0.5 Mile of the Kingston Reservation

3.17.1.2 Alternative A

3.17.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The chosen CC/Aero CT Plant site is in an undeveloped portion of the Kingston Reservation comprised of largely disturbed earth and hay/pasture. Burns & McDonnell conducted a preliminary sound study for the proposed CC/Aero CT Plant (Burns & McDonnell 2022). The study consists of sound monitoring of the existing environment and predictive sound modeling of the Project to analyze potential off-site sound impacts from its operation, and results are summarized below. The full study is attached in Appendix O.

Noise measurements for the existing ambient and baseline environment were collected in June of 2022 as recommended by American National Standards Institute S1.4. Five continuous long-term sound level meters were set up at the measurement locations, labeled MP01 through MP05, shown in Figure A-1 of Appendix O. During the measurements, the microphone cable associated with MP01 was chewed through by an animal, and data was only collected from 4:00 p.m. to 10:00 p.m.; therefore, MP01 could not be calibrated at the end of the measurement and is excluded from the analysis. The measurement periods for each sound monitor are given in Table 4-1 of Appendix O. The daytime and nighttime average L_{eq} and lowest 1-hour average L_{eq} measured values for each measurement location are provided in Table 3.17-3.

Table 3.17-3. Average Sound Levels

Location	Daytime Average[1] (L_{eq} dBA)	Nighttime Average[1] (L_{eq} dBA)	Lowest 1-Hour (L_{eq} dBA)
MP02	47	44	37
MP03	47	45	41
MP04	53	46	38
MP05	52	48	42

[1] Daytime is from 7:00 a.m. to 10:00 p.m. Nighttime is from 10:00 p.m. to 7:00 a.m.

The existing KIF coal-fired units were operating at base load throughout the monitoring period. Local roadway traffic and naturally occurring sounds were the largest contributors to measured sound levels at the monitoring locations. The KIF Plant was faintly audible at MP03 and not audible at the other measurement locations during daytime hours when the equipment was being set up and torn down.

The closest sensitive receptors to the proposed site include residential subdivisions, with homes located approximately 0.4 miles south of the proposed plant site (Figure 3.17-1).

3.17.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation, therefore the affected environment and existing conditions described above for the Kingston Reservation in Section 3.17.1.1 apply to the proposed solar facility.

3.17.1.2.3 Construction and Operation of a 100-MW Battery Storage Facility on Kingston Reservation

The proposed 100-MW battery storage facility would be located on one of three potential sites located on the Kingston Reservation, therefore the affected environment and existing conditions described above for the Kingston Reservation in Section 3.17.1.1 apply to the proposed 100-MW battery storage facility.

3.17.1.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT facilities and switchyard, as well as a new transmission line for the proposed battery facility. Therefore, the affected environment for on-site transmission upgrades and installation is described in Section 3.17.1.1.

3.17.1.2.5 Off-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines, five near the Kingston Reservation (L5108, L5116, L5280, L5302, and L5381) and one in Crossville (L5383). Descriptions of these improvements can be found in Section 2.1.3.5.2. Noise receptors within the vicinity of each transmission line are described below.

3.17.1.2.5.1 Eastern Transmission Corridor

There are a total of 6,481 noise receptors within 0.5 mile of the Eastern Transmission Corridor, most being residences and vacant buildings. The total number of noise receptors within 0.5 mile of the corridor and their classifications can be seen in Table 3.17-4 and Figure 3.17-2a through Figure 3.17-2d.

Table 3.17-4. Noise Receptors Within 0.5 Mile of L5108 of the Eastern Transmission Corridor

Noise Receptor Type	Number within 0.5 Mile of Alternative A – L5108
Business	65
Church	16
Farm Buildings	10
Industrial	70
Residential	4622
School	17
Campground/Sports Field	18
Vacant Buildings (garage/shed)	445
Unknown	1218
Total	**6,481**

Transmission lines L5302, L5280, L5381, and L5116 extend from the Kingston Reservation travelling eastbound and terminating in the city of Oak Ridge. There are a total of 822 noise receptors within 0.5 mile of L5302, L5280, L5381, and L5116 of the Eastern Transmission Corridor, most being residences, industrial buildings, and vacant buildings. The total number of noise receptors within 0.5 mile of the corridor and their classifications can be seen in Table 3.17-5 and Figure 3.17-2a through Figure 3.17-2d.

Table 3.17-5. Noise Receptors Within 0.5 Mile of L5116, L5280, L5302, and L5381 of the Eastern Transmission Corridor

Noise Receptor Type	Number within 0.5 Mile of Alternative A – L5302, L5280, L5381, and L5116
Business	7

Noise Receptor Type	Number within 0.5 Mile of Alternative A – L5302, L5280, L5381, and L5116
Church	7
Farm Buildings	7
Industrial	214
Residential	271
School	0
Campground/Sports Field	0
Vacant Buildings (garage/shed)	195
Unknown	121
Total	**822**

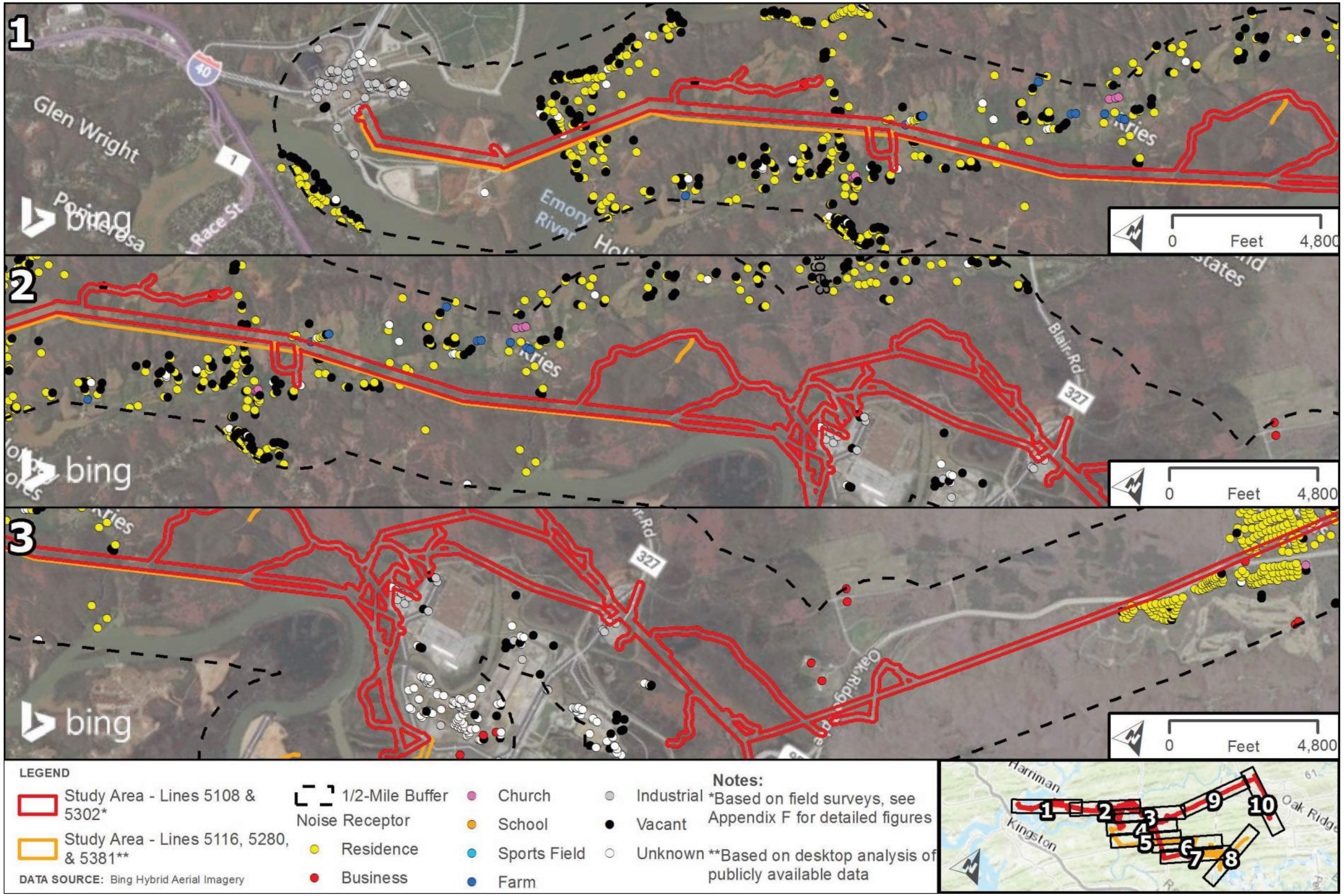

Figure 3.17-2a. Noise Receptors Within 0.5 Mile of the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381)

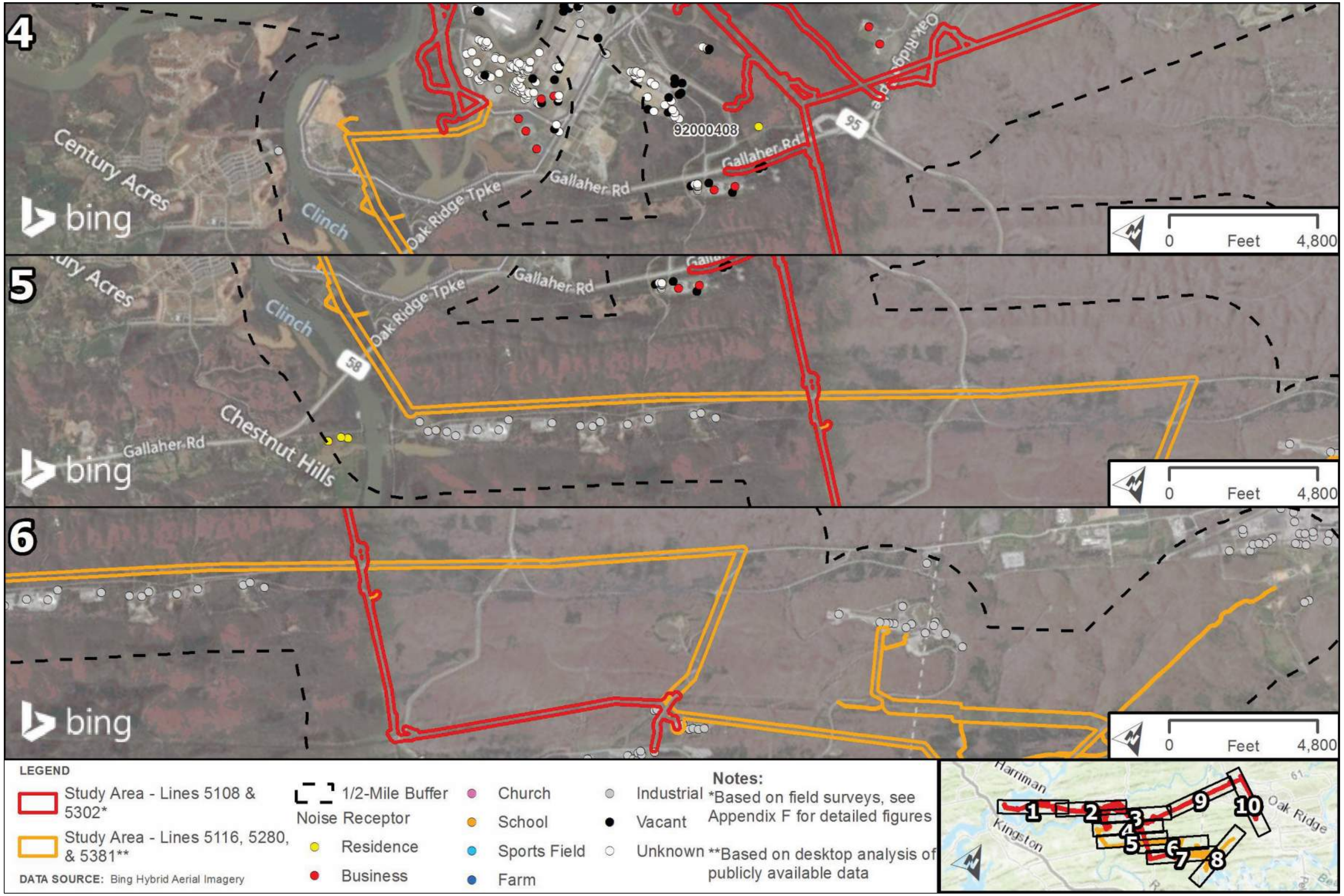

Figure 3.17-2b. Noise Receptors Within 0.5 Mile of the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381)

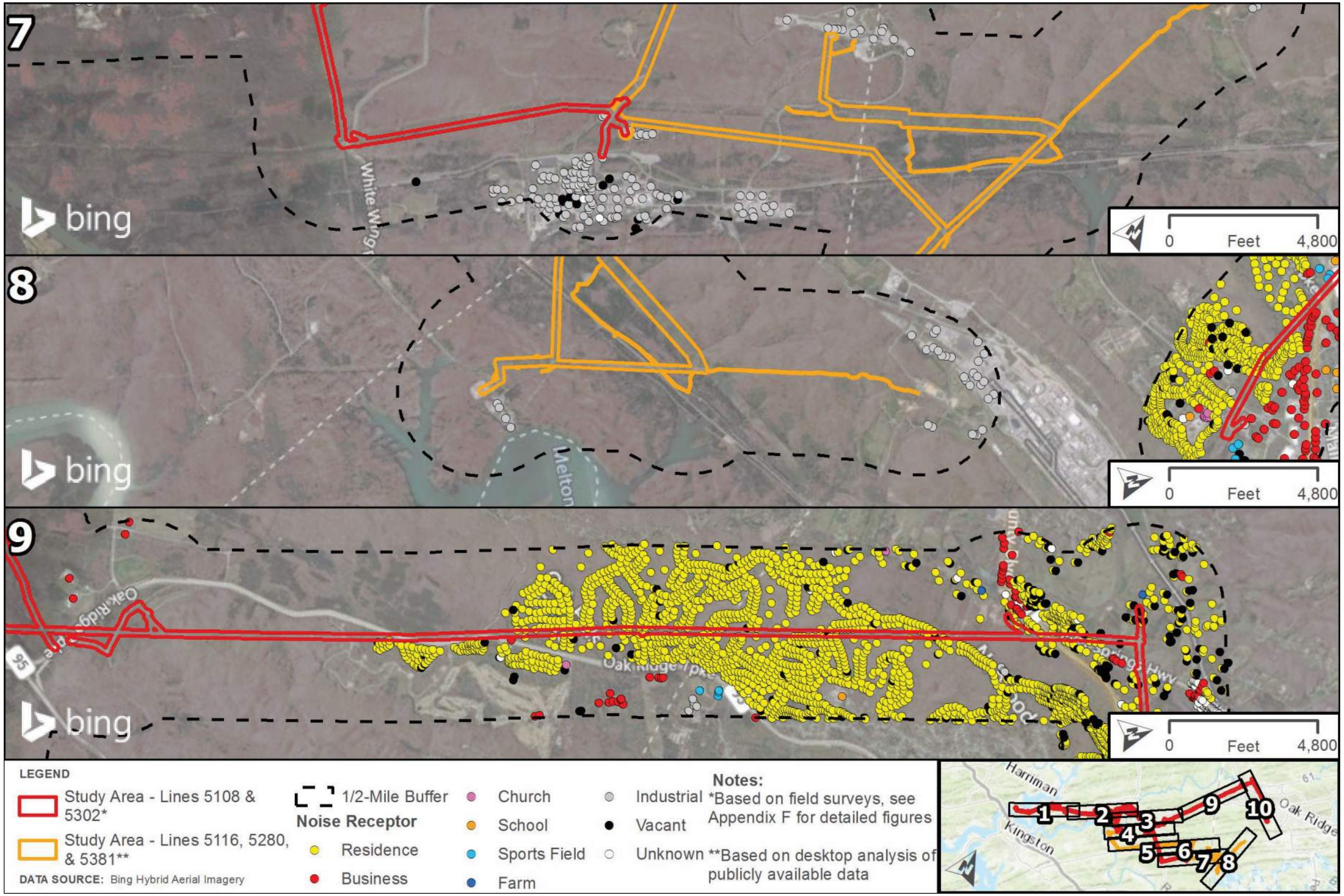

Figure 3.17-2c. **Noise Receptors Within 0.5 Mile of the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381)**

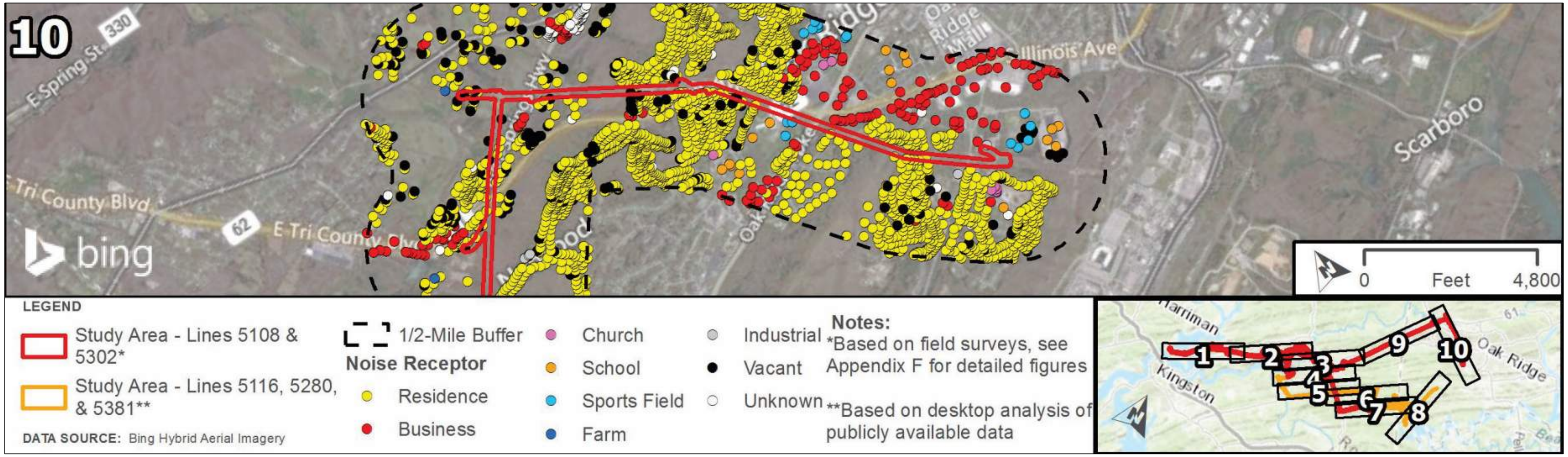

Figure 3.17-2d. **Noise Receptors Within 0.5 Mile of the Eastern Transmission Corridor (L5108, L5116, L5280, L5302, and L5381)**

3.17.1.2.5.2 Western Transmission Corridor

There are a total of 516 noise receptors within a 0.5 mile of the Western Transmission Corridor, most consisting of residences (63.8 percent), farm buildings (15.1 percent), and vacant buildings (12.8 percent). The total number of noise receptors within 0.5 mile of the corridor and their classifications are presented in Table 3.17-6 and Figure 3.17-3.

Table 3.17-6. Noise Receptors Within 0.5 Mile of L5383 of the Western Transmission Corridor

Noise Receptor Type	Number of Noise Receptors within 0.5 Mile of the Western Transmission Corridor
Business	37
Church	5
Farm Buildings	78
Industrial	1
Residential	329
Vacant Buildings (garage/shed)	66
Total	**516**

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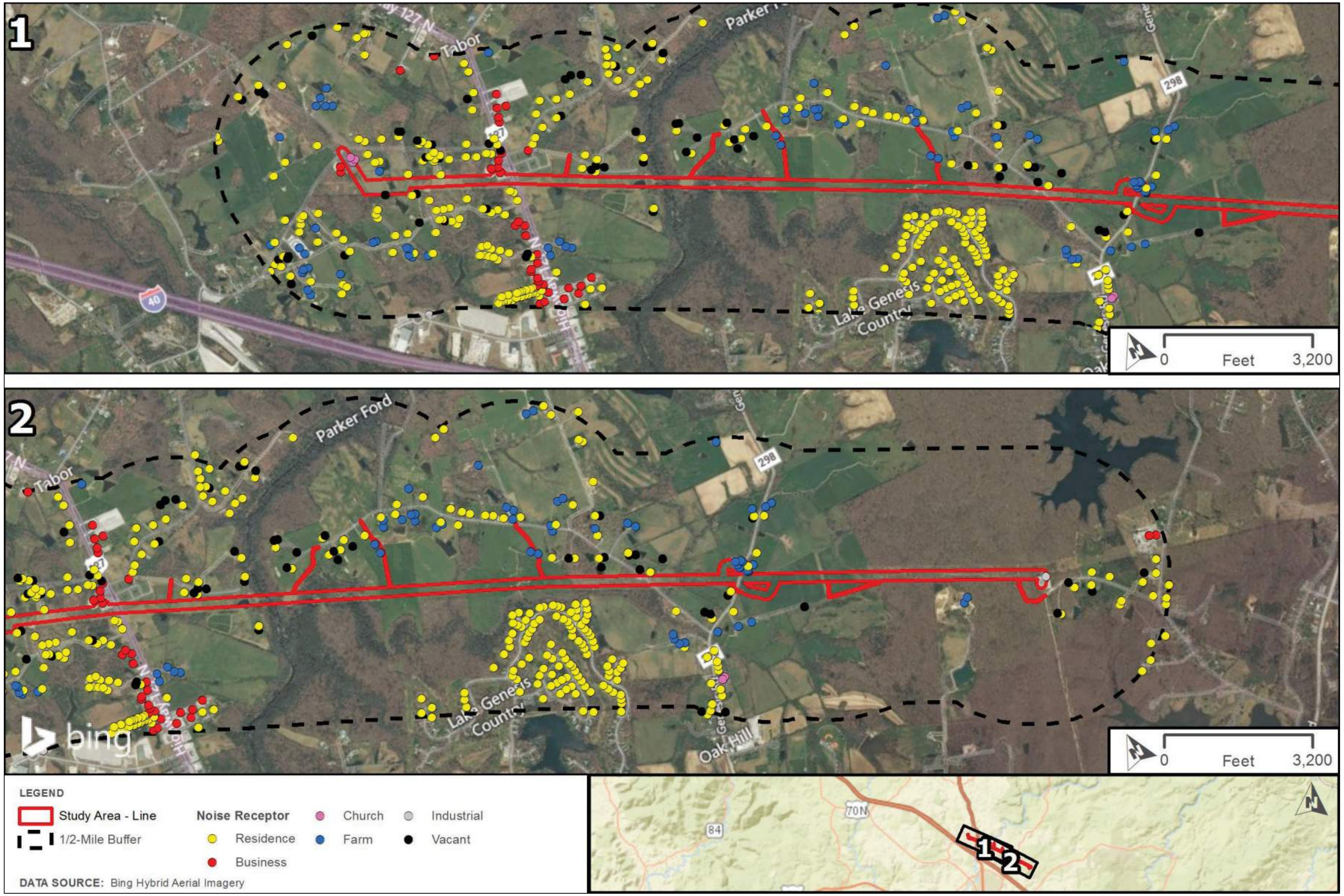

Figure 3.17-3. Noise Receptors within 0.5 Mile of the Western Transmission Corridor (L5383)

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3.17.1.2.6 Construction and Operation of a Natural Gas Pipeline

ETNG would be developing ambient sound surveys for HDD locations, the Hartsville Compressor Station, and the three M&R stations associated with pipeline construction. These would be provided along with the final Resource Reports included in the Project Application to FERC (ETNG 2022j). These sound surveys would include nearby noise receptors.

Since ETNG's analyses are not yet complete but will be provided in the final filing of Resource Reports with FERC, TVA conducted an initial desktop review of the natural gas pipeline using a 200-foot buffer, hereafter referred to as the TVA Expanded Construction ROW. Approximately 1,110 noise receptors were noted within the TVA Expanded Construction ROW area, as provided in Table 3.17-7 and shown in Appendix D-8.

Table 3.17-7. Alternative A Pipeline Construction Noise Receptors

Noise Receptor Type	Number within the TVA Expanded Construction ROW
Business	38
Church	9
Farm	35
Industrial	10
Residential	511
Sports Field	1
Unknown	31
Vacant	475
Total	**1,110**

Once the gas pipeline is operational, the number of noise receptors would be greatly reduced and would generally be limited to noise receptors in the vicinity of the aboveground facilities including the Hartsville Compressor Station, two meter stations, and three crossover locations. ETNG is in the process of identifying noise receptors in the vicinity of the aboveground facilities; however, ETNG anticipates that noise levels at nearby noise receptors will be at or below the Ldn 55 dBA FERC sound level requirement either by distance and/or terrain or through mitigation measures implemented at the facilities. The pipeline would not produce perceptible noise once constructed.

3.17.1.3 Alternative B

3.17.1.3.1 East Tennessee TVA Power Service Area

The proposed solar and storage facilities would likely be located in agricultural, rural, and/or undeveloped areas within portions of East Tennessee. Ambient noise in these types of settings typically consist of agricultural sounds, such as noises from farm machinery; natural sounds, such as from wind and wildlife; and moderate traffic sounds. If sites are located in industrial areas or near transportation facilities, the setting may have higher ambient noise levels.

3.17.2 Environmental Consequences

3.17.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate and maintain the KIF plant. TVA would implement all of the planned actions related to the current and future management and storage of CCRs at the coal plants, which have either been reviewed or would be in subsequent NEPA analyses. Under the No Action Alternative, regular operational noise would continue to contribute to daily ambient noise levels.

3.17.2.2 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

Under both action alternatives, TVA would retire, decommission, decontaminate, and deconstruct the KIF units and site. Noise impacts as a result of these actions would be associated with the removal of equipment and materials on-site, installation of bulkheads and/or fill tunnels, demolition via mechanical deconstruction and/or explosives, and demolition-related traffic to and from the Kingston Reservation. There are 278 total noise receptors within a 0.5 mile of the Kingston Reservation boundary, which largely consist of residences (Table 3.17-2). These receptors would experience temporary noise impacts as a result of deconstruction activities.

Noise associated with demolition activities, the greatest of which would be due to blasting with a higher range of approximately 94 dB at a 50-foot distance is assumed not to attenuate at the closest receptors that exist on or directly adjacent to the Project boundary (FHWA 2017). While this level due to blasting is higher than the USEPA noise guidance for Ldn of 55 dBA and the HUD guidelines for Ldn of 65 dBA, such activity would be temporary. Other noise levels associated with demolition activities, such as construction equipment operation, will be much lower. Given the temporary and intermittent nature of demolition noise, the impact of noise generated is expected to be minor. Noise impacts from demolition-related traffic are expected to be minor as construction related traffic would utilize interstate highways or major arterial roadways as much as possible and likely would not have a noticeable increase on traffic volume and consequently traffic noise near those major roadways.

Explosive demolition activities would be single occurrences that would be temporary and short-term. The noise associated with the collapse of the structures would follow closely behind and be perceived as a single noise event. Notifications to the public, including area emergency services, would be issued prior to the use of explosives for demolition. With warning to the public prior to blasting activities, residents would be prepared for a single loud noise; therefore, direct impacts to noise levels in the area associated with blasting would be minor and temporary.

Impacts from additional vehicular traffic are expected to be minor as the roads within the plant are already predominately used by employees and for industrial activity. This small increase in noise would be temporary and intermittent and only last until D4 activities have been completed. Therefore, the increase in current noise levels is estimated to be less than 3 dBA and, as such, traffic noise is not anticipated to increase perceptibly.

In addition, vibrations associated with explosives would also occur. Vibrations from explosive demolition events can potentially affect nearby structures. Seismologic analyses carried out at recent demolitions of other tall industrial chimneys in the United States strongly suggest that the vibrations would not result in measurable effects on nearby structures (TVA 2016c). These seismological analyses were conducted to measure the effects from demolition-related vibrations on standing structures in the vicinity of the chimney demolitions. In each case, vibrations were below the recommended limits set by the U.S. Bureau of Mines Report (Siskind et al. 1980). The report's authors concluded in each case that the demolitions would not cause damage to structures within the radius of influence. Vibrations resulting from the demolition of the Kingston Reservation structures would be of similar magnitude. The use of BMPs, including wetting down the structure prior to felling, use of misting systems during stack felling, and use of berms during demolition would also serve as a form of noise/vibration control. Therefore, no damage to structures is anticipated. Due to the temporary nature of the operation, noise and vibration effects on the environment are expected to be minor and temporary.

Projects in vicinity of the D4 activities, such as the CCR management activities, could create temporary, cumulative increases in construction and traffic noise in the area.

3.17.2.2.1 Environmental Justice Considerations

Noise-related effects that would occur as a result of KIF retirement and D4 activities would be temporary, minor, and are not anticipated to have amplified effects on EJ populations. Residences are not present on Kingston and only non-EJ qualifying populations are present in the immediate vicinity.

3.17.2.3 Alternative A

3.17.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

During the construction of the CC/Aero CT Plant and Switchyard, there would be a slight noise increase from the existing conditions due to an increase in personnel, cranes, and other equipment in the area. Due to the temporary nature of the activities, noise impacts during construction would be considered minor.

Given the potential for up to 600 individuals to be present during construction, there may be a significant increase in both vehicular and pedestrian traffic in the area. In particular, the hauling of materials from the Kingston Reservation could lead to an uptick in traffic along heavily trafficked roads such as I-40, SR-29, and Swan Pond Road. This increase in traffic could result in more noticeable impacts on the daily lives of residents, particularly in terms of increased noise and potential safety concerns. However, the increase would be mitigated by the fact that the nearby roads are presently heavily trafficked. As such, the increase in noise would blend in with present surroundings. The noise impacts would be temporary and intermittent and only last until construction activities have been completed.

Burns & McDonnell performed predictive sound modeling for the Project operation using computer aided noise abatement. Based on this study, the Project is expected to contribute a maximum absolute sound level of approximately 53 dBA at MP02, 54 dBA at MP03, 50 dBA at MP04, 51 dBA at MP05, and 55 dBA in the vicinity of the nearest residential noise receptors, approximately 0.4 miles south of the proposed CC/Aero CT Plant (Appendix O). These noise levels are below both the HUD and USEPA guidelines of 65 dBA and 55 dBA, respectively. Therefore, the operation of the CC/Aero CT Plant would result in minor permanent noise impacts.

3.17.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

During the construction of the solar facility, there would likely be a slight noise increase from the existing conditions due to an increase in personnel, cranes, and other equipment in the area, which could temporarily impact nearby residential communities. However, these impacts are temporary and would be mitigated through measures, such as scheduling construction activities during non-peak hours. Once the solar facility is operational, the noise level would decrease significantly, as solar power generation does not create any significant noise pollution.

3.17.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The noise impacts from the construction of the BESS would be the same as the impacts noted for the solar facility noted in Section 3.17.2.3.2.

3.17.2.3.4 On-site Transmission Upgrades

Alterations to existing transmission lines on Kingston Reservation associated with Alternative A would primarily involve upgrades to existing facilities and are not expected to significantly affect noise levels. Installation of the new existing transmission line for the battery facility is not anticipated to significantly affect noise levels as they would occur within the existing reservation. Improvement of existing access roads or construction of new access roads may be necessary to perform upgrades and periodic maintenance in the existing transmission lines, but any construction would be temporary and intermittent in nature.

3.17.2.3.5 Off-site Transmission Upgrades

Upgrades to off-site transmission corridors would have the same impact to noise levels as described for on-site improvements in Section 3.17.2.3.4.

3.17.2.3.6 Construction and Operation of a Natural Gas Pipeline

Construction Noise

Noise impacts during pipeline construction would be associated with heavy equipment operation, including HDD rigs, the excavation and laying of the pipeline, and construction-related traffic (construction workforce and the shipment of goods and equipment) to and from the ETNG Construction ROW. To limit noise impacts associated with the pipeline, construction activities generally would be conducted during the daytime (7 a.m. to 7 p.m.), except in cases where nighttime construction may be necessary due to certain activities, including longer HDDs, hydrostatic testing, and tie-ins.

Typical equipment used to construct and operate the pipeline would consist of trucks, cranes, rollers, bulldozers, pickup trucks, and backhoes. Typical noise levels from construction equipment used along the corridor are expected to be 85 dBA or less at a distance of 50 feet from the corridor (ETNG 2022j). According to ETNG's analysis, occupants of nearby residences and buildings may notice the construction noise, "but the overall impact would be short-lived and insignificant" (ETNG 2022j). The cumulative acoustical impact of HDD operations on identified representative NSAs would be calculated using Computer Aided Noise Abatement acoustic modeling software. As stated by ETNG, "construction would not result in the generation of, or exposure of persons to excessive noise or vibration levels for lengthy periods" (ETNG 2022j).

Once the HDD locations have been determined, ETNG would conduct baseline noise modeling and would calculate the acoustical impact of the HDD operations at NSAs nearest to HDD operations (the entry and exit pits). The noise impacts would be determined assuming no active noise mitigation measures, such as the usage of sound barriers.

If the unmitigated HDD noise levels exceed 55 dBA Ldn at NSA residential locations, ETNG would mitigate noise through use of measures which may including the following:

- installing plywood noise barriers between noise-generating equipment and the NSA(s);
- using residential-grade exhaust silencers on engines (e.g., generators, pumps, and hydraulic power units);
- using low-noise generators;

- installing a partial enclosure around the mud mixing/cleaning system;
- installing a partial barrier around engine jacket-water coolers; or
- providing compensation or temporary relocation for landowners to a nearby hotel for several days.

Noise modeling results would be available as part of information provided along with ETNG's application filing with FERC for a Certificate of Public Convenience under Section 7(c) of the Natural Gas Act, which is currently planned for July 2023.

Operational Noise
ETNG would conduct ambient sound surveys and acoustical analysis for the NSAs nearest to the compressor station as a part of the final Resource Reports submitted to FERC (ETNG 2022j).

Measures to minimize the impact of vibrations are provided in ETNG's Resource Report 9 (ETNG 2022j), which TVA has independently reviewed. Pertinent excerpts from this report are provided below:

> [ETNG] will take steps to minimize the impact of vibration, where practicable, on nearby residences. [ETNG] will inform nearby residents of the [pipeline] and the upcoming construction activities, including HDD operation and will respond and investigate concerns. Excavators and other heavy equipment must be used more than 50 feet from existing building structures, where practicable. [ETNG] contractors will route heavily loaded trucks and equipment away from residential streets and vibration-sensitive sites, where practicable. [ETNG] contractors will sequence phases of construction activities such as earth-moving and ground impacting so as not to occur in the same time period and minimize nighttime activity.
>
> Vibration levels are highly dependent on equipment models, modes of operation, and local ground conditions. [ETNG] contractors will monitor vibration levels at existing building structures if the 50-foot setback distances cannot be maintained due to site constraints (ETNG 2022j).

3.17.2.3.7 Summary of Alternative A

TVA Actions
Temporary noise effects would occur during demolition of the coal plant and as a result of construction traffic for the CC/Aero CT Plant and transmission lines. Noise effects from construction-related traffic are expected to be temporary and minor. The majority of noise disturbances would occur during construction of Alternative A components. Typical noise levels from construction equipment used for the CC/Aero CT Plant, BESS, solar facility, and existing transmission line components are expected to be 85 dBA or less at a distance of 50 feet from the construction activities (FHWA 2017). The increase in current noise levels is estimated to be less than 3 dBA. Construction would not result in the generation of, or exposure of persons to excessive noise or vibration levels for lengthy periods, and noise mitigation efforts would be implemented by TVA.

ETNG Actions - Natural Gas Pipeline and Associated Structures
Temporary noise effects would occur as a result of construction for the pipeline. Noise effects from construction-related traffic are expected to be temporary and minor. Typical noise levels

from construction equipment used for the pipeline construction and operation are expected to be 85 dBA or less at a distance of 50 feet from the construction activities (FHWA 2017). The increase in current noise levels is estimated to be less than 3 dBA. Construction would not result in the generation of, or exposure of persons to excessive noise or vibration levels for lengthy periods, and noise mitigation efforts would be implemented by ETNG. After the construction of the pipeline, TVA anticipates that there would be little to no noise increases during operation aside from occasional maintenance activities in areas where operational noise was not already occurring, such as the periodic mowing of the pipeline ROW.

3.17.2.3.8 Environmental Justice Considerations

TVA Actions

Noise effects would occur during demolition of the coal plant and as a result of construction of the CC/Aero CT Plant. These activities would increase the noise effects on local populations. However, given the absence of EJ populations near the CC/Aero CT Plant location, there would not be amplified effects on those near the Kingston Reservation.

ETNG Actions - Natural Gas Pipeline and Associated Structures

Noise-related effects, including vehicular traffic, in the ETNG Construction ROW would generally be experienced by EJ populations more than other populations. Further, some of the loudest activities and components are located in EJ population areas. While these effects would be mitigated by ETNG, to the extent practical, it is TVA’s current assessment that noise effects are likely to be amplified for EJ populations. ETNG will be preparing additional noise studies and studying potential effects to EJ populations, and TVA may update its conclusions in the final EIS based on ETNG’s findings.

3.17.2.4 Alternative B

3.17.2.4.1 Construction and Operations of Solar and Storage Facilities

While exact locations of sites are not currently known, typical direct and indirect noise impacts associated with solar and storage facilities would primarily occur during construction. Construction equipment produces a range of sounds while operational. Noisy construction equipment, such as delivery trucks, dump trucks, water trucks, service trucks, bulldozers, chain saws, bush hogs, or other large mowers for tree clearing, produce maximum noise levels at 50 feet of approximately 84 to 85 dBA. Construction noise would likely cause temporary and minor adverse impacts to the ambient sound environment around each project site. Nearby noise receptors would temporarily experience heightened noise during construction, primarily from pile-driving activities.

The activity likely to make the most noise for an extended time period would be pile driving during the construction of the solar array foundations. Standard construction pile drivers are estimated to produce between 90 to 95 dBA at a distance of 50 feet (FHWA 2011). Following completion of construction activities, the ambient sound environment on and surrounding the solar or storage facility sites would be expected to return to existing levels. The moving parts of the PV arrays would be electric-powered and produce little noise. The central inverters associated with solar sites would produce noise levels of approximately 65 dBA at 33 feet, and substations typically emit approximately 50 dBA at 300 feet. For storage facility sites, the average sound level is less than 82 dB from 10 feet surrounding the on-site transformers.

Solar and storage facilities located near commercial operations or agricultural complexes would have lesser effects since the ambient sounds near such commercial or agricultural complexes are already at or higher than the typical 45 to 55 dBA. Additionally, construction would primarily occur during daylight hours, between sunrise and sunset; therefore, project construction would not affect ambient noise levels at night during most of the construction period. Most of the proposed equipment would not be operating on-site for the entire construction period but would be phased in and out according to the progress of the projects.

The periodic mowing of solar sites to manage the height of vegetation surrounding the solar panels would produce sound levels comparable to those of agricultural operations. Overall, Alternative B would likely result in minor, temporary adverse impacts to the ambient noise environment during construction, and minor to negligible impacts during operation and maintenance of the solar facility. Detailed analyses of noise impacts would occur for each solar and storage facility under future NEPA reviews.

Cumulative impacts would also occur since the solar sites under Alternative B would be in addition to the 10,000 MW expansion of solar planned in the 2019 TVA IRP, which could create temporary, cumulative increases in construction and traffic noise in the region.

3.17.2.4.2 Transmission and Other Components

Construction of existing transmission lines and existing transmission line upgrades associated with solar and BESS sites would result in temporary, minor noise impacts related to construction and construction-related traffic. After the construction of the existing transmission lines, there would not be significant continued noise as a result of its operation aside from occasional maintenance activities.

3.17.2.4.3 Environmental Justice Considerations

Noise-related effects that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to be amplified for EJ populations. These effects would be temporary (primarily during the period of construction), minor, and limited to the immediate project sites and transmission line corridors. Site-specific evaluations of impacts to EJ populations in relation to solar and storage facilities would be conducted as appropriate.

3.18 Visual

3.18.1 Affected Environment

Visual resources compose the visible character of a place and include both natural and human-made attributes. Visual resources influence how an observer experiences a particular location and distinguishes it from other locations. Such resources are important to people living in or traveling through an area and can be an essential component of historically and culturally significant settings. The visual classification criteria used in this analysis are adapted from a scenic management system developed by the U.S. Forest Service (USFS) and integrated with planning methods used by TVA (USFS 1995). Potential visual impacts to cultural and historic resources are not included in this analysis, as they are assessed separately in Section 3.13.

The subjective perceptions of a landscape's aesthetic quality and sense of place is dependent on where and how they are viewed. Views of the landscape are described in terms of what is seen in the foreground (within 0.5 mile), middleground (0.5-4 miles), and background (4-10 miles) distances. The resulting scenic value class of a landscape is determined by combining the levels of scenic attractiveness, scenic integrity, and visibility. Scenic attractiveness is a measure of the scenic beauty of a landscape and is based on perceptions of the visual appeal of landforms, waterways, vegetation, and the human-built environment. Scenic attractiveness is assessed as either distinctive, typical/common, or indistinctive. As adapted for this analysis, scenic integrity measures the degree of visual unity of the natural and cultural character of the landscape. Scenic integrity is evaluated as either low, moderate, or high.

3.18.1.1 Kingston Reservation (No Action and D4 Activities)

The Kingston Reservation is located at the confluence of the Clinch and Emory rivers and is surrounded by water on three sides. The topography surrounding the Kingston Reservation ranges from relatively flat near the banks of the Clinch and Emory Rivers to moderately sloping in the western portion of the reservation. A clear view of I-40 exists to the south of the reservation. Emory Gap, a small residential area, exists to the west of the project area along State Route 29. Night lighting is widespread at the Kingston Reservation and the nearby commercial businesses along I-40.

Except for the Kingston Reservation, the surrounding region is largely undeveloped with residential development to the west and commercial development in the vicinity of I-40 to the south. Components of the existing KIF are dominant elements on the landscape and include the original nine stacks, two 1,000-foot-high emissions stacks, and one additional stack roughly the height of the original nine stacks that generates steam in the flue gases emitted from that stack. Condensed water vapor emitted from this stack is also a prominent visual element during much of the time the plant is operating. There is also a large transmission line corridor that extends outside of the Reservation that is visible. Much of the area around the coal plant buildings is devoid of any vegetation, although there are some small patches of lawn and trees along roadways and forested areas on the perimeter (Figure 2.1-5).

The viewscape of the coal plant facility includes broadly horizontal buildings and industrial equipment and the twelve emissions stacks. Therefore, scenic attractiveness of these areas are minimal, and scenic integrity ranges from low to very low. Scenic attractiveness of the area is considered common, and scenic integrity is considered moderate due to human alteration in the area. The ratings for scenic attractiveness assigned to the project sites are due to the ordinary or common visual quality. The forms, colors, and textures in the affected environment are normally seen through the characteristic landscape and are not considered to have distinctive quality. In the foreground and middleground, the scenic integrity has been lowered by slight human alteration such as residential and industrial development. However, in the background, these alterations are not substantive enough to dominate the view of the landscape (Figure 3.18-1). Based on the criteria used for this analysis, the overall scenic value class for the affected environment ranges from poor within the plant facility to good in the surrounding area.

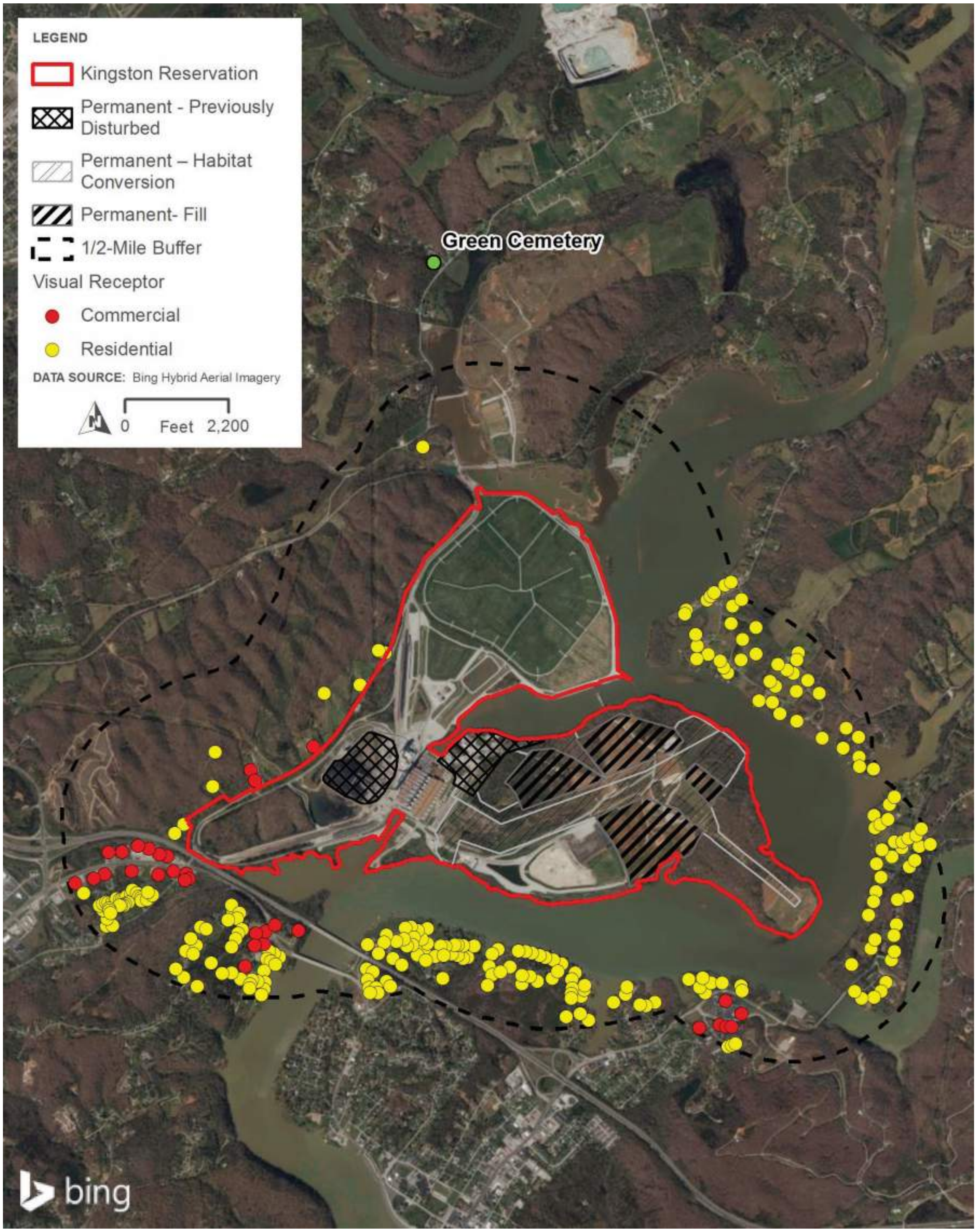

Figure 3.18-1. Kingston Reservation Visual Receptors

The total number of visual receptors, which are receptors within the line of sight of the source, within 0.5 mile of the Kingston Reservation and their classifications are provided in Table 3.18-1 and Figure 3.18-1. Some of the receptors identified within this section may be out of the line of sight due to changes in vegetation, air quality, or angles that were not accounted for in this analysis.

Table 3.18-1. Kingston Reservation Visual Receptors

Visual Receptor Type	Alternative A – Kingston Reservation
Cemetery	1
Church	0
Commercial	31
Industrial	0
Recreation	0
Residential	247
Total	**278**

3.18.1.2 Alternative A

3.18.1.2.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The chosen CC/Aero CT Plant site is in an undeveloped portion of the Kingston Reservation comprised of largely disturbed earth and hay/pasture. The closest sensitive receptors to the proposed site include residential subdivisions, with homes located approximately 0.6 mile south of the proposed plant site (Figure 3.18-1).

3.18.1.2.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The proposed 3- to 4-MW solar facility would be located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.18.1.1 apply to the proposed 3- to 4-MW solar facility.

3.18.1.2.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The proposed 100-MW BESS would be located on one of three potential sites located on the Kingston Reservation. The affected environment and existing conditions described above for the Kingston Reservation in Section 3.18.1.1 apply to the proposed 100-MW BESS.

3.18.1.2.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new existing transmission line connections to the proposed CC/Aero CT facilities and switchyard. TVA would also install a new transmission line for the proposed battery facility. Therefore, the affected environment for on-site transmission upgrades is described in Section 3.18.1.1.

3.18.1.2.5 Off-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines, five near the Kingston Reservation (L5108, L5116, L5280, L5302, and L5381) and one in Crossville, (L5383). Descriptions of these improvements can be found in Section 2.1.3.5.2. The visual landscapes within the vicinity of each transmission line are described below.

3.18.1.2.5.1 Eastern Transmission Corridor

Transmission line L5108 extends from the current Kingston Reservation travelling eastbound and terminating in the city of Oak Ridge. Several access roads are proposed largely along routes that have already been cleared. The viewshed varies at different points on the corridor, with the surrounding area consisting largely of forest, developed open space, and pastureland.

In the western-most portions of the corridor, the Clinch and Emory rivers exist within the viewshed.

There are a total of 6,481 visual receptors within a 0.5 mile of the L5108 Eastern Transmission Corridor, most being residences and vacant buildings. The total number of visual receptors within 0.5 mile of the corridor and their classifications can be seen in Table 3.18-2 and Figure 3.18-2a through Figure 3.18-2d. Some of the receptors identified within this section may be out of the line of sight due to changes in vegetation, air quality, or angles that were not accounted for in this analysis.

Table 3.18-2. Visual Receptors Within 0.5 Mile of L5108 of the Eastern Transmission Corridor

Visual Receptor Type	Alternative A – L5108
Business	65
Church	16
Farm Buildings	10
Industrial	70
Residential	4622
School	17
Campground/Sports Field	18
Vacant Buildings (garage/shed)	445
Unknown	1218
Total	**6,481**

Transmission Lines L5302, L5280, L5381, and L5116 extend from the Kingston Reservation travelling eastbound and terminating in the city of Oak Ridge. Several access roads are proposed largely along routes that have already been cleared. The viewshed varies at different points on the corridor, with the surrounding area consisting largely of forest, developed open space, and pastureland. In the western-most portions of the corridor, the Clinch and Emory rivers exist within the viewshed.

There are a total of 822 visual receptors within 0.5 mile of the L5302, L5280, L5381, and L5116 Eastern Transmission Corridors, most being residences, industrial buildings, and vacant buildings. The total number of visual receptors within 0.5 mile of the corridor and their classifications can be seen in Table 3.18-3 and Figure 3.18-2a through Figure 3.18-2d. Some of the receptors identified within this section may be out of the line of sight due to changes in vegetation, air quality, or angles that were not accounted for in this analysis.

Table 3.18-3. Visual Receptors within 0.5 Mile of L5302, L5280, L5381, and L5116 of the Eastern Transmission Corridor

Visual Receptor Type	Alternative A – L5302, L5280, L5381, and L5116
Business	7
Church	7
Farm Buildings	7
Industrial	214
Residential	271

Visual Receptor Type	**Alternative A – L5302, L5280, L5381, and L5116**
School	0
Campground/Sports Field	0
Vacant Buildings (garage/shed)	195
Unknown	121
Total	**822**

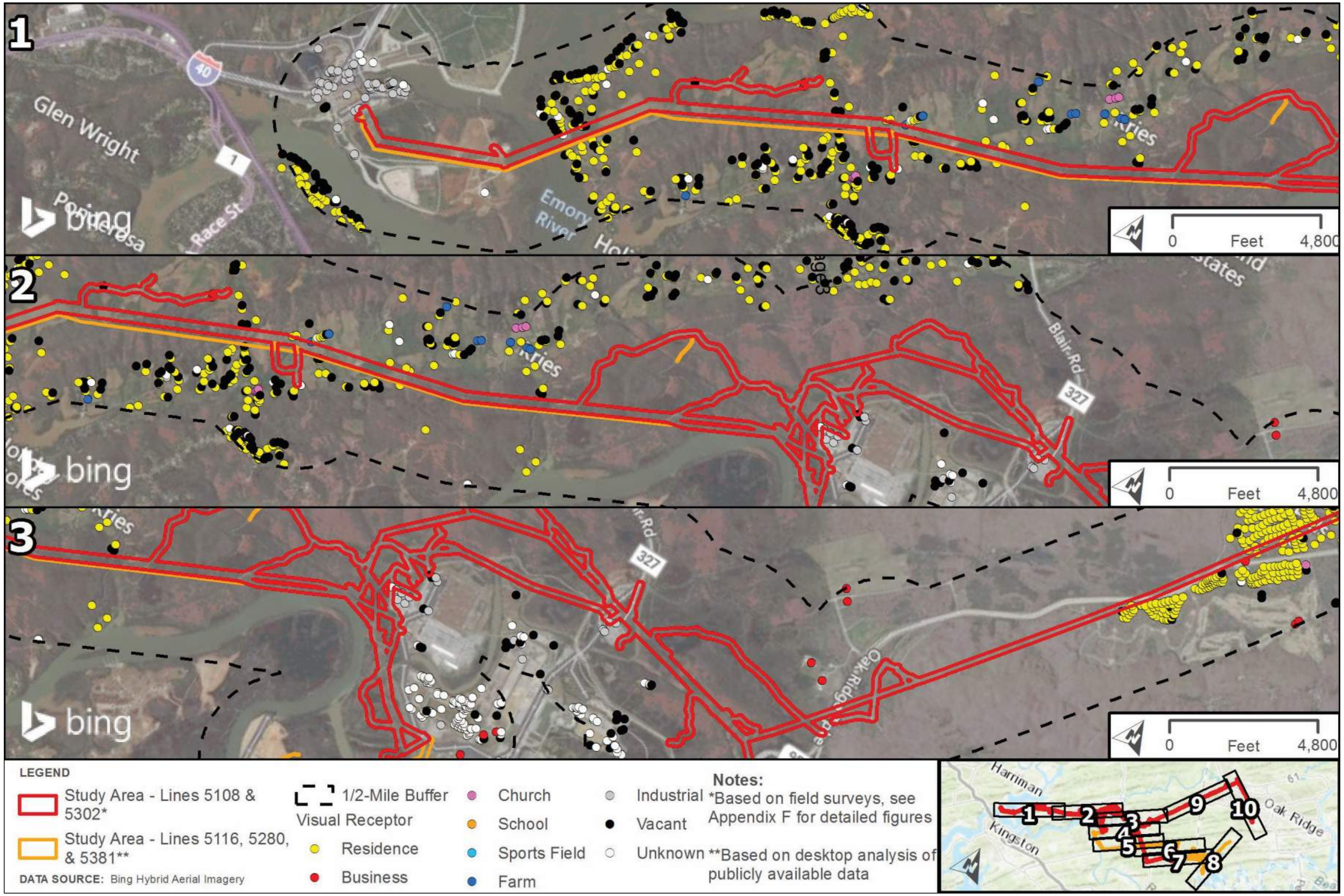

Figure 3.18-2a. Eastern Transmission Corridor Visual Receptors

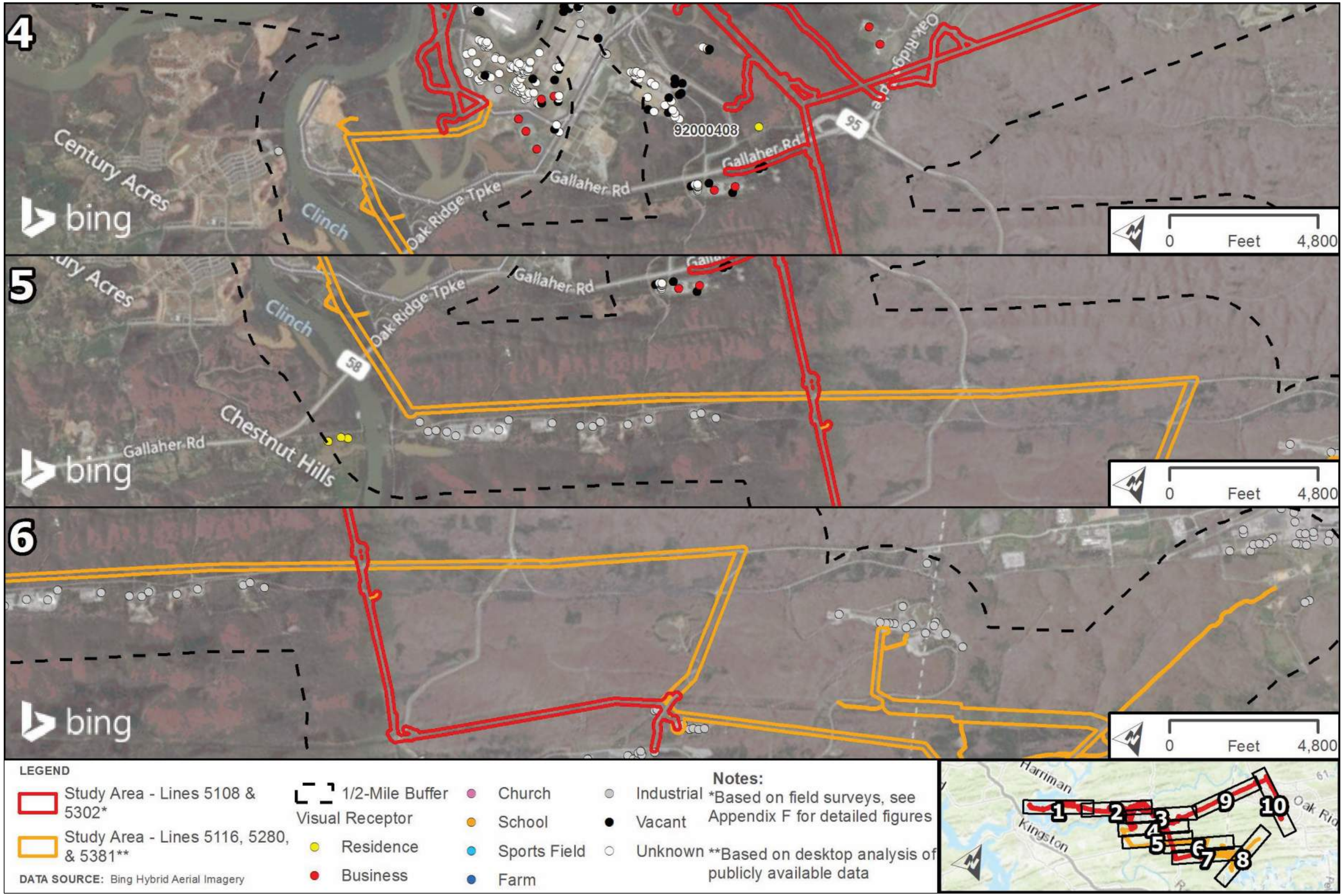

Figure 3.18-2b. Eastern Transmission Corridor Visual Receptors

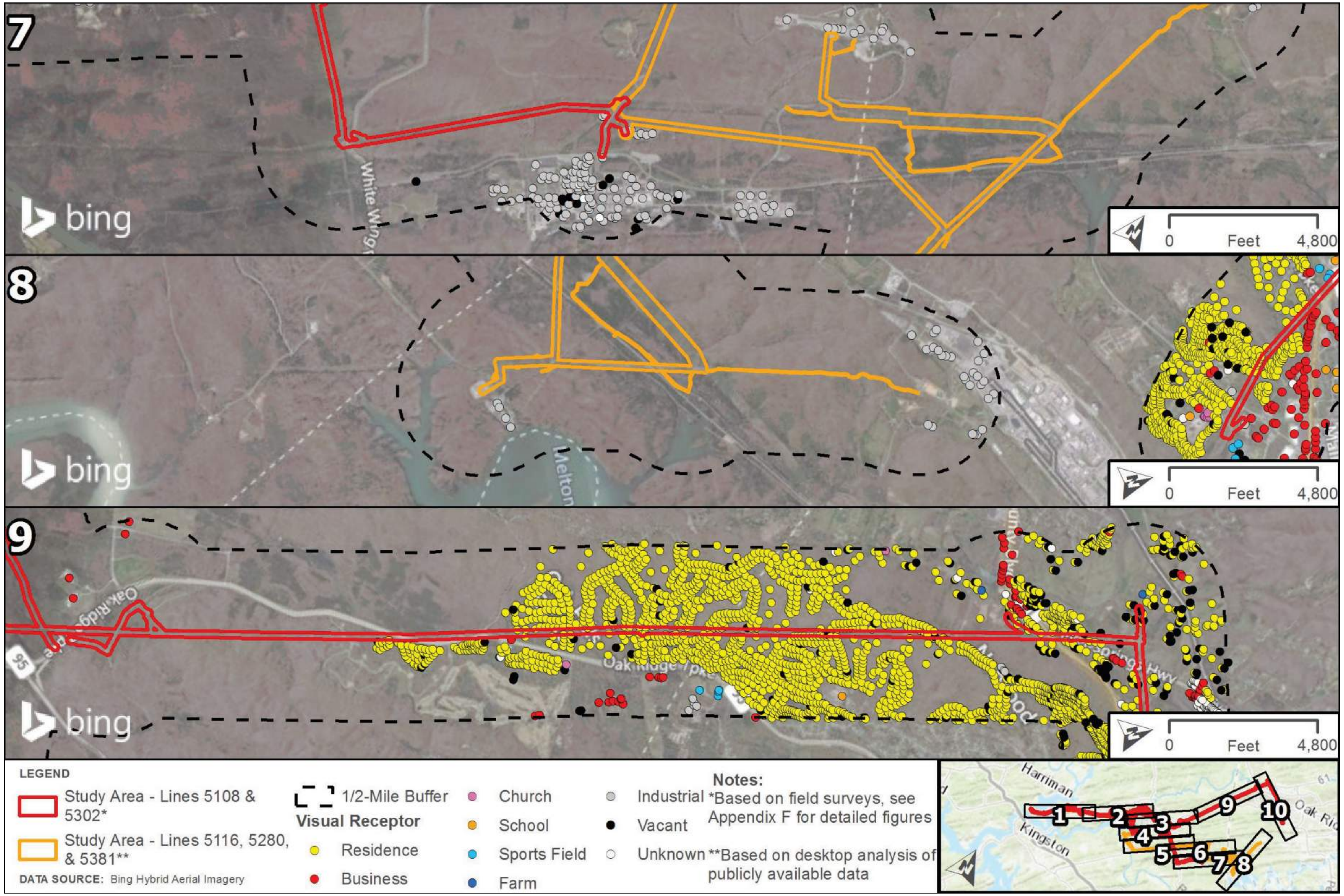

Figure 3.18-2c. Eastern Transmission Corridor Visual Receptors

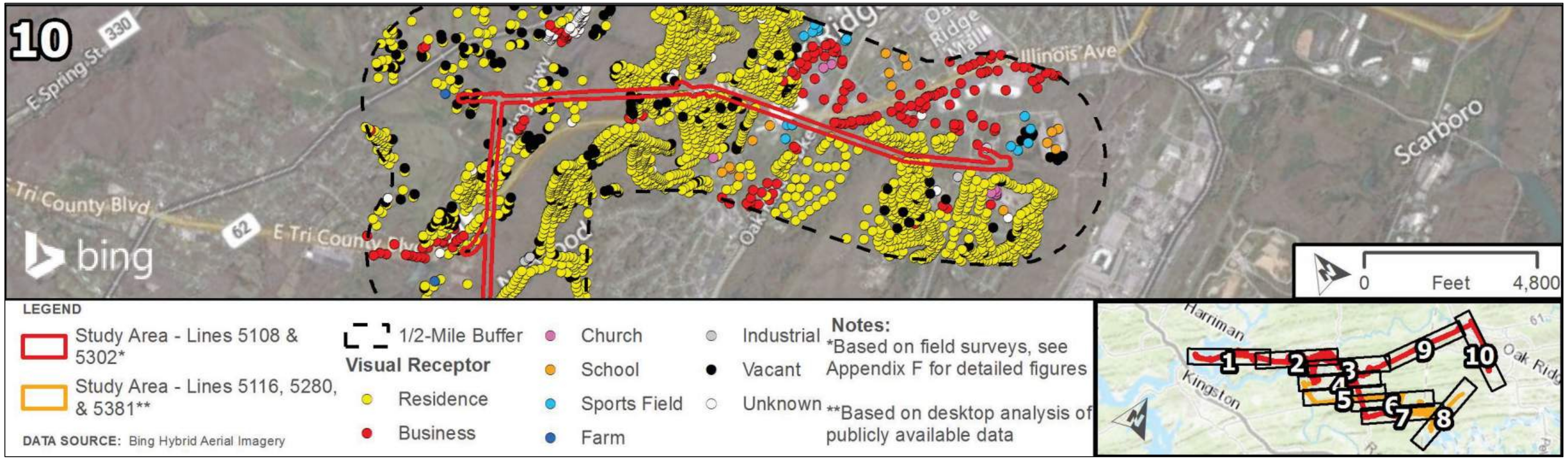

Figure 3.18-2d. Eastern Transmission Corridor Visual Receptors

3.18.1.2.5.2 Western Transmission Corridor

The viewshed of the Western Transmission Corridor varies at different points on the corridor, with the surrounding area consisting largely of forest and pastureland. There are a total of 516 visual receptors within 0.5 mile of the Western Transmission Corridor, most being residences, farm buildings, and vacant buildings. The total number of receptors within 0.5 mile of the corridor and their classifications can be seen in Table 3.18-4 and Figure 3.18-3. Some of the receptors identified within this section may be out of the line of sight due to changes in vegetation, air quality, or angles that were not accounted for in this analysis.

Table 3.18-4. Noise Receptors Within 0.5 Mile of L5383 of the Wester Transmission Corridor

Visual Receptor Type	Alternative A – L5383
Business	37
Church	5
Farm Buildings	78
Industrial	1
Residential	329
Vacant Buildings (Garage/Shed)	66
Total	**516**

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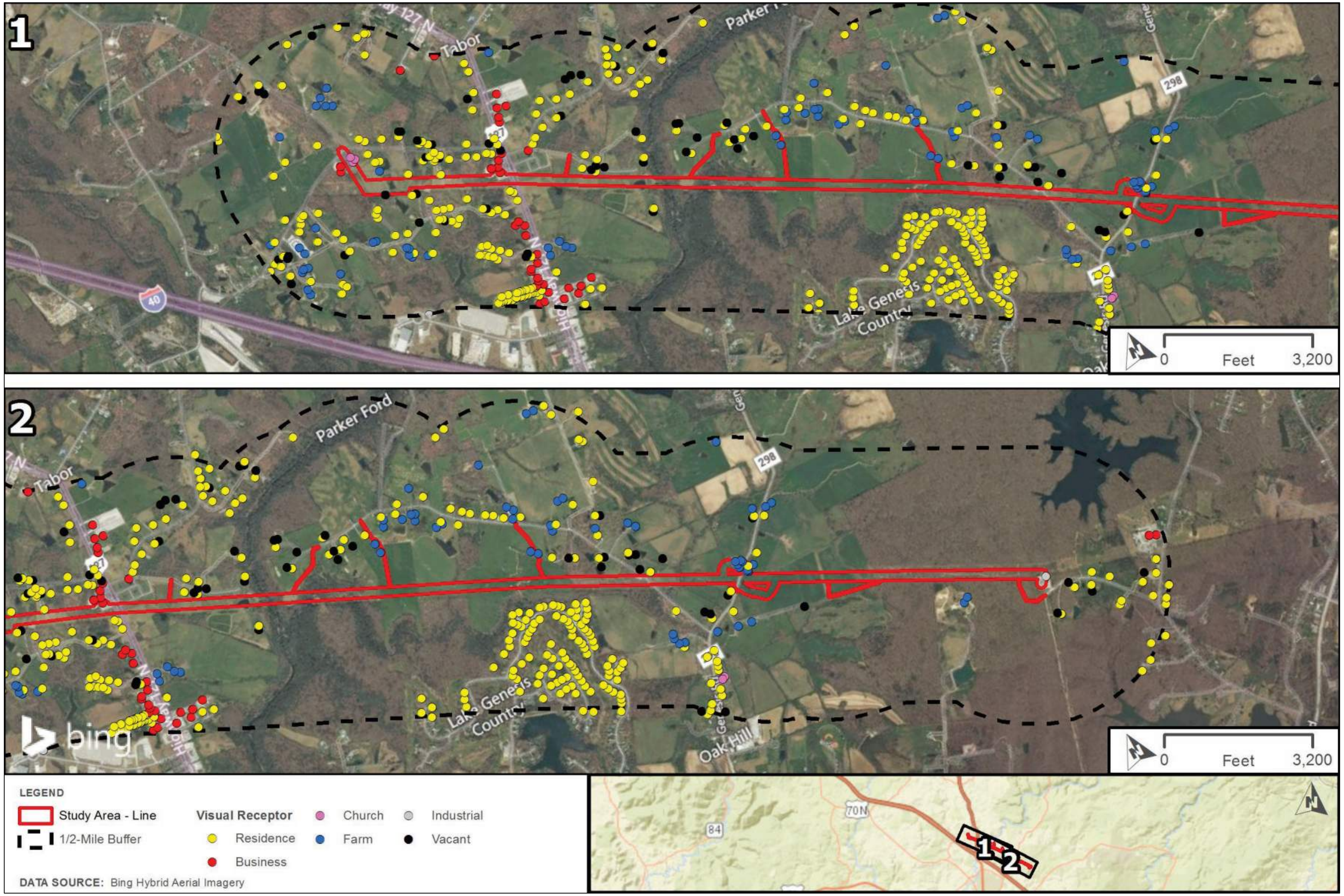

Figure 3.18-3. Western Transmission Corridor Visual Receptors

3.18.1.2.6 Construction and Operation of a Natural Gas Pipeline

No special or unique features or viewsheds have been identified to date within the ETNG Construction ROW (ETNG 2022i). As part of this review, TVA also conducted a desktop review of the natural gas pipeline using a 200-foot buffer, hereafter referred to as the TVA Expanded Construction ROW. A total of 1,110 visual receptors were identified within the TVA Expanded Construction ROW, most consisting of residences and vacant buildings. The total number of visual receptors within the corridor and their classifications can be seen in Table 3.18-5 and Appendix D-9.

Visual receptors within the ETNG Construction ROW are discussed in ETNG's Resource Report 8 (ETNG 2022i). Pertinent excerpts from the report are provided below:

> Construction of the Hartsville Compressor Station will occur in a rural area that is characterized by a mix of open, agricultural, and forested lands. There are no special or unique scenic features or designated scenic areas within view of the compressor station. The Columbia Gulf M&R Station will be in a rural area with few nearby residences.

Table 3.18-5. Pipeline Visual Receptors Identified Within TVA's Pipeline Study Area Under Alternative A

Visual Receptor Type	Alternative A – Pipeline
Business	38
Church	9
Farm	35
Industrial	10
Residential	511
Sports Field	1
Unknown	31
Vacant	475
Total	**1110**

3.18.1.3 Alternative B

3.18.1.3.1 East Tennessee TVA Power Service Area

Solar and storage facilities sites would likely be in agricultural, rural, and/or undeveloped areas within portions of East Tennessee, with common scenic attractiveness and varying levels of scenic integrity. The affected environment of visual resources would be more fully addressed for each solar and storage facility under future NEPA reviews.

3.18.2 Environmental Consequences

3.18.2.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to operate the KIF Plant. TVA would implement all the planned actions related to the current and future management and storage of CCRs at the fossil plants, which have either been reviewed or would be in subsequent NEPA analyses. Under this alternative, the fossil plant would continue to operate and none of the physical infrastructure currently at the site would change. The primary features in the visual environment, including the stacks, plant buildings, and connecting transmission lines leaving the plant site, would remain in place. Therefore, the overall scenic value class would remain in the range from poor within the plant facility to good in the surrounding area.

3.18.2.2 Retirement, Decommissioning, Decontamination, and Deconstruction of KIF Plant

All buildings, structures, conveyors, and silos associated with plant operations would be decontaminated and demolished to three feet below final grade. All below-grade building areas would be backfilled, and the site would be restored to grade, thereby changing the visuals in the Kingston Reservation. Demolition of the twelve stacks would cause a beneficial visual effect to receptors in the foreground, middleground, and background distance. Visibility of the remaining deconstruction actions is expected to be limited to receptors within the middleground and foreground viewing distances due to the screening effect of surrounding topography and vegetation. At the background distance, most of the deconstruction actions are not expected to be discernible due to the screening effects of terrain and overall distance, nor would they contrast with the overall landscape.

TVA would maintain the site until it is redeveloped at some time in the future, largely dependent on the alternative chosen. During the retirement and demolition of the KIF, there would be slight visual discord from the existing conditions due to an increase in personnel, cranes, and other tall and colorful equipment in the area. As potential visual disturbances would only be visible to a few people with nearby vantage points and due to the temporary nature of the activities, visual impacts during demolition of the outlying facilities would be considered insignificant.

There would likely be an increase in vehicular traffic along SR-109 during the hauling of material from the Kingston Reservation, which would be noticeable to residents in the area. Impacts from additional vehicular traffic are expected to be minor as the roads within the plant are already predominately used by employees and for industrial activity. This small increase in visual discord would be temporary and intermittent and only last until demolition activities are completed.

The KIF site would either be returned to grade and revegetated or repurposed into a different energy source depending on the alternative chosen. Should the site be returned to grade and revegetated, it would fold into the surrounding mixed landscape of trees and agriculture along the rivers.

3.18.2.2.1 Environmental Justice Considerations

Visual effects that would occur because of KIF retirement and D4 activities would be temporary, minor, and are not anticipated to have amplified effects on EJ populations. Residences are not present on Kingston and only non-EJ qualifying populations are present in the vicinity.

3.18.2.3 Alternative A

3.18.2.3.1 Construction and Operation of a CC/Aero CT Plant and Switchyard on the Kingston Reservation

The new CC/Aero CT Plant and accompanying equipment would be visually similar to existing conditions in the current landscape. Proposed stack height is a function of air permit modeling and is not yet known; however, the proposed stacks would be no more than 199 feet high. The new stacks would likely be visible to rural residential receptors near the proposed plant site. With the exception of the stacks, visibility of the proposed CC/Aero CT Plant construction is expected to be limited to receptors within the middleground viewing distance due to the screening effect of surrounding topography and vegetation. At the background distance, the proposed actions are not expected to be discernible due to the screening effects of terrain and overall distance, nor would they contrast with the existing overall landscape. The new plant would be mainly seen by employees and facility operators, as well as motorists on the adjacent I-40. Border trees and hedges may be planted as needed, and existing border vegetation would be maintained. The facility proposed by Alternative A would be visually very similar to current conditions. The use of downward and inward facing lighting would create a permanent visual impact within the project site.

During the construction of the CC/Aero CT Plant, there would be slight visual discord from the existing conditions due to an increase in personnel and equipment in the area. There would also be a likely increase in vehicular traffic in the area due to employee traffic. Barge and rail traffic would also likely increase during the hauling of material to and from the Kingston Reservation, which would be noticeable to residents in the area. Impacts from additional vehicular traffic are expected to be minor as the roads within the plant are already predominately used by employees and for industrial activity. This small increase in visual discord would be temporary and intermittent and only last until construction activities have been completed.

3.18.2.3.2 Construction and Operation of a 3- to 4-MW Solar Facility on Kingston Reservation

The construction and operation of a 3- to 4-MW solar facility on the existing coal yard could have a minor visual impact on nearby residential communities. During construction, the installation of solar panels on piles, as well as the installation of associated infrastructure, such as inverters, access roads, and a perimeter safety/security chain-link fence, may be visible from surrounding areas. This construction may be seen as disruptive to the natural landscape; however, the industrial nature of the facility would be similar to the existing surroundings within the Reservation and would not create significant discord. The facility would also have a low-profile, with the total height at less than 10 feet above ground.

3.18.2.3.3 Construction and Operation of a 100-MW BESS on Kingston Reservation

The construction and operation of a 100-MW BESS could have a minor visual impact on nearby residential communities. During construction, the installation of the battery storage units and associated infrastructure, such as breakers, switchgear, and one or more transformers, may be visible from surrounding areas. However, since the facility would be located on the Kingston Reservation, it would largely blend in with the existing infrastructure, minimizing the visual impact to nearby receptors.

Overall, the visual impact of the construction and operation of the BESS is likely to be minor, and it could be largely unnoticed by the nearby residential communities once operational.

3.18.2.3.4 On-site Transmission Upgrades

Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new transmission line connections to the proposed CC/Aero CT facilities and switchyard. TVA would also install a new transmission line for the proposed battery facility. Alterations to transmission lines associated with Alternative A would primarily involve upgrades to existing facilities and are not expected to significantly affect the visual environment. The proposed transmission line for the battery facility is not anticipated to significantly affect the visual environment because many transmission lines already exist within the reservation and is anticipated to blend in with the natural environment. Improvement of existing access roads or construction of new access roads may be necessary to maintain the improved transmission lines, but any construction would be temporary and intermittent in nature and would fold into the landscape of transmission lines already present.

3.18.2.3.5 Off-site Transmission Upgrades

Depending on access needs to the off-site transmission corridors, existing access roads may require modifications, such as brush clearing or tree trimming, to allow for passage of equipment and bucket trucks, which would impose temporary visual impacts during construction. Minor ground disturbance is expected in these areas, but if the ground is disturbed, the access road area would be revegetated using native, low-growing plant species after required transmission line upgrade work is completed.

Permanent adverse visual impacts would occur in areas where land uses are converted to maintained open space, as described in more detail in Section 3.10.1.2.6. Areas such as pasture, agricultural fields, or lawns would be returned to their former condition.

3.18.2.3.6 Construction and Operation of a Natural Gas Pipeline

Visual impacts associated with the pipeline would likely be greatest during active construction as a result of construction equipment, personnel, and disturbed soil. Permanent visual changes associated with pipeline installation typically include the cleared permanent ROW in wooded areas and the installation of pipeline markers. Aboveground facilities would also incur permanent adverse impacts. Approximately 113 of the 122 miles of the proposed pipeline would be co-located with the existing 3100 Line ROW, which reduces visual discord and the acreage of wooded areas that would be cleared, as the 3100 Line ROW is already maintained open space.

Construction and operation of the new compressor station and solar farm would represent a permanent impact on viewshed. The compressor station and solar farm may have visual impacts, depending on the visual character of the location they are sited in. If sited in an agricultural or rural area, there would be a permanent, adverse impact due to the introduction of industrial elements. Solar facility components are typically low profile, except for taller structures supporting electrical lines that connect the facilities to existing nearby transmission lines. These sites would likely be enclosed by security fencing and night-lighting is typically motion-activated. Where visual impacts are identified as a concern during facility design, or as required by ordinances in some communities, the facilities may be screened by planted trees and shrubs and/or constructed berms. Mitigation measures that could be implemented to minimize visual impacts include painting buildings a neutral color, utilizing forested buffers for screening, and limiting the height of facilities.

ETNG's Resource Report 8 (ETNG 2022i), which TVA has independently reviewed, provides:

> Visual impacts associated with the permanent operation of the […] pipeline will […] be minimal to surrounding landowners.
>
> Construction and operation of the Hartsville Compressor Station is not expected to have a significant effect on visual resources due to the presence of existing vegetative screening between compressor facilities as well as the topography of the site. In addition, [ETNG] will, if possible, preserve existing trees along the compressor station property boundary abutting existing roadways to provide screening and minimize potential visual effects. Maintenance of a vegetated buffer along roadways should aid in screening views of the site from points along the roadways and nearby residences. [ETNG] will paint the compressor station buildings a neutral color to match the surrounding landscape. Lighting will be required for safe operation of the facility at night but will be the minimum required. Flood lights will be hooded and directed downward to minimize impacts from lighting.
>
> […] The M&R Station could be visible in a cleared access road corridor from Bass Road. Existing vegetation will be maintained as practicable to screen views of the station from all but a small portion of Bass Road. Visual screening is not proposed at the Columbia

Gulf M&R station. Modifications to the existing Texas Eastern and Midwestern Gas M&R stations will occur within the existing sites; no impacts to aesthetics are anticipated. [ETNG] is in the process of identifying a site and designing the layout for the Kingston M&R Station. Information on land use for this station will be submitted with the Project Application.

The [pipeline] MLVs will be small facilities located within the permanent ROW. There would be no additional disturbance or removal of vegetation associated with these facilities. The MLVs would generally be unobtrusive because they are small in scale and would be painted to harmonize with surrounding landscape colors. There would be no significant effect to visual resources from the operation of pipeline appurtenant facilities. [ETNG] is in the process of identifying the nearest residences to the MLV locations and will determine the need for any visual screening. The final evaluation of any screening requirements will be provided in the final Resource Report 8 included in the Project Application (ETNG 2022i).

3.18.2.3.7 Summary of Alternative A

TVA Actions

Most of the deconstruction actions are not expected to be discernible due to the screening effects of terrain and overall distance, nor would they contrast with the overall landscape. The proposed CC/Aero CT Plant would generally be absorbed by surrounding industrial components and would become visually subordinate to the overall landscape character associated with the plant site. While most of the off-site transmission lines would not be visible once buried and operational, based on TVA's desktop review of the corridors, there would be permanent visual effects due to the conversion of forest to fields. In sum, permanent visual effects would occur as a result of the construction of the CC/Aero CT Plant and accompanying equipment and areas along transmission lines where forestland is converted to maintained open space. Where mitigation is necessary due to adverse visual impacts, fencing and vegetative screening would be utilized. Overall, the construction of Alternative A would largely blend in with the existing industrial environment and would not create significant visual discord.

ETNG Actions - Natural Gas Pipeline and Associated Structures

While most of the proposed pipeline would not be visible once buried and operational, based on the desktop review of TVA Expanded Construction ROW, there would be permanent visual effects due to the conversion of forest to fields. Permanent visual effects would occur as a result of the construction of the aboveground natural gas structures and areas along the pipeline and ROWs where forestland is converted to maintained open space. Where mitigation is necessary due to adverse visual impacts, fencing and vegetative screening would be utilized. Overall, the construction of Alternative A would largely blend in with the existing industrial environment and would not create significant visual discord.

3.18.2.3.8 Environmental Justice Considerations

3.18.2.3.8.1 TVA Actions

Visual effects that would occur as a result of the proposed CC/Aero CT Plant are anticipated to be minor. These effects would also be limited to the Kingston Reservation, where residences are not present.

3.18.2.3.8.2 ETNG Actions - Natural Gas Pipeline and Associated Structures

Construction of the proposed natural gas pipeline and associated structures would result in moderate permanent visual effects due to the creation of new and widening of the existing combined utility corridor; thus, resulting in conversion of contiguous forest to herbaceous fields. Construction of pipeline components would occur where EJ populations are distributed among other populations. Therefore, visual-related effects experienced by both EJ and non-EJ populations would be comparable and EJ populations are not anticipated to experience amplified effects.

Although TVA has assessed these impacts to be moderate and permanent for vegetation clearing activities, identified EJ populations are not expected to experience amplified or disproportionate effects. ETNG is still evaluating effects of its proposed project, and TVA may update its conclusions in TVA's final EIS based on ETNG's findings.

3.18.2.4 Alternative B

3.18.2.4.1 Construction and Operations of Solar and Storage Facilities

The construction of the proposed solar and storage facilities would result in localized visual impacts as they would introduce industrial elements onto sites that are typically relatively flat and largely cropland, pasture, and/or hayfields. The solar and storage facility components are typically low profile and less than 25 feet tall, except for taller structures supporting electrical lines that connect the facilities to existing nearby transmission lines. The solar facility sites are typically replanted with grasses and other low vegetation following construction, and low-profile vegetation is maintained during operation by periodic mowing or grazing. The solar and storage facility sites are enclosed by security fencing and any night-lighting is typically motion-activated. Where visual impacts are identified as a concern during facility design, or as required by ordinances in some communities, the facilities may be screened by planted trees and shrubs and/or constructed berms. Detailed analyses of visual impacts would occur for each solar or BESS site under future NEPA reviews.

Cumulative visual impacts would occur if Alternative B was combined with the 10,000 MW expansion of solar planned in the 2019 TVA IRP, which would create permanent, cumulative increases in viewshed changes in the region. Cumulative impacts would be minimized through proper siting, setbacks, visual screening and buffers, and lighting.

3.18.2.4.2 Transmission and Other Components

Construction of transmission line upgrades associated with solar and BESS sites would result in temporary, minor visual impacts related to construction and construction-related traffic. The construction of new transmission lines would have the potential to result in moderate adverse visual impacts, resulting in a prominent cleared corridor if the line crosses forested areas. The transmission line may be visible at foreground, middleground, and background distances, depending on the extent of vegetation and topography.

During the construction of the transmission lines and other electrical system components, there would be slight visual discord from the existing conditions due to an increase in personnel and equipment in the area. This small increase in visual discord would be temporary and intermittent and only last until construction activities have been completed.

3.18.2.4.3 Environmental Justice Considerations

Visual effects that would occur as a result of the proposed solar facilities and transmission line activities are not anticipated to be amplified among EJ populations. These effects would be temporary (primarily during the period of construction), minor, and limited to the immediate project sites and transmission line corridors. Site-specific evaluations of impacts to EJ populations in relation to solar and storage facilities would be conducted as appropriate.

3.19 Unavoidable Adverse Environmental Impacts

Unavoidable adverse effects can be described as the effects of the proposed action on natural and human resources that would remain after mitigation measures or BMPs have been applied. Effects associated with the retirement and deconstruction of the KIF Plant, the construction and operation of the proposed Kingston Reservation CC/Aero CT Plant, switchyard, on-site solar and battery storage, and natural gas pipeline (Alternative A), or solar and storage facilities (Alternative B) and associated transmission line upgrades and new connections have the potential to cause unavoidable adverse effects to several natural and human environmental resources. TVA has reduced the potential for adverse effects through appropriate planning in designing replacement generation facilities. In addition, TVA would implement mitigation measures (see Section 2.3) to further reduce potential adverse effects to certain environmental resources.

The replacement generation alternatives would result in the permanent conversion of undeveloped land into an industrial use. The new pipeline built by ETNG and new transmission lines or connections would also convert forest and agricultural land into cleared, maintained corridors. Land that was previously unforested open space would be returned to its previous use.

Under Alternative A, the construction of the replacement generation would also result in minor effects to surface water and wetland resources. These effects would be mitigated through adherence to permit requirements and the provision of appropriate compensatory mitigative measures, if needed. The proposed natural gas pipeline (Alternative A) would likely avoid and/or greatly minimize the potential for surface water impacts to some of these features by boring or drilling (HDD) beneath them. Temporary effects to water quality from runoff during construction, as well as ongoing vegetation maintenance along the pipeline and transmission lines, could affect nearby receiving water bodies but would be reduced with application of appropriate BMPs.

Unavoidable localized increases in air and noise emissions would also occur during construction activities. Activities associated with the use of construction equipment may result in varying amounts of dust, air emissions, and noise that may potentially affect on-site workers, users of adjacent recreational lands and water bodies, and residents located near the off-site transmission line segments and natural gas pipeline. Potential noise effects also include traffic noise associated with the construction workforce traveling to and from the site. Emissions from construction activities and equipment would be minimized through implementation of BMPs, including proper maintenance of construction equipment and vehicles. Low-income and minority communities near the Kingston Reservation and pipeline associated with Alternative A may experience some amplified air, dust, noise, transportation, or waste effects.

Temporary increases in traffic would be minimized or mitigated by specific measures designed to address traffic flow issues, if necessary. Temporary increases in health and safety risks would be minimized by implementation of the project health and safety plan. Construction and operation would have minor, localized effects on soil erosion and sedimentation that would be minimized by using appropriate BMPs through the establishment and maintenance of stream and wetland buffers, soil stabilization, and vegetation management measures.

Construction of the proposed solar facilities under Alternative B would be subject to CWA Section 404/401 permitting, as typical solar developments can result in unavoidable adverse impacts to waters of the U.S, as indicated in Table 3.2-1. Any unavoidable permanent effects would be mitigated through adherence to application of permit conditions in authorizations issued under the under an approved CWA permit authorization. Alternative B would result in the conversion of largely agricultural land to industrial use, although livestock grazing is likely occurring now on at least some of the solar facility sites (Table 3.2-1). Revegetation of solar sites with native and/or non-invasive grasses and herbaceous vegetation would help minimize effects to open, grassy habitats.

These habitat alterations would result in effects to localized plant communities and wildlife habitat on the affected lands. However, due to the abundant habitat of similar quality within the vicinity of the project sites, the overall effect to vegetation and wildlife is considered minor. Effects to federally listed endangered and threatened species would be mitigated in consultation with the USFWS. When actions fall under those addressed in TVA's Programmatic Consultation with USFWS addressing routine actions and federally listed bats, project-specific Conservation Measures would be identified on TVA's Bat Strategy Form, which is included in Appendix B. These Conservation Measures would minimize effects to federally listed bats. TVA and developers under power purchase agreements would also employ avoidance measures to avoid significant effects to any state-listed plants and any previously undocumented populations of federally or state-listed species identified during future surveys.

Consultation with TN SHPO and tribes is ongoing for Alternative A. While the retirement and deconstruction of the KIF plant would not result in adverse effects to cultural resources, the proposed replacement generation and associated pipeline or transmission line infrastructure may result in adverse effects and require development of mitigation measures through Section 106 consultation.

In the context of the availability of regional resources that are similar to those unavoidably adversely affected by the project, coupled with the application of appropriate BMPs and adherence to permit requirements, unavoidable adverse effects would be minor.

3.20 Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires a discussion of the relationship between short-term uses of the environment and the maintenance and enhancement of long-term productivity. This EIS focuses on the analyses of environmental effects associated with the retirement, decommissioning, and deconstruction of the existing KIF plant, and replacement of power generated through construction of a CC/Aero CT Plant on the Kingston Reservation (Alternative A) or construction of solar and BESS facilities (Alternative B), as well as associated off-site natural gas pipelines and transmission line upgrades. These activities are considered short-term uses of the environment for the purposes of this section. In contrast, the long-term productivity is considered to be that which occurs beyond the conclusion of decommissioning the plants and associated infrastructure. This section includes an evaluation of the extent that the short-term uses preclude any options for future long-term use of the project sites.

All buildings and structures within the proposed KIF plant demolition (D4) boundary would be decontaminated and demolished to grade. In the long-term, the site could become productive if commercial or industrial facilities were to be established, thereby producing employment opportunities and tax revenue and enhancing long-term productivity of the site.

Construction of the replacement generation CC/Aero CT Plant, switchyard, and associated pipelines, and transmission line upgrades would cause a minor, short-term deterioration in existing air quality during construction. These effects would be mitigated through implementation of mitigative measures to reduce emissions from construction phase equipment and minimize emissions of fugitive dust. All of the action alternatives would result in a long-term beneficial effect on air quality and GHG emissions. Therefore, there would be no effect on the enhancement of long-term productivity related to air quality or climate change following decommissioning of the KIF plant.

Construction of the proposed CC/Aero CT Plant, including the new switchyard, natural gas pipeline, and associated structures and transmission line upgrades (Alternative A) would reduce the long-term productivity of the land for other purposes while these facilities are in operation. The proposed generation facility is located on an existing TVA reservation and the 3- to 4-MW solar facility would be located on the site of the existing KIF coal yard. The project area includes similar vegetation and habitat types; therefore, the short-term disturbance to support plant operations is not expected to significantly alter long-term productivity of wildlife, agriculture, or other natural resources. After decommissioning, the lands could be reused and made available for other uses.

Constructing solar facilities (Alternative B) would affect short-term uses of the project sites by converting them from agricultural and forested land uses to solar power generation. The effects on long-term productivity would be minor, as existing land uses could be readily restored on the sites following the decommissioning and removal of the solar facilities.

3.21 Irreversible and Irretrievable Commitments of Resources

The term “irreversible commitments of resources” describes environmental resources that are potentially changed by the construction or operation of the proposed projects that could not be restored to their prior state by practical means at some later time. Irreversible commitments generally occur to nonrenewable resources such as minerals or cultural resources and to those resources that are renewable only over long timespans, such as soil productivity. A resource commitment is considered irretrievable when the use or consumption is neither renewable nor recoverable for use until reclamation is successfully applied. Irretrievable commitments generally apply to the loss of production, harvest, or other natural resources and are not necessarily irreversible.

Resources required by decontamination and deconstruction activities, including labor and fossil fuels, would be irretrievably lost. Nonrenewable fossil fuels would be irretrievably lost through the use of gasoline and diesel-powered equipment during construction. However, it is unlikely that their limited use in these projects would adversely affect the overall future availability of these resources.

The land used for the proposed CC/Aero CT Plant (Alternative A) or solar/storage (Alternative B) plants and associated infrastructure is not irreversibly committed because once the facilities cease operations and are decommissioned, the land supporting the facilities could be returned to other industrial or nonindustrial uses. The ROW used for the natural gas pipeline would constitute an irretrievable commitment of on-site resources, such as wildlife habitat and forest resources, for the length of time the pipeline is in place. However, the approximate previous land use and land cover could be returned upon retirement. In the interim, compatible uses of the ROW could continue.

Operation of the CC/Aero CT Plant would result in the irretrievable loss of natural gas and fuel oil, which would be used to fuel the CC/Aero CT Plant. In addition, the materials used for the construction of the proposed site would be committed for the life of the facilities. However, these fossil fuels and building materials are not in short supply at this time and their use would not have an adverse effect upon continued availability of these resources.

The implementation of Alternative B would involve irreversible commitment of fuel and resource labor required for the construction, maintenance, and operation of the solar and BESS facilities. Because removal of the solar arrays and associated on-site infrastructure could be accomplished rather easily, and the facilities would not irreversibly alter the site, the project sites could be returned to their original condition or be used for other productive purposes once the solar facility is decommissioned. Most of the solar facility components could also be recycled after the facility is decommissioned.

CHAPTER 4 – SUBMITTED ALTERNATIVES, INFORMATION AND ANALYSES

4.1 Submitted Alternatives, Information and Analyses

4.1.1 Public Comments on Kingston Scoping Report

The draft EIS includes a summary that identifies all alternatives, information and analyses submitted by State, Tribal, and local governments, in Section 1.5.2, and other public commenters during the scoping process for consideration in developing the draft EIS (40 CFR 1502.17). During the scoping period, the Southern Environmental Law Center (SELC) recommended that in addition to the alternatives proposed in the Scoping Report, the EIS should include these alternatives:

- Distributed solar;
- Onshore wind;
- Demand response and energy efficiency;
- Blended solar (distributed and utility-scale), onshore wind, energy efficiency, demand response, and battery storage; and
- Purchased carbon-free power.

TVA's 2019 IRP included an evaluation of these proposed alternatives, including distributed solar, onshore wind, and demand response and energy efficiency. The Target Power Supply mix adopted from the IRP optimizes each of these resource generation types. The Alternatives selected for consideration in this EIS are one aspect of the overall asset strategy that resulted from the IRP. Alternative B evaluates the potential for at least 1,500 MW of utility-scale solar and 2,200 MW of energy storage facilities. This 1,500 MW would be in addition to the approximately 10,000 MW of solar additions by 2035 that is currently included in TVA's long-term plans. Section 2.1 provides additional information related to the proposed alternatives.

Additionally, SELC requested that TVA:

- Accurately quantify the GHG emissions of any proposed gas plants using the Social Cost of Carbon.
- Use appropriate tools to fairly identify EJ populations and assess the potential for disproportionate harm to specific communities.

TVA has quantified the GHG emissions and performed a comparative assessment of the social cost of carbon based on the GHG emissions estimated under each of the alternatives. These analyses and resulting social costs of carbon include results of an alternative-specific lifecycle analysis (LCA), which is provided as Appendix H.

This EIS provides in Section 3.4 a detailed explanation of the methodology and tools used to acquire, analyze, and summarize available public information to identify the presence and location of EJ populations. These data were then used to evaluate the potential for identified EJ populations to experience amplified or disproportionate effects anticipated under each alternative and summarized in the Environmental Justice Considerations section for resource areas with anticipated effects. Conclusions of the EJ analyses are presented in Table 3.4-17.

4.1.2 Cooperating Agency Comments and Input for the Draft EIS

During the public scoping period, NPS submitted with their comments a request to be a cooperating agency on the EIS. Subsequently, TVA submitted an invitation to participate as a cooperating agency to the USEPA. TVA received a letter from USEPA on March 6, 2023, accepting TVA's invitation to participate as a cooperating agency. As such, USEPA and NPS personnel participated in preliminary reviews of the draft EIS and provided comments to TVA; those comments were reviewed and incorporated, where appropriate, and summarized along with TVA's responses in Comment Response Tables provided in Appendix P.

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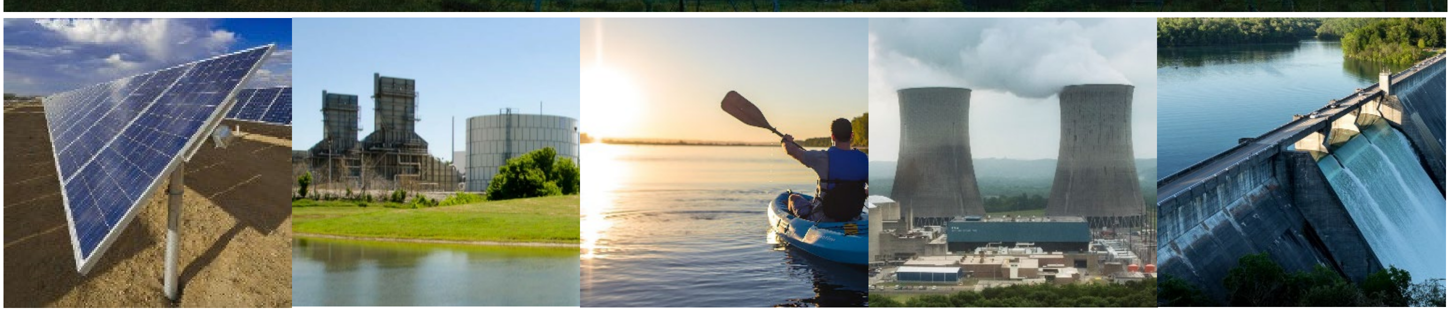
Appendix A – TVA IRP Executive Summary

2019 Integrated Resource Plan

EXECUTIVE SUMMARY



TENNESSEE VALLEY AUTHORITY

Introduction

PURPOSE AND NEED

The Tennessee Valley Authority's 2019 Integrated Resource Plan (IRP) is a long-term plan that provides direction on how TVA can best meet future demand for power. It shapes how TVA will provide low-cost, reliable and clean electricity; support environmental stewardship; and foster economic development in the Tennessee Valley for the next 20 years. The plan is a crucial element for TVA's success in a constantly changing business and regulatory environment, and it will better equip TVA to meet many of the challenges facing the electric utility industry in the coming years to benefit the Valley. The IRP will enhance TVA's ability to create a more flexible power-generation system that can successfully integrate increasing amounts of renewable energy sources and distributed energy resources (DER) while ensuring reliability. The IRP also will inform TVA's next Long-Range Financial Plan.

TVA POWER SYSTEM

As the nation's largest public power provider, TVA delivers safe, reliable, clean, competitively priced electricity to 154 local power companies and 58 directly served customers. TVA's power portfolio is dynamic and adaptable in the face of changing demands and regulations. TVA's portfolio has evolved over the past decade to a more diverse, reliable and cleaner mix of generation resources, which today provides 54 percent carbon-free power. In Fiscal Year (FY) 2018, TVA efficiently delivered more than 163 billion kilowatt-hours of electricity to customers from a power supply that was 39 percent nuclear, 26 percent natural gas, 21 percent coal-fired, 10 percent hydro, and 3 percent wind and solar. The remaining one percent results from TVA programmatic energy efficiency efforts.

SUMMARY OF IRP PROCESS AND GOALS

TVA used an integrated, least-cost framework that considered multiple views of the future to determine how potential power-generation resource portfolios could perform in different market and external conditions. We conducted the IRP process in a transparent, inclusive manner that provided numerous opportunities for public education and participation. Stakeholders and the public provided invaluable input that helped shape the IRP. The analysis performed in this IRP study relied on industry-standard models and incorporated best practices while using an innovative methodology to more fully evaluate the role of distributed energy resources as resources in our power supply. Resource cost and performance input data were independently validated. TVA's goal with the IRP was to identify an optimal energy resource plan that performs well under a variety of future conditions, taking into account cost, risk, environmental stewardship, operational flexibility and Valley economics. Per the National Environmental Policy Act (NEPA), TVA also prepared an Environmental Impact Statement (EIS) to analyze the 2019 IRP's potential impacts on the environment, economy and population in the Tennessee Valley.

2019 Integrated Resource Plan (IRP)
Executive Summary

TVA's 2019 IRP Recommendation

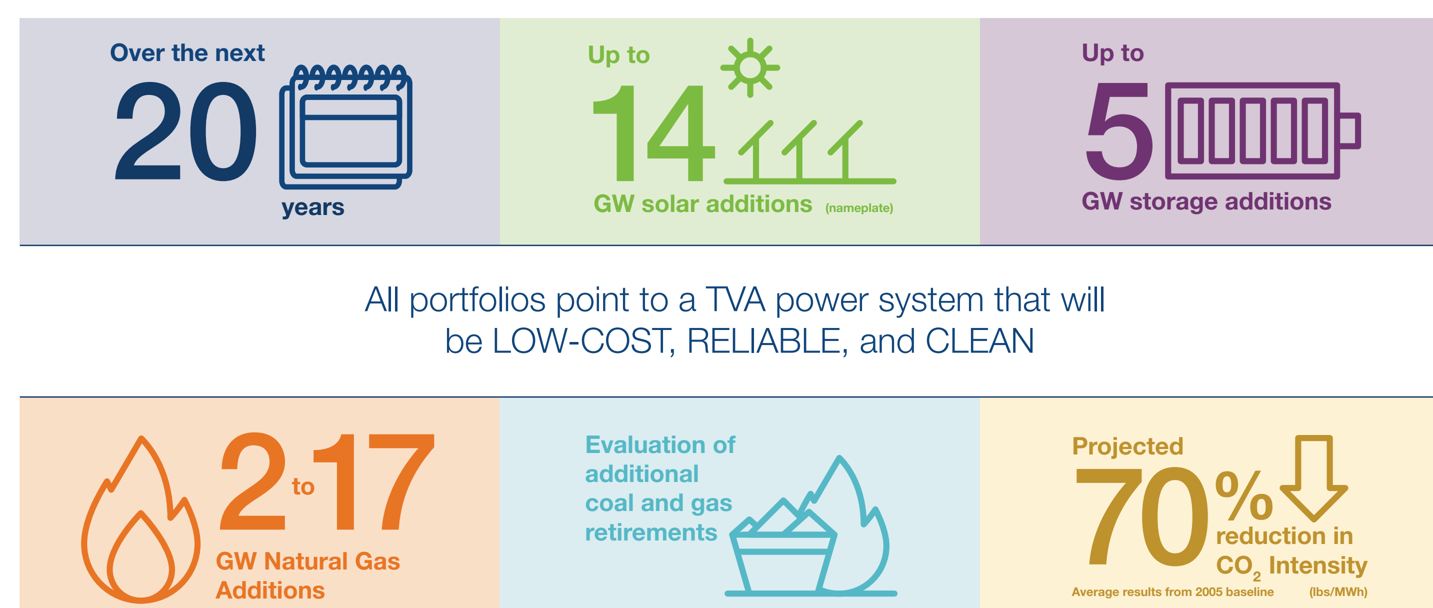
STUDY RESULTS

During the IRP process, TVA — with significant input from stakeholders and the public — considered a wide range of future scenarios, various business strategies and a diverse mix of power-generation resources to build on TVA's existing asset portfolio. IRP study results show:

- There is a need for new capacity in all scenarios to replace expiring or retiring capacity.
- Solar expansion plays a substantial role in all futures.
- Gas, storage and demand response additions provide reliability and/or flexibility.
- No baseload resources (designed to operate around the clock) are added, highlighting the need for operational flexibility in the resource portfolio.
- Additional coal retirements occur in certain futures.
- Energy efficiency (EE) levels depend on market depth and cost-competitiveness.
- Wind could play a role if it becomes cost-competitive.
- In all cases, TVA will continue to provide for economic growth in the Tennessee Valley.

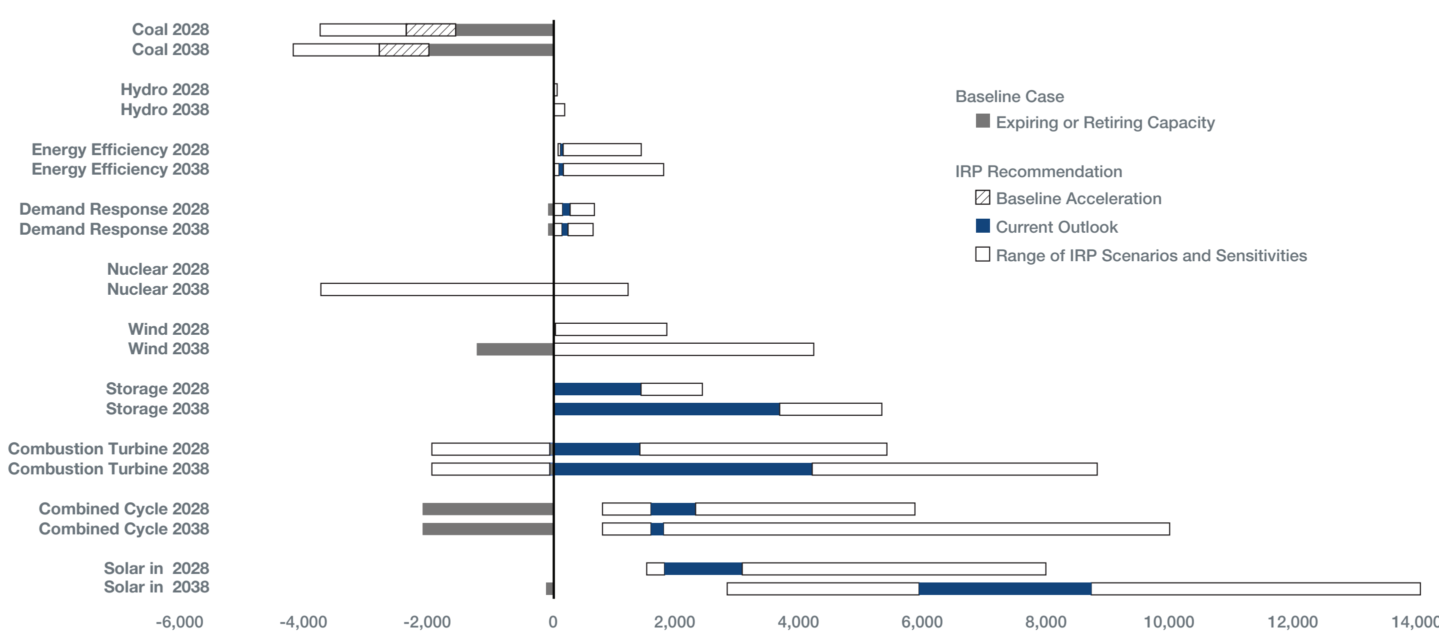
OBSERVATIONS

TVA has observed that the scenario, or future environment, it finds itself operating in will have more impact on overall results than the strategy or strategies it implements. TVA also recognizes that all strategies have positive aspects but also have unique tradeoffs to consider. If TVA needs to shift its resource mix, that need will be driven by these key variables: changing market conditions, more stringent regulations and technology advancements. Recognizing that a variety of future scenarios are possible and each strategy has positive aspects, all IRP results are included in the IRP Recommendation to provide flexibility for how the future evolves.



TVA's 2019 IRP Recommendation

Range of MW Additions and Subtractions by 2028 and 2038



Notes

- **MWs are incremental additions from 2019 forward. Board-approved coal retirements are excluded from the totals.**
- **Browns Ferry Nuclear Plant license is not extended in the No Nuclear Extensions Scenario (outside of TVA control).**
- **Upper bounds of potential natural gas and solar additions are driven by the Valley Load Growth Scenario.**
- **Solar and wind are shown in nameplate capacity; accelerated solar additions are reflected in the IRP Recommendation.**
- **Solar, gas, and storage ranges include utility-scale and distributed additions (where promoted in a strategy).**

TVA's 2019 IRP Recommendation

TVA's recommended planning direction affirms its commitment to a diverse and flexible resource portfolio guided by the least-cost system planning mandate. The ranges shown, stated in megawatts (MW) of capacity, provide a general guideline for resource selections. In developing a Recommendation from the study, TVA elected to establish guideline ranges for key resource types (owned or contracted) that make up the target power supply mix. This general planning direction is expressed over the 20-year study period while also including more specific direction over the first 10-year period. Meeting the Valley's future needs in accordance with the resource technologies and ranges in this Recommendation will position TVA to continue to deliver low-cost, reliable and clean power to the people of the Tennessee Valley.

Coal: Continue with announced plans to retire Paradise in 2020 and Bull Run in 2023. Evaluate retirements of up to 2,200 MW of additional coal capacity if cost-effective.

Hydro: All portfolios reflect continued investment in the hydro fleet to maintain capacity. Consider additional hydro capacity where feasible.

Energy Efficiency: Achieve savings of up to 1,800 MW by 2028 and up to 2,200 MW by 2038. Work with our local power company partners to expand programs for low-income residents and refine program designs and delivery mechanisms with the goal of lowering total cost.

Demand Response: Add up to 500 MW of demand response by 2038 depending on availability and cost of the resource.

Nuclear: Pursue option for second license renewal of Browns Ferry for an additional 20 years. Continue to evaluate emerging nuclear technologies, including small modular reactors, (SMR) as part of technology innovation efforts.

Wind: Existing wind contracts expire in the early 2030s. Consider the addition of up to 1,800 MW of wind by 2028 and up to 4,200 MW by 2038 if cost-effective.

Storage: Add up to 2,400 MW of storage by 2028 and up to 5,300 MW by 2038. Additions may be a combination of utility and distributed scale. The trajectory and timing of additions will be highly dependent on the evolution of storage technologies.

Gas Combustion Turbine: Evaluate retirements of up to 2,000 MW of existing combustion turbines if cost-effective. Add up to 5,200 MW of combustion turbines by 2028 and up to 8,600 MW by 2038 if a high level of load growth materializes. Future CT needs are driven by demand for electricity, solar penetration, and evolution of other peaking technologies.

Gas Combined Cycle: Add between 800 and 5,700 MW of combined cycle by 2028 and up to 9,800 MW by 2038 if a high level of load growth materializes. Future CC needs are driven by demand for electricity and gas prices, as well as by solar penetration that tends to drive CT instead of CC additions.

Solar: Add between 1,500 and 8,000 MW of solar by 2028 and up to 14,000 MW by 2038 if a high level of load growth materializes. Additions may be a combination of utility and distributed scale. Future solar needs are driven by pricing, customer demand, and demand for electricity.

The IRP Recommendation meets the dual objective of ensuring flexibility to respond to the future while providing guidance on how our resource portfolio should change as the future unfolds.

Implementation

CONSIDERATIONS

With the implementation of the IRP Recommendation will come certain challenges. For example, the IRP Recommendation includes significant renewables expansion, which means it will become increasingly important to know the location of renewable resources, both utility and distributed scale, and how weather impacts solar generation. Early experience with battery storage on the system would provide additional insight to how the various storage-use cases might be employed to provide economic benefit and system flexibility, especially with increasing penetration of renewables. TVA will need to partner with local power companies and other stakeholders in the region to better understand the potential for distributed resources in the Valley and their locational value to inform resource decisions. Finally, the IRP Recommendation also includes more conventional resources, primarily gas-fired, and TVA will need to consider the implementation challenges in the areas of siting and permitting, both for the units themselves and associated transmission lines and gas pipelines.

In the process of developing the IRP, stakeholders raised a number of policy-related issues that are outside the scope of the IRP itself but will need to be considered as TVA moves toward implementation of recommendations from the IRP study. These considerations include continued evolution of programs that provide flexibility for customer-owned generation, evolution of federal/state energy and environmental policies, advancements in customer expectations and requirements for clean energy, and enhancing low-income equity and energy/environmental justice.

NEAR-TERM ACTIONS

The scenarios and strategies evaluated in the IRP provide insights to how TVA's resource portfolio may need to evolve as the future becomes clearer. The results indicate there are near-term actions that would provide benefit across multiple futures. The actions include:

RENEWABLES & FLEXIBILITY

- Add solar based on economics and to meet customer demand.
- Enhance system flexibility to integrate renewables and distributed resources.
- Evaluate demonstration battery storage to gain operational experience.

EXISTING FLEET

- Pursue option for license renewal for TVA's nuclear fleet.
- Evaluate engineering end-of-life dates for aging fossil units to inform long-term planning.

ENERGY USAGE

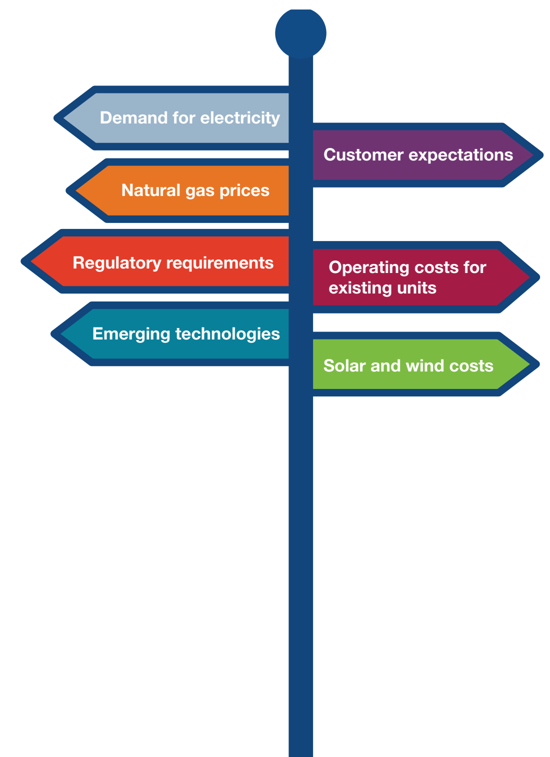
- Conduct market potential study for energy efficiency and demand response.
- Collaborate with states and local communities to address low-income energy efficiency.
- Collaboratively deploy initiatives to stimulate the local electric vehicle market.

DISTRIBUTION PLANNING

- Support development of Distribution Resource Planning for integration into TVA's planning process.

KEY SIGNPOSTS TO GUIDE DECISIONS IN THE LONGER TERM

As the future unfolds, TVA will monitor key signposts that will guide decisions in the longer term. The signposts relate to key variables that could have a significant influence on the future generation portfolio. These key signposts include:



TVA will closely monitor these key drivers related to changing market conditions, more stringent regulations, and technology advancements to inform appropriate actions within the recommended ranges and appropriate timing for initiating the next IRP.

How TVA Developed the Integrated Resource Plan: An 18-Month Process

OVERVIEW

Developing the 2019 IRP has been an approximately 18-month process that began in February 2018 and will conclude when a Record of Decision is released. The IRP process will have included the following activities:

- **Scoping,** which took place in winter/spring 2018 and identified issues important to the public and laid the foundation for developing the IRP.
- **Development of Model Input and Framework,** which occurred in spring/summer 2018 and included identifying and developing scenarios, resource options and business strategies to evaluate how a future portfolio might change under different conditions.
- **Analysis and Evaluation,** which took place in fall 2018 and included developing and evaluating the performance of the 30 resource portfolios.
- **Presentation of Initial Results,** which occurred in February 2019 with release of the draft IRP and EIS.
- **Public Comment Period,** which was held from February 15 to April 8, 2019.
- **Additional Analysis,** which was completed in response to stakeholder and public comments.
- **Completion of the Study**, which includes the IRP Recommendation, near-term actions and key signposts, and the final environmental assessment.
- **Publication of the Final IRP and EIS** on June 28, 2019, on TVA's website.
- **Expected Request for Approval** of the IRP Recommendation from the Board in August 2019.
- **Record of Decision** will be published after Board approval.

2019 Integrated Resource Plan (IRP)
Executive Summary

Developing the IRP

PLANNING APPROACH

Uncertainties and Scenarios
With input from the IRP Working Group, TVA designed scenarios that are outside of TVA's control but represent possible futures in which TVA may find itself operating. TVA created a list of uncertainties that could alter the future operating environment and affect the cost of electricity and/or mix of optimal resources. The scenarios are:

	SCENARIOS
1	**CURRENT OUTLOOK** which represents TVAs current forecast for these key uncertainties and reflects modest economic growth offset by increasing efficiencies;
2	**ECONOMIC DOWNTURN** which represents a prolonged stagnation in the economy, resulting in declining loads (customers using less power) and delayed expansion of new generation;
3	**VALLEY LOAD GROWTH** which represents economic growth driven by migration into the Valley and a technology-driven boost to productivity, underscored by increased electrification of industry and transportation;
4	**DECARBONIZATION** which is driven by a strong push to curb greenhouse gas emissions due to concern over climate change, resulting in high CO_2 emission penalties and incentives for non-emitting technologies;
5	**RAPID DER ADOPTION** which is driven by growing consumer awareness and preference for energy choice, coupled with rapid advances in technologies, resulting in high penetration of distributed generation, storage and energy management;
6	**NO NUCLEAR EXTENSIONS** which is driven by a regulatory challenge to relicense existing nuclear plants and construct new, large-scale nuclear. This scenario also assumes subsidies to drive small modular reactor (SMR) technology advancements and improved economics.

Strategies
With input from the IRP Working Group, TVA developed five strategies, which are business decisions or directions that TVA could employ in each scenario. As it relates to strategies in the IRP, the word "promote" means an incentive was modeled to make the resource more attractive for adoption or selection. The five strategies are:

	STRATEGIES
A	**BASE CASE** which represents TVAs current assumptions for resource costs and applies a planning reserve margin constraint. This constraint applies in every strategy and represents the minimum amount of capacity required to ensure reliable power;
B	**PROMOTE DISTRIBUTED ENERGY RESOURCES** which incents DER to achieve higher, long-term penetration levels. The DER options include energy efficiency, demand response, combined heat and power, distributed solar and storage;
C	**PROMOTE RESILIENCY** which incents small, agile capacity to maximize operational flexibility and the ability to respond to short-term disruptions on the power system;
D	**PROMOTE EFFICIENT LOAD SHAPE** which incents targeted electrification (by incentivizing customers to increase electricity usage in off-peak hours) and demand response (by incentivizing customers to reduce electricity usage during peak hours). This strategy promotes efficient energy usage for all customers, including those with low income;
E	**PROMOTE RENEWABLES** which incents renewables at all scales (from utility size to residential) to meet growing or existing consumer demand for renewable energy.

MODELING ASSUMPTIONS AND CANDIDATE TECHNOLOGIES

TVA uses an industry standard model to derive an optimal capacity plan, considering the focus of each strategy evaluated in each scenario. Modeling assumptions, the framework of IRP planning, are the constraints and planning guidelines that are put into the model. The reliability constraint is especially critical, as it ensures we have enough capacity at all times to provide reliable electricity to customers. For the 2019 IRP, it also is crucial to understand how the system would operate with more renewables and DER on the system – driving a greater need for operational flexibility. TVA considered a broader range of mature and emerging technologies in this IRP, including some distributed energy technologies.

STAKEHOLDER & PUBLIC INVOLVEMENT

Throughout the IRP process, TVA engaged external stakeholders to understand diverse opinions and to challenge assumptions. TVA established the IRP Working Group, whose 20 members represent diverse interests in the Valley. The IRP Working Group met approximately monthly to review input assumptions and preliminary results and to enable its members to provide their respective views to TVA. TVA also presented IRP progress updates to the Regional Energy Resource Council (RERC), a federal advisory committee that provides advice to the TVA Board of Directors on a range of energy-related matters, including the IRP.

During a 60-day scoping period from February 15 through April 16, 2018, TVA obtained public comments on the scope of the effort to develop this IRP, which helped shape the draft IRP and EIS. After the release of the draft IRP and EIS on February 15, 2019, TVA provided a public comment period through April 8, 2019. TVA held meetings across the Tennessee Valley and an online webinar, and accepted public comments via mail, email, online and in-person at the meetings. Input was critical in shaping the IRP and EIS, and many of the sensitivity analyses that were performed were informed by stakeholder and public input.

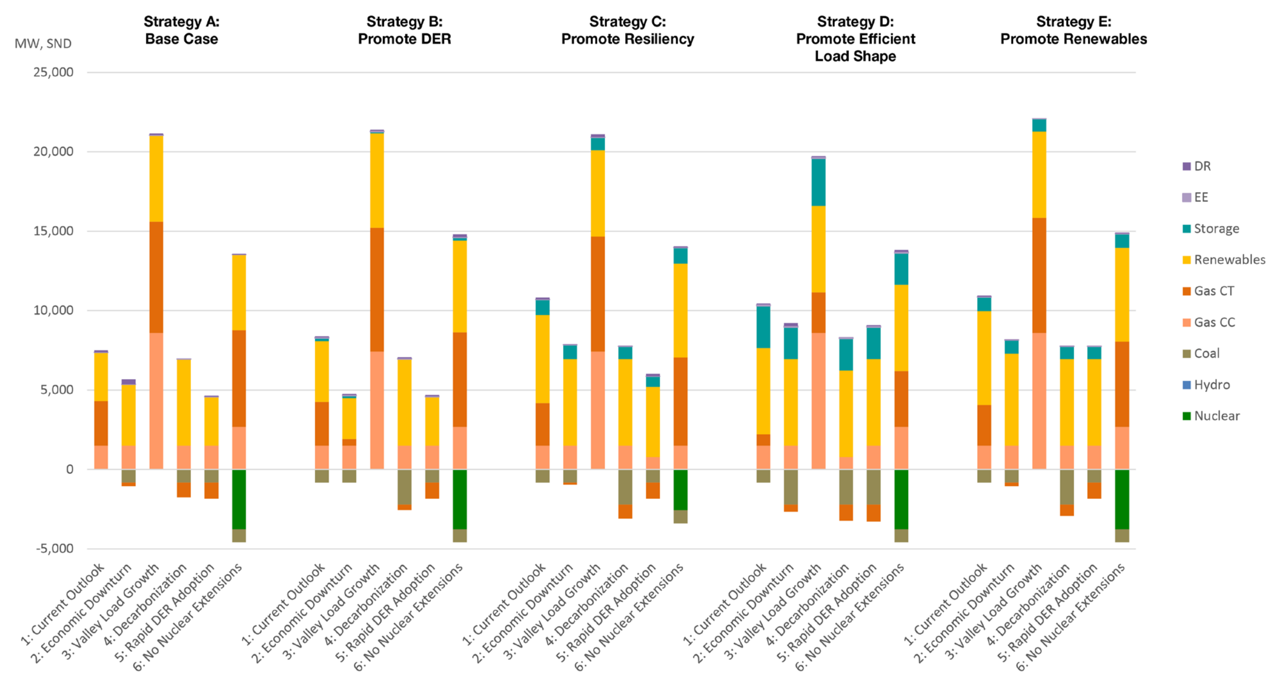
The IRP Working Group included representatives from:

- State and local governments
- Academia and research groups
- Advocacy groups
- Local power companies (LPCs)
- Economic development organizations
- Directly-served/ industrial customers

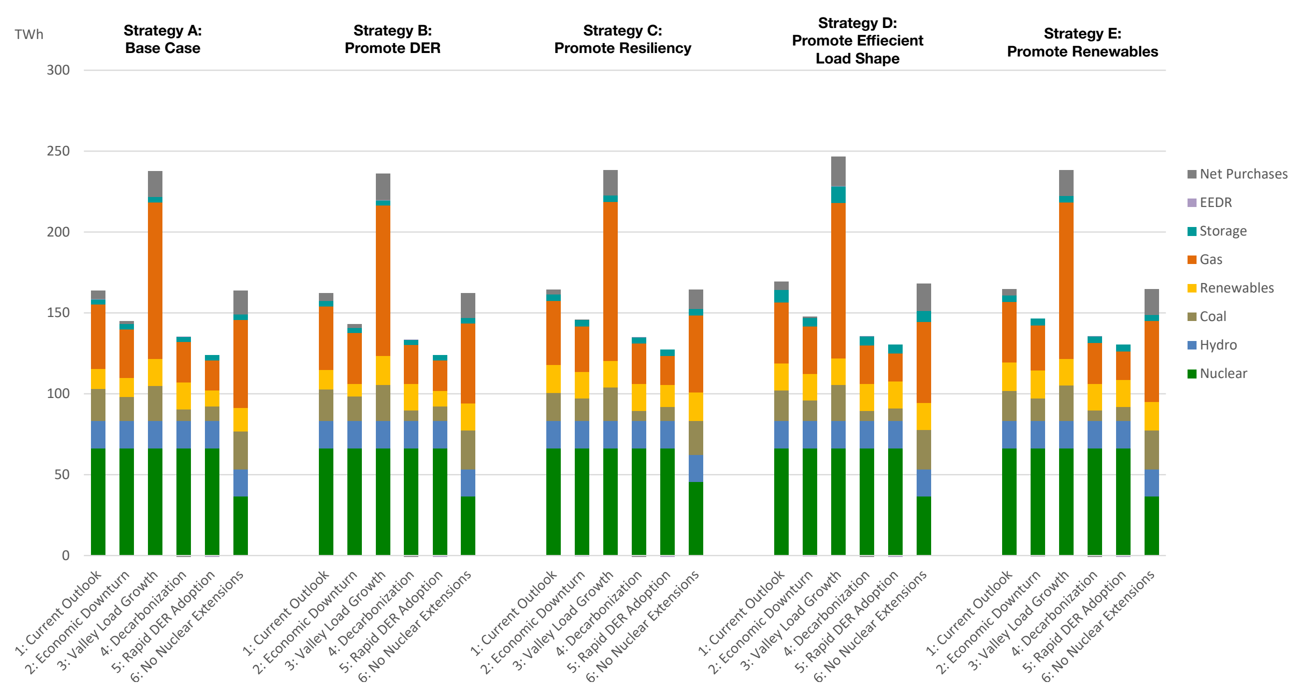
Developing the IRP

EVALUATING THE PORTFOLIOS

Incremental capacity by 2038 consists of additions of new energy resources and retirement of existing energy resources for the portfolios associated with each strategy.



Total Energy in 2038 by resource type in the portfolios associated with each strategy.



2019 Integrated Resource Plan (IRP)
Executive Summary

EVALUATING THE PORTFOLIOS

Each IRP case represents a combination of expectations about the future environment TVA operates in and potential strategies TVA could employ that result in unique resource portfolios. The modeling process resulted in 30 resource portfolios. The model analyzed how to achieve the lowest-cost portfolio with each strategy in each scenario, looking for the optimal solution within that particular combination. With input from the IRP Working Group and RERC, TVA identified 14 metrics that reflect desired goals and priorities in areas related to cost, risk, environmental stewardship, operational flexibility and Valley economics. The metrics were used to evaluate tradeoffs among the 30 resource portfolios.

Strategy Performance

	COST	RISK	ENVIRONMENTAL STEWARDSHIP		OPERATIONAL FLEXIBILITY	VALLEY ECONOMICS
			CO_2, Water, Waste	Land Use		
STRATEGY A: BASE CASE						All strategies have similar impacts on the Valley economy as measured by per capita income and employment
STRATEGY B: PROMOTE DER						
STRATEGY C: PROMOTE RESILIENCY						
STRATEGY D: PROMOTE EFFICIENT LOAD SHAPE						
STRATEGY E: PROMOTE RENEWABLES						

Good Better Best

Developing the IRP

SENSITIVITY ANALYSIS

When analyzing results from the draft IRP, TVA identified issues that warranted further evaluation prior to finalizing the study. In addition, TVA received helpful input from the IRP Working Group and the RERC, as well as from the public during the comment period. Many of the questions raised by TVA, stakeholders and the public focused on certain key assumptions that could influence results. To explore the impacts of changes in key assumptions and to inform the Recommendation, TVA evaluated sensitivities related to the following categories: natural gas prices; storage, wind, combined heat and power (CHP) and small modular reactor (SMR) capital costs; greater energy efficiency (EE) and demand response (DR) market depth; integration cost and flexibility benefit; pace and magnitude of solar additions; higher operating costs for coal plants; more stringent carbon constraints; and variation in climate.

Summary of 2019 IRP Sensitivities

SENSITIVITY CASE Base Case comparison is the Current Outlook unless otherwise noted	CAPACITY EXPANSION IMPACTS BY 2038 GREEN indicates increase and RED indicated decrease in resource					
	NUCLEAR	COAL	GAS	HYDRO	SOLAR	WIND	EEDR
Higher Natural Gas Prices				+55 MW	+2,050 MW		
Lower Natural Gas Prices			2,000 MW CT replaced by CC		-5,900 MW		
Lower Wind Costs			-1,100 MW		-3,100 MW	+4,200 MW	
Greater EE & DR Market Depth			-2,000 MW		-2,200 MW		+2,100 MW
Integration Cost & Flexibility Benefit			Minor timing differences		Minor timing differences		
Pace & Magnitude of Solar Additions					+1,100 MW		
Magnitude of Solar Additions (Valley Load Growth)			1,000 MW CC replaced by CT		+6,000 MW		
Higher Operating Costs for Coal Plants		-2,200 MW	+1,500 MW				
More Stringent Carbon Constraints (Decarbonization)		-2,000 MW accelerated	CC expansion accelerated	+175 MW			
Variation in Climate	Summer derates	Summer derates	CT expansion accelerated		+2,100 MW		

Note

- **Impacts shown in Summer Net Dependable MW, except for solar and wind that are shown in nameplate MW**

FORMING THE IRP RECOMMENDATION

The IRP results — including the 30 primary cases and the sensitivity cases — provide a robust set of potential resource additions and retirements. The final Recommendation is derived from this evaluation. The Recommendation takes into account customer priorities around power cost and reliability across different futures, along with environmental stewardship and Valley economics considerations. In developing a recommendation from the study, TVA elected to establish guideline ranges for key resource types (owned or contracted) that make up the target power supply mix. In order to distill the considerable number of cases evaluated through the original scenario and strategy analysis and the sensitivity cases, the Recommendation uses ranges that are centered on results obtained under the Current Outlook scenario. The other scenario and sensitivity results provide a sense of how the target power supply mix might change as the future changes. Recognizing that a variety of future scenarios are possible and each strategy has positive aspects, all IRP results are included in the Recommendation to provide flexibility for how the future evolves. Implementing the least-cost resource plan with all of these priorities in mind will help ensure TVA continues to fulfill its mission to serve the people of the Tennessee Valley.

The IRP and the Tennessee Valley Environment

PURPOSE OF THE EIS

TVA's EIS assesses the natural, cultural and socioeconomic impacts associated with the 2019 IRP. The five strategies are the basis for the alternatives discussed in the EIS. The Base Case serves as the No-Action Alternative, and the remaining four strategies are the Action Alternatives. The draft EIS analyzed and identified the relationship of the natural and human environment to each of the five alternative strategies. The final EIS includes an additional alternative, the 2019 Recommendation (Target Power Supply Mix). The portfolios associated with each of the five alternative strategies, as well as the 2019 Recommendation, are quantitatively and qualitatively evaluated to determine the environmental impact. This evaluation addresses systemwide topics, including

- Greenhouse gas emissions
- Fuel consumption
- Air quality
- Water quality and quantity
- Waste generation and disposal
- Land requirements
- Socioeconomic impacts
- Environmental justice.

Public comments on the draft EIS and draft IRP are addressed in the final EIS.

The primary study area described in the EIS includes the combined TVA service area; the Tennessee River watershed; and parts of the Cumberland, Mississippi, Green and Ohio Rivers in TVA's power service area. For some resources, such as air quality and climate change, the assessment area extends beyond the TVA region. For some socioeconomic resources, the study area consists of the 170 counties where TVA is a major provider of electric power and/or operates generating facilities.

The IRP and the Tennessee Valley Environment

ENVIRONMENTAL IMPACTS OF THE 2019 IRP

Under all the portfolios and the 2019 Recommendation, there is a need for new capacity, with a significant expansion of solar generation overall. Uncertainty around future environmental standards for carbon dioxide emissions, along with the outlook for loads and gas prices, are key considerations when evaluating potential coal retirements. Emissions of air pollutants, the intensity of greenhouse gas emissions (CO_2 intensity) and generation of coal waste decrease under all strategies. Strategies focused on resiliency, load shape and renewables have the largest amounts of solar and storage expansion and coal retirements, resulting in lower environmental impact overall but higher land use. For most environmental resources, the impacts are greatest for the No Action alternative. The exception is the land area required for new generating facilities, which is greater for the action alternatives, particularly strategies which focus on resiliency, load shape and renewables. Most of this land area would be occupied by solar facilities, which, compared to most other energy resources, have a relatively low level of impact to the land. Additional sensitivity analysis showed the potential for an extended range of resource additions and retirements, which generally resulted in reduced impacts to most environmental resources. The land area occupied by solar facilities, however, could greatly increase.

Conclusion

TVA finds considerable value in undertaking an IRP and EIS, and especially appreciates the input, review and insights of individuals on the IRP Working Group and the Regional Energy Resource Council. They spent considerable time helping TVA develop a robust plan that meets all the criteria outlined in its objectives. TVA values their involvement and the expertise they provided on behalf of their respective stakeholders in making this a better IRP.

As with any long-term plan, TVA's IRP reflects what we know today and can reasonably expect for the coming years. TVA and our employees across the Valley stand ready every day to carry out our three-part mission around energy, the environment and economic development. In an ever-changing world, TVA will do its best to continue to serve the people of the Tennessee Valley by providing low-cost, reliable and clean power in an environmentally responsible manner while promoting economic development across the Valley.

TVA

Appendix B – Bat Strategy Form

Project Review Form - TVA Bat Strategy *(06/2019)*

*This form should **only** be completed if project includes activities in Tables 2 or 3 (STEP 2 below). This form is not required if project activities are limited to Table 1 (STEP 2) or otherwise determined to have no effect on federally listed bats. If so, include the following statement in your environmental compliance document (e.g., add as a comment in the project CEC): "Project activities limited to Bat Strategy Table 1 or otherwise determined to have no effect on federally listed bats. Bat Strategy Project Review Form NOT required." This form is to assist in determining required conservation measures per TVA's ESA Section 7 programmatic consultation for routine actions and federally listed bats.*[1]

Project Name: Kingston Retirement Environmental Impact Statement (EIS) **Date:** 5/10/2023

Contact(s): Chevy Williams/Emily Willard **CEC#:** **Project ID:** ESCS39170

Project Location (City, County, State): Roane County, Tennessee

Project Description:

Retirement and Decommissioning, Deconstruction, and Demolition of KIF, and proposed replacement generation of a CC gas plant with a solar facility at the KIF location.

SECTION 1: PROJECT INFORMATION - ACTION AND ACTIVITIES

STEP 1) Select TVA Action. If none are applicable, contact environmental support staff, Environmental Project Lead, or Terrestrial Zoologist to discuss whether form (i.e., application of Bat Programmatic Consultation) is appropriate for project:

- ☐ 1 Manage Biological Resources for Biodiversity and Public Use on TVA Reservoir Lands
- ☐ 2 Protect Cultural Resources on TVA-Retained Land
- ☐ 3 Manage Land Use and Disposal of TVA-Retained Land
- ☐ 4 Manage Permitting under Section 26a of the TVA Act
- ☒ 5 Operate, Maintain, Retire, Expand, Construct Power Plants
- ☐ 6 Maintain Existing Electric Transmission Assets
- ☐ 7 Convey Property associated with Electric Transmission
- ☐ 8 Expand or Construct New Electric Transmission Assets
- ☐ 9 Promote Economic Development
- ☐ 10 Promote Mid-Scale Solar Generation

STEP 2) Select all activities from Tables 1, 2, and 3 below that are included in the proposed project.

TABLE 1. Activities with no effect to bats. Conservation measures & completion of bat strategy project review form NOT required.		
☐ 1. Loans and/or grant awards	☐ 8. Sale of TVA property	☐ 19. Site-specific enhancements in streams and reservoirs for aquatic animals
☐ 2. Purchase of property	☐ 9. Lease of TVA property	☐ 20. Nesting platforms
☐ 3. Purchase of equipment for industrial facilities	☐ 10. Deed modification associated with TVA rights or TVA property	☐ 41. Minor water-based structures (this does not include boat docks, boat slips or piers)
☐ 4. Environmental education	☐ 11. Abandonment of TVA retained rights	☐ 42. Internal renovation or internal expansion of an existing facility
☐ 5. Transfer of ROW easement and/or ROW equipment	☐ 12. Sufferance agreement	☒ 43. Replacement or removal of TL poles
☐ 6. Property and/or equipment transfer	☐ 13. Engineering or environmental planning or studies	☐ 44. Conductor and overhead ground wire installation and replacement
☐ 7. Easement on TVA property	☐ 14. Harbor limits delineation	☐ 49. Non-navigable houseboats

TABLE 2. Activities not likely to adversely affect bats with implementation of conservation measures. Conservation measures and completion of bat strategy project review form REQUIRED; review of bat records in proximity to project NOT required.		
☒ 18. Erosion control, minor	☐ 57. Water intake - non-industrial	☐ 79. Swimming pools/associated equipment
☐ 24. Tree planting	☐ 58. Wastewater outfalls	☐ 81. Water intakes – industrial
☐ 30. Dredging and excavation; recessed harbor areas	☐ 59. Marine fueling facilities	☒ 84. On-site/off-site public utility relocation or construction or extension
☐ 39. Berm development	☐ 60. Commercial water-use facilities (e.g., marinas)	☐ 85. Playground equipment - land-based
☐ 40. Closed loop heat exchangers (heat pumps)	☐ 61. Septic fields	☐ 87. Aboveground storage tanks
☐ 45. Stream monitoring equipment - placement and use	☐ 66. Private, residential docks, piers, boathouses	☐ 88. Underground storage tanks
☐ 46. Floating boat slips within approved harbor limits	☒ 67. Siting of temporary office trailers	☐ 90. Pond closure
☒ 48. Laydown areas	☐ 68. Financing for speculative building construction	☐ 93. Standard License
☐ 50. Minor land based structures	☐ 72. Ferry landings/service operations	☐ 94. Special Use License
☐ 51. Signage installation	☐ 74. Recreational vehicle campsites	☐ 95. Recreation License
☐ 53. Mooring buoys or posts	☒ 75. Utility lines/light poles	☐ 96. Land Use Permit
☐ 56. Culverts	☐ 76. Concrete sidewalks	

Table 3: Activities that may adversely affect federally listed bats. Conservation measures AND completion of bat strategy project review form REQUIRED; review of bat records in proximity of project REQUIRED by OSAR/Heritage eMap reviewer or Terrestrial Zoologist.		
☐ 15. Windshield and ground surveys for archaeological resources	☒ 34. Mechanical vegetation removal, includes trees or tree branches > 3 inches in diameter	☐ 69. Renovation of existing structures
☐ 16. Drilling	☐ 35. Stabilization (major erosion control)	☐ 70. Lock maintenance/ construction
☒ 17. Mechanical vegetation removal, does not include trees or branches > 3” in diameter (in Table 3 due to potential for woody burn piles)	☒ 36. Grading	☐ 71. Concrete dam modification
☒ 21. Herbicide use	☐ 37. Installation of soil improvements	☐ 73. Boat launching ramps
☐ 22. Grubbing	☐ 38. Drain installations for ponds	☒ 77. Construction or expansion of land-based buildings
☐ 23. Prescribed burns	☐ 47. Conduit installation	☐ 78. Wastewater treatment plants
☐ 25. Maintenance, improvement or construction of pedestrian or vehicular access corridors	☐ 52. Floating buildings	☐ 80. Barge fleeting areas
☐ 26. Maintenance/construction of access control measures	☐ 54. Maintenance of water control structures (dewatering units, spillways, levees)	☐ 82. Construction of dam/weirs/ levees
☒ 27. Restoration of sites following human use and abuse	☐ 55. Solar panels	☐ 83. Submarine pipeline, directional boring operations
☒ 28. Removal of debris (e.g., dump sites, hazardous material, unauthorized structures)	☒ 62. Blasting	☐ 86. Landfill construction
☐ 29. Acquisition and use of fill/borrow material	☒ 63. Foundation installation for transmission support	☒ 89. Structure demolition
☒ 31. Stream/wetland crossings	☒ 64. Installation of steel structure, overhead bus, equipment, etc.	☐ 91. Bridge replacement
☐ 32. Clean-up following storm damage	☒ 65. Pole and/or tower installation and/or extension	☐ 92. Return of archaeological remains to former burial sites
☐ 33. Removal of hazardous trees/tree branches		

STEP 3) Project includes one or more activities in Table 3? ◉ **YES (Go to Step 4)** ○ **NO (Go to Step 13)**

STEP 4) Answer questions *a* through *e* below (applies to projects with activities from Table 3 ONLY)

a) Will project involve continuous noise (i.e., ≥ 24 hrs) that is greater than 75 decibels measured on the A scale (e.g., loud machinery)?

(•) **NO** (NV2 does not apply)
( ) **YES** (NV2 applies, subject to records review)

b) Will project involve entry into/survey of cave?

(•) **NO** (HP1/HP2 do not apply)
( ) **YES** (HP1/HP2 applies, subject to review of bat records)

c) If conducting **prescribed burning** (**activity 23)**, estimated acreage**:** [ ] and timeframe(s) below; ■ **N/A**

STATE	SWARMING	WINTER	NON-WINTER	PUP
GA, KY, TN	☐ Oct 15 - Nov 14	☐ Nov 15 - Mar 31	☐ Apr 1 - May 31, Aug 1- Oct 14	☐ Jun 1 - Jul 31
VA	☐ Sep 16 - Nov 15	☐ Nov 16 - Apr 14	☐ Apr 15 - May 31, Aug 1 – Sept 15	☐ Jun 1 - Jul 31
AL	☐ Oct 15 - Nov 14	☐ Nov 15 - Mar 15	☐ Mar 16 - May 31, Aug 1 - Oct 14	☐ Jun 1 - Jul 31
NC	☐ Oct 15 - Nov 14	☐ Nov 15 - Apr 15	☐ Apr 16 - May 31, Aug 1 - Oct 14	☐ Jun 1 - Jul 31
MS	☐ Oct 1 - Nov 14	☐ Nov 15 - Apr 14	☐ Apr 15 - May 31, Aug 1 – Sept 30	☐ Jun 1 - Jul 31

d) Will the project involve vegetation piling/burning?

(•) **NO** (SSPC4/ SHF7/SHF8 do not apply)
( ) **YES** (SSPC4/SHF7/SHF8 applies, subject to review of bat records)

e) If **tree removal (activity 33 or 34)**, estimated amount: 113.1 (•) **ac** ( ) **trees** ( ) **N/A**

STATE	SWARMING	WINTER	NON-WINTER	PUP
GA, KY, TN	☐ Oct 15 - Nov 14	■ Nov 15 - Mar 31	■ Apr 1 - May 31, Aug 1- Oct 14	☐ Jun 1 - Jul 31
VA	☐ Sep 16 - Nov 15	☐ Nov 16 - Apr 14	☐ Apr 15 - May 31, Aug 1 – Sept 15	☐ Jun 1 - Jul 31
AL	☐ Oct 15 - Nov 14	☐ Nov 15 - Mar 15	☐ Mar 16 - May 31, Aug 1 - Oct 14	☐ Jun 1 - Jul 31
NC	☐ Oct 15 - Nov 14	☐ Nov 15 - Apr 15	☐ Apr 16 - May 31, Aug 1 - Oct 14	☐ Jun 1 - Jul 31
MS	☐ Oct 1 - Nov 14	☐ Nov 15 - Apr 14	☐ Apr 15 - May 31, Aug 1 – Sept 30	☐ Jun 1 - Jul 31

If warranted, does project have flexibility for bat surveys (May 15-Aug 15): ( ) **MAYBE** (•) **YES** ( ) **NO**

**** For **PROJECT LEADS** whose projects will be reviewed by a Heritage Reviewer (Natural Resources Organization only), **STOP HERE**. Click File/ Save As, name form as "ProjectLead_BatForm_CEC-or-ProjectIDNo_Date", and submit with project information. Otherwise continue to Step 5. ****

SECTION 2: REVIEW OF BAT RECORDS (applies to projects with activities from Table 3 ONLY)

STEP 5) Review of bat/cave records conducted by Heritage/OSAR reviewer?

( ) **YES** (•) **NO** (Go to Step 13)

Info below completed by:

☐ **Heritage Reviewer**	(name)		Date	
☐ **OSAR Reviewer**	(name)		Date	
■ **Terrestrial Zoologist**	(name)	Elizabeth Hamrick	Date	May 11, 2023

Gray bat records: ☐ None ☒ Within 3 miles* ☒ Within a cave* ☒ Within the County

Indiana bat records: ☐ None ☒ Within 10 miles* ☐ Within a cave* ☒ Capture/roost tree* ☒ Within the County

Northern long-eared bat records: ☐ None ☒ Within 5 miles* ☒ Within a cave* ☒ Capture/roost tree* ☒ Within the County

Virginia big-eared bat records: ☒ None ☐ Within 6 miles* ☐ Within the County

Caves: ☐ None within 3 mi ☐ Within 3 miles but > 0.5 mi ☒ Within 0.5 mi but > 0.25 mi* ☐ Within 0.25 mi but > 200 feet* ☐ Within 200 feet*

Bat Habitat Inspection Sheet completed? (•) **NO** ( ) **YES**

Amount of SUITABLE habitat to be removed/burned (may differ from STEP 4e): [ ] ((•) **ac** ( ) **trees)*** ( ) **N/A**

STEP 6) Provide any additional notes resulting from Heritage Reviewer records review in Notes box below then . . . . Go to Step 13

Notes from Bat Records Review (e.g., historic record; bats not on landscape during action; DOT bridge survey with negative results):

Bat Mist-Net Surveys to be performed will determine remaining records review. Scope finalization will determine amount of suitable habitat to be removed. THIS FORM IS NOT YET FINAL.

STEPS 7-12 To be Completed by Terrestrial Zoologist (if warranted):

STEP 7) Project will involve:

- ☐ Removal of suitable trees within 0.5 mile of P1-P2 Indiana bat hibernacula or 0.25 mile of P3-P4 Indiana bat hibernacula or any NLEB hibernacula.
- ☐ Removal of suitable trees within 10 miles of documented Indiana bat (or within 5 miles of NLEB) hibernacula.
- ☐ Removal of suitable trees > 10 miles from documented Indiana bat (> 5 miles from NLEB) hibernacula.
- ☐ Removal of trees within 150 feet of a documented Indiana bat or northern long-eared bat maternity roost tree.
- ☐ Removal of suitable trees within 2.5 miles of Indiana bat roost trees or within 5 miles of Indiana bat capture sites.
- ☐ Removal of suitable trees > 2.5 miles from Indiana bat roost trees or > 5 miles from Indiana bat capture sites.
- ☐ Removal of documented Indiana bat or NLEB roost tree, if still suitable.
- ☐ N/A

STEP 8) Presence/absence surveys were/will be conducted: ◉ **YES** ○ **NO** ○ **TBD**

STEP 9) Presence/absence survey results, on ☐ ○ **NEGATIVE** ○ **POSITIVE** ○ **N/A**

STEP 10) Project ○ **WILL** ○ **WILL NOT** require use of Incidental Take in the amount of ☐ ○ **acres or** ○ **trees** proposed to be used during the ○ **WINTER** ○ **VOLANT SEASON** ○ **NON-VOLANT SEASON** ○ **N/A**

STEP 11) Available Incidental Take (prior to accounting for this project) as of ☐

TVA Action	Total 20-year	Winter	Volant Season	Non-Volant Season
5 Operate, Maintain, Retire, Expand, Construct Power Plants				

STEP 12) Amount contributed to TVA's Bat Conservation Fund upon activity completion: $ ☐ OR ○ **N/A**

TERRESTRIAL ZOOLOGISTS, after completing SECTION 2, review Table 4, modify as needed, and then complete section for Terrestrial Zoologists at end of form.

SECTION 3: REQUIRED CONSERVATION MEASURES

STEP 13) Review Conservation Measures in Table 4 and ensure those selected are relevant to the project. If not, manually override and uncheck irrelevant measures, and explain why in ADDITIONAL NOTES below Table 4.

Did review of Table 4 result in ANY remaining Conservation Measures in **RED**?

○ **NO** (Go to Step 14)

◉ **YES** (STOP HERE; Submit for Terrestrial Zoology Review. Click File/Save As, name form as "ProjectLead_BatForm_CEC-or-ProjectIDNo_Date", and submit with project information).

Table 4. TVA's ESA Section 7 Programmatic Bat Consultation Required Conservation Measures

The Conservation Measures in Table 4 are automatically selected based on your choices in Tables 2 and 3 but can be manually overridden, if necessary. To Manually override, press the button and enter your name.

Manual Override

Name: Elizabeth Hamrick

Check if Applies to Project	Activities Subject To Conservation Measure	Conservation Measure Description
▣	15, 16, 17, 18, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 45, 47, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 90, 91, 92, 93, 94, 95, 96	**NV1** - Noise will be short-term, transient, and not significantly different from urban interface or natural events (i.e., thunderstorms) that bats are frequently exposed to when present on the landscape.
▣	33, 34	**TR1*** - Removal of potentially suitable summer roosting habitat during time of potential occupancy has been quantified and minimized programmatically. TVA will track and document alignment of activities that include tree removal (i.e., hazard trees, mechanical vegetation removal) with the programmatic quantitative cumulative estimate of seasonal removal of potential summer roost trees for Indiana bat and northern long-eared bat. Project will therefore communicate completion of tree removal to appropriate TVA staff.
▣	33, 34	**TR3*** - Removal of suitable summer roosting habitat within documented bat habitat (i.e., within 10 miles of documented Indiana bat hibernacula, within 5 miles of documented northern long-eared bat hibernacula, within 2.5 miles of documented Indiana bat summer roost trees, within 5 miles of Indiana bat capture sites, within 1 mile of documented northern long-eared bat summer roost trees, within 3 miles of northern long-eared bat capture sites) will be tracked, documented, and included in annual reporting. Project will therefore communicate completion of tree removal to appropriate TVA staff.
▣	33, 34	**TR4*** - Removal of suitable summer roosting habitat within potential habitat for Indiana bat or northern long-eared bat will be tracked, documented, and included in annual reporting. Project will therefore communicate completion of tree removal to appropriate TVA staff.
▣	33, 34	**TR5** - Removal of any trees **within 150 feet of a documented Indiana bat or northern long-eared bat maternity summer roost tree** during non-winter season, range- wide pup season or swarming season (if site is within known swarming habitat), will first require a site-specific review and assessment. If pups are present in trees to be removed (determined either by mist netting and assessment of adult females, or by visual assessment of trees following evening emergence counts), TVA will coordinate with the USFWS to determine how to minimize impacts to pups to the extent possible. May include establishment of artificial roosts before removal of roost tree(s).
▣	33, 34	**TR6** - Removal of a documented Indiana bat or northern long-eared bat roost tree that is still suitable and that needs to occur during non-winter season, range-wide pup season, or swarming season (if site is within known swarming habitat) will first require a site-specific review and assessment. If pups are present in trees to be removed (determined either by mist netting and assessment of adult females, or by visual assessment of trees following evening emergence counts), TVA will coordinate with USFWS to determine how to minimize impacts to pups to the extent possible. This may include establishment of artificial roosts before removal of roost tree(s).
▣	33, 34	**TR7** (**Existing Transmission ROW only**) - **Tree removal within 100 feet of existing transmission ROWs will be limited to hazard trees**. On or adjacent to TLs, a hazard tree is a tree that is tall enough to fall within an unsafe distance of TLs under maximum sag and blowout conditions and/or are also dead, diseased, dying, and/or leaning. Hazard tree removal includes removal of trees that 1) currently are tall enough to threaten the integrity of operation and maintenance of a TL or 2) have the ability in the future to threaten the integrity of operation and maintenance of a TL.
▣	33, 34	**TR8** (**TVA Reservoir Land only**) - Requests for removal of hazard trees on or adjacent to TVA reservoir land will be inspected by staff knowledgeable in identifying hazard trees per International Society of Arboriculture and TVA's checklist for hazard trees. Approval will be limited to trees with a defined target.

■	33, 34	**TR9** - If removal of suitable summer roosting habitat occurs when bats are present on the landscape, a funding contribution (based on amount of habitat removed) towards future conservation and recovery efforts for federally listed bats would be carried out. Project can consider seasonal bat presence/absence surveys (mist netting or emergence counts) that allow for positive detections without resulting in increased constraints in cost and project schedule. This will enable TVA to contribute to increased knowledge of bat presence on the landscape while carrying out TVA's broad mission and responsibilities.
■	69, 77, 89, 91	**AR1** - Projects that involve structural modification or demolition of buildings, bridges, and potentially suitable box culverts, will require assessment to determine if structure has characteristics that make it a potentially suitable unconventional bat roost. If so a survey to determine if bats may be present will be conducted. Structural assessment will include: o Visual check that includes an exhaustive internal/external inspection of building to look for evidence of bats (e.g., bat droppings, roost entrance/exit holes); this can be done at any time of year, preferably when bats are active. o Where accessible and health and safety considerations allow, a survey of roof space for evidence of bats (e.g., droppings, scratch marks, staining, sightings), noting relevant characteristics of internal features that provide potential access points and roosting opportunities. Suitable characteristic may include: gaps between tiles and roof lining, access points via eaves, gaps between timbers or around mortise joints, gaps around top and gable end walls, gaps within roof walling or around tops of chimney breasts, and clean ridge beams. o Features with high-medium likelihood of harboring bats but cannot be checked visually include soffits, cavity walls, space between roof covering and roof lining. o Applies to box culverts that are at least 5 feet (1.5 meters) tall and with one or more of the following characteristics. Suitable culverts for bat day roosts have the following characteristics: • Location in relatively warm areas • Between 5-10 feet (1.5-3 meters) tall and 300 ft (100 m) or more long • Openings protected from high winds • Not susceptible to flooding • Inner areas relatively dark with roughened walls or ceilings • Crevices, imperfections, or swallow nests o Bridge survey protocols will be adapted from the Programmatic Biological Opinion for the Federal Highway Administration (Appendix D of USFWS 2016c, which includes a Bridge Structure Assessment Guidance and a Bridge Structure Assessment Form). o Bat surveys usually are NOT needed in the following circumstances: • Domestic garages /sheds with no enclosed roof space (with no ceiling) • Modern flat-roofed buildings • Metal framed and roofed buildings • Buildings where roof space is regularly used (e.g., attic space converted to living space, living space open to rafters) or where all roof space is lit from skylights or windows. Large/tall roof spaces may be dark enough at apex to provide roost space
■	69, 77, 89, 91	**AR2** - Additional bat P/A surveys (e.g., emergence counts) conducted if warranted (i.e., when AR1 indicates that bats may be present).

■	16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, 39, 48, 50, 51, 56, 61, 62, 63, 64, 65, 67, 69, 84, 89	**SSPC1** (**Transmission only**) - Transmission actions and activities will continue to Implement A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities. This focuses on control of sediment and pollutants, including herbicides. Following are key measures: o BMPs minimize erosion and prevent/control water pollution in accordance with state-specific construction storm water permits. BMPS are designed to keep soil in place and aid in reducing risk of other pollutants reaching surface waters, wetlands and ground water. BMPs will undertake the following principles: • Plan clearing, grading, and construction to minimize area and duration of soil exposure. • Maintain existing vegetation wherever and whenever possible. • Minimize disturbance of natural contours and drains. • As much as practicable, operate on dry soils when they are least susceptible to structural damage and erosion. • Limit vehicular and equipment traffic in disturbed areas. Keep equipment paths dispersed or designate single traffic flow paths with appropriate road BMPs to manage runoff. • Divert runoff away from disturbed areas. • Provide for dispersal of surface flow that carries sediment into undisturbed surface zones with high infiltration capacity and ground cover conditions. • Prepare drainage ways and outlets to handle concentrated/increased runoff. • Minimize length and steepness of slopes. Interrupt long slopes frequently. • Keep runoff velocities low and/or check flows. • Trap sediment on-site. • Inspect/maintain control measures regularly & after significant rain. • Re-vegetate and mulch disturbed areas as soon as practical. o Specific guidelines regarding sensitive resources and buffer zones: • Extra precaution (wider buffers) within SMZs is taken to protect stream banks and water quality for streams, springs, sinkholes, and surrounding habitat. • BMPs are implemented to protect and enhance wetlands. Select use of equipment and seasonal clearing is conducted when needed for rare plants; construction activities are restricted in areas with identified rare plants. • Standard requirements exist to avoid adverse impacts to caves, protected animals, unique/ important habitat (e.g., cave buffers, restricted herbicide use, seasonal clearing of suitable habitat).
■	16, 17, 18, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 48, 50, 51, 52, 53, 54, 55, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 70, 71, 73, 76, 77, 78, 80, 81, 82, 83, 86, 87, 88, 89, 90	**SSPC2** - Operations involving chemical/fuel storage or resupply and vehicle servicing will be handled outside of riparian zones (streamside management zones) in a manner to prevent these items from reaching a watercourse. Earthen berms or other effective means are installed to protect stream channel from direct surface runoff. Servicing will be done with care to avoid leakage, spillage, and subsequent stream, wetland, or ground water contamination. Oil waste, filters, other litter will be collected and disposed of properly. Equipment servicing and chemical/fuel storage will be limited to locations greater than 300-ft from sinkholes, fissures, or areas draining into known sinkholes, fissures, or other karst features.

■	16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 48, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 61, 62, 63, 64, 65, 66, 67, 69, 70, 71, 73, 76, 77, 80, 81, 82, 83, 84, 86, 87, 88, 89, 90, 91	**SSPC3** (**Power Plants only**) - Power Plant actions and activities will continue to implement standard environmental practices. These include: o Best Management Practices (BMPs) in accordance with regulations: • Ensure proper disposal of waste, ex: used rags, used oil, empty containers, general trash, dependent on plant policy • Maintain every site with well-equipped spill response kits, included in some heavy equipment • Conduct Quarterly Internal Environmental Field Assessments at each sight • Every project must have an approved work package that contains an environmental checklist that is approved by sight Environmental Health & Safety consultant. • When refueling, vehicle is positioned as close to pump as possible to prevent drips, and overfilling of tank. Hose and nozzle are held in a vertical position to prevent spillage o Construction Site Protection Methods • Sediment basin for runoff - used to trap sediments and temporarily detain runoff on larger construction sites • Storm drain protection device • Check dam to help slow down silt flow • Silt fencing to reduce sediment movement o Storm Water Pollution Prevention (SWPP) Pollution Control Strategies • Minimize storm water contact with disturbed soils at construction site • Protect disturbed soil areas from erosion • Minimize sediment in storm water before discharge • Prevent storm water contact with other pollutants • Construction sites also may be required to have a storm water permit, depending on size of land disturbance (>1ac) o Every site has a Spill Prevention and Control Countermeasures (SPCC) Plan and requires training. Several hundred pieces of equipment often managed at the same time on power generation properties. Goal is to • Minimize fuel and chemical use Ensure proper disposal of waste, ex: used rags, used oil, empty containers, general trash, dependent on plant policy • Maintain every site with well-equipped spill response kits, included in some heavy equipment • Conduct Quarterly Internal Environmental Field Assessments at each sight • Every project must have an approved work package that contains an environmental checklist that is approved by sight Environmental Health & Safety consultant. • When refueling, vehicle is positioned as close to pump as possible to prevent drips, and overfilling of tank. Hose and nozzle are held in a vertical position to prevent spillage o Construction Site Protection Methods • Sediment basin for runoff - used to trap sediments and temporarily detain runoff on larger construction sites • Storm drain protection device • Check dam to help slow down silt flow • Silt fencing to reduce sediment movement o Storm Water Pollution Prevention (SWPP) Pollution Control Strategies • Minimize storm water contact with disturbed soils at construction site • Protect disturbed soil areas from erosion • Minimize sediment in storm water before discharge • Prevent storm water contact with other pollutants • Construction sites also may be required to have a storm water permit, depending on size of land disturbance (>1ac) o Every site has a Spill Prevention and Control Countermeasures (SPCC) Plan and requires training. Several hundred pieces of equipment often managed at the same time on power generation properties. Goal is to minimize fuel and chemical use
■	21, 54	**SSPC6** - Herbicide use will be avoided **within 200 ft of portals associated with caves, cave collapse areas, mines and sinkholes** are capable of supporting cave-associated species. Herbicides are not applied to surface water or wetlands unless specifically labeled for aquatic use. Filter and buffer strips will conform at least to federal and state regulations and label requirements.
■	17, 21, 25, 26, 27, 28, 29, 31, 32, 33, 34, 35, 36, 37, 38, 54, 55	**SSPC7** - Clearing of vegetation **within a 200-ft radius of documented caves** will be limited to hand or small machinery clearing only (e.g., chainsaws, bush-hog, mowers). This will protect potential recharge areas of cave streams and other karst features that are connected hydrologically to caves.

▣	16, 26, 36, 37, 38, 39, 48, 50, 52, 59, 60, 62, 66, 67, 69, 72, 75, 77, 78, 79, 86	**L1** - Direct temporary lighting away from suitable habitat during the active season.
▣	16, 26, 36, 37, 38, 39, 48, 50, 52, 59, 60, 62, 66, 67, 69, 72, 75, 77, 78, 79, 86	**L2** - Evaluate the use of outdoor lighting during the active season and seek to minimize light pollution when installing new or replacing existing permanent lights by angling lights downward or via other light minimization measures (e.g., dimming, directed lighting, motion-sensitive lighting).

[1]Bats addressed in consultation (02/2018), which includes gray bat (listed in 1976), Indiana bat (listed in 1967), northern long-eared bat (listed in 2015), and Virginia big-eared bat (listed in 1979).

Hide All Unchecked Conservation Measures

- (•) HIDE
- ( ) UNHIDE

Hide Table 4 Columns 1 and 2 to Facilitate Clean Copy and Paste

- ( ) HIDE
- ( ) UNHIDE

NOTES (additional info from field review, explanation of no impact or removal of conservation measures).

THIS FORM IS NOT YET FINALIZED

STEP 14) Save completed form (Click File/Save As, name form as "ProjectLead_BatForm_CEC-or-ProjectIDNo_Date") in project environmental documentation (e.g. CEC, Appendix to EA) AND send a copy of form to batstrategy@tva.gov
Submission of this form indicates that Project Lead/Applicant:

[ ] (name) is (or will be made) aware of the requirements below.

- Implementation of conservation measures identified in Table 4 is required to comply with TVA's Endangered Species Act programmatic bat consultation.
- TVA may conduct post-project monitoring to determine if conservation measures were effective in minimizing or avoiding impacts to federally listed bats.

For Use by Terrestrial Zoologist Only

☒ Terrestrial Zoologist acknowledges that Project Lead/Contact (name) [Chevy Williams] has been informed of any relevant conservation measures and/or provided a copy of this form.

☒ For projects that require use of Take and/or contribution to TVA's Bat Conservation Fund, Terrestrial Zoologist acknowledges that Project Lead/Contact has been informed that project will result in use of Incidental Take [ ] ◯ ac ◯ trees and that use of Take will require $ [ ] contribution to TVA's Conservation Fund upon completion of activity (amount entered should be $0 if cleared in winter).

For Terrestrial Zoology Use Only. Finalize and Print to Noneditable PDF.

Appendix C – TVA Alternatives Evaluation

Kingston Retirement EIS: Alternatives Evaluation

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TVA Asset Strategy Overview

TVA's asset strategy incorporates the strategic direction from the 2019 Integrated Resource Plan (IRP) and continues to support affordable, reliable, resilient, and cleaner energy for the customers we serve.

Highlights from the asset strategy include:

- Maintaining the existing low-cost, carbon-free nuclear and hydro fleets
- Retiring aging coal units as they reach the end of their useful life, expected by 2035
- Adding 10,000 MW of solar by 2035 to meet customer and system needs, complemented with storage
- Using natural gas to enable coal retirements and solar expansion
- Leveraging demand-side options, in partnership with local power companies
- Partnering to develop new carbon-free technologies for deeper decarbonization

Coal Fleet End-of-life Evaluations

The 2019 IRP acknowledged the potential for coal retirements and recommended a near-term action to evaluate end-of-life dates for aging fossil units to inform planning.

Evaluations assessed the cost, reliability, and environmental implications associated with continued operation of TVA's coal fleet and concluded that it is:

- Among the oldest in the nation (Cumberland 1973, all other plants 1950s vintage)
- Experiencing material condition and performance challenges, especially Cumberland and Kingston
- Projected to have increasing performance challenges due to lack of portfolio fit
- Contributing to environmental, economic, and reliability risks

Retirement planning assumptions were developed based on relative unit condition and fit, as well as the time required to build replacement generation, subject to further evaluation in environmental reviews under the National Environmental Policy Act (NEPA).

December 2023	December 2026	December 2027	December 2028	December 2031	December 2033
Bull Run (Board-approved)	Cumberland 1 unit (Board-approved)	Kingston 9 units	Cumberland 1 unit	Gallatin 4 units	Shawnee 9 units

Compliance with ELG Rule requires installation of controls by December 2025 or retirement by December 2028

Compliance with ELG Rule requires installation of controls by December 2025

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Project Purpose and Need and Project Alternatives

Kingston EIS Background and Purpose and Need

TVA's IRP acknowledged continued operational challenges for the aging coal fleet and included a recommendation to conduct end-of-life evaluations on TVA's remaining coal plants.

The decision associated with this EIS is a specific, discrete component of TVA's blended asset strategy and consistent with the recommended target power supply mix in the 2019 IRP

TVA's recent evaluations confirm:

- The aging coal fleet is among the oldest in the nation and is experiencing deterioration of material condition and performance challenges.
- TVA has developed planning assumptions for Kingston Fossil Plant (KIF) unit retirements.
- TVA proposes to retire and decommission the KIF units by 2027, and to provide replacement generation that can supply at least 1,500 MW of firm, dispatchable power.

Need for Firm, Dispatchable Power

The 1,500 MW of replacement generation needed to replace the retirement of Kingston must be firm, dispatchable power and must be operational by 2027 so as not to leave TVA short on required generation and capacity to meet system demands and planning reserve margin targets.

Firm, dispatchable power ensures that TVA can call on the generating capacity year-round, particularly during peak load events – those periods of maximum electricity demand from customers, typically late afternoon in the summer and before or around dawn in the winter.

Firm, dispatchable power provides a backstop for solar resources that are unable to or are very limited in their ability to meet maximum demand that occurs in the pre-daylight or early-daylight hours of the winter season.

Replacement generation is needed in the East Tennessee area.

TVA would need to continue operating the coal-fired units if replacement generation is not in place by 2027.

Transmission

Kingston Fossil plant's location on the 161 kV system near Knoxville makes it integral to maintaining system reliability and stability in the area. Retirement of Kingston Fossil without replacement generation in the area or appropriate transmission upgrades would, significantly impact the ability to add additional load in the area, degrade the stability of Watts Bar and Sequoyah nuclear plants to a point where generation would need to be curtailed, and potentially violate NERC Transmission Planning (TPL-001) standard criteria.

Returning the Knoxville area to current system performance without local generation would require approximately $500M in transmission work such as a 500/161 kV intertie bank, construction of four additional 161 kV lines, multiple 161 kV line upgrades, synchronous condensers and at least three STATCOMS. The transmission system would also need to be upgraded to integrate the replacement power in alternative locations.

Future integration of Inverter Based Resources, such as solar and batteries, will degrade area stability and require synchronous condensing or STATCOMS in all alternatives considered, even the No Action Alternative.

Project Action Alternatives

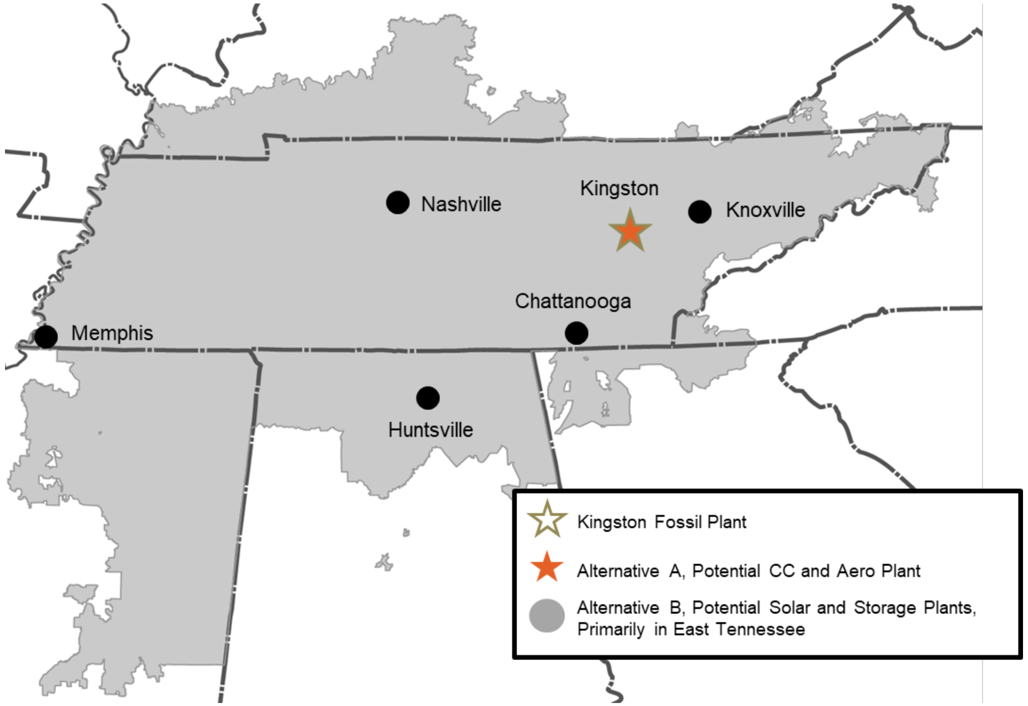
The Kingston Fossil Plant (KIF) Retirement EIS includes two action alternatives, which include the demolition of KIF, in addition to the no action alternative. To recover the generation capacity lost from retirement, TVA staff evaluated the following alternatives for replacement generation:

Alternative A

Retirement of KIF and construction and operation of a Combined Cycle Combustion Turbine (CC) Gas Plant, Aeroderivative Combustion Turbine (Aero CT), and storage and solar facilities on the KIF reservation

Alterative B

Retirement of KIF and construction and operation of solar and storage facilities, primarily in East Tennessee



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No Action Alternative

Under the No Action Alternative, TVA will continue to operate Kingston Fossil.

The No Action Alternative includes increased operating costs consistent with the Higher Operating Costs for Coal Plants sensitivity studied in the 2019 IRP.

The No Action Alternative also includes costs over $600M for plant modifications necessary to ensure compliance with USEPA's March 2023 Proposed ELG Rule. These upgrades may be further updated through changes to the ELG guidelines by USEPA.

This alternative would require specific actions related to wastewater treatment and the management and disposal of CCR, primary solid wastes, at KIF. Projects have been previously analyzed in NEPA documents or are future projects, which are either underway or would commence within the next five years.

Alternative A: Retire KIF and Construct CC, Aero CT, storage, and solar facilities

Retirement of KIF in 2027 with demolition to follow

Construction and operation of a CC Gas Plant, Aero CT Gas Plant, and storage and solar facilities on the KIF reservation

CC plant would be associated with an estimated 122-mile pipeline and gas compressor station.

The construction of the natural gas pipeline(s) under Alternative A would be subject to Federal Energy Regulatory Commission (FERC) jurisdiction and additional review will be taken by FERC in accordance with its own NEPA procedures.

Alternative A: CC, Aero CT, storage and solar facilities

Alternative A includes a 673 MW CC plant, 848 MW Aero CT plant, 100 MW battery, and 3-4 MW solar site to recover the dependable capacity KIF as well as account for modest load forecast increases

The Kingston Reservation offers several key benefits:

- Existing TVA property
- Existing transmission interconnection to the TVA system, which can largely be repurposed
- Nearby to a major interstate natural gas pipeline with adequate capacity and potential to generally locate proposed pipeline lateral along existing transmission line corridor
- Favorable air permitting prospects, since it will be replacing a higher emitting coal unit

CC	Aero CT	Solar & Storage
• Effective in baseload or intermediate operations with high fuel efficiency, relatively low construction costs, and flexible operations • Can provide grid support, follow load, and are fully dispatchable year-round	• Peaking units with the ability to start and ramp quickly, and offer flexible operations • CT plants can provide grid support and are fully dispatchable year-round • Offer synchronous condensing capability	• Carbon-free • Variable energy resource, matches up well with summer demand • Stores energy at lower loads to meet peaks and manage intermittency
Unit flexibility and dispatchability is increasingly important as TVA integrates about 10,000 MW of solar by 2035		

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Alternative B: Retire KIF and Construct Solar and Storage

Retirement of KIF in 2027 with demolition to follow

Construction and operation of solar and storage facilities to replace the generation and capacity of KIF

Alternative uses generic site analysis and assumes procurement via competitive request for proposal (RFP) process with a power purchase agreement (PPA) structure and TVA constructed, subject to site-specific NEPA review

Solar and storage facilities will need to be primarily located in East Tennessee for regional grid support

Alternative B: Solar and Battery Storage Facilities

Solar resources are becoming more competitive on a cost per MWh basis; however, they are not dispatchable, and generation is intermittent in nature, varying by time of day, weather, and season.

In order to provide dependable peak capacity needs for the TVA system, solar generation must be paired with dispatchable resources, such as gas and/or storage.

Battery energy storage systems (BESS) typically represent one of the lowest cost storage options today, with four-hour BESS systems providing a reasonable balance of cost, output, and duration.

Alternative B includes 1,500 MW of solar and 2,200 MW of battery storage to recover the generation and dependable capacity of the Kingston retirement as well as account for modest load forecast increases.

TVA has determined that although solar can also be paired with battery storage to achieve similar demand following capabilities, such a pairing is constrained in that lithium-ion batteries are energy limited. The energy limited nature of battery storage makes Alternative B operationally challenged in its ability to meet required year-round generation needs, such as sustained high electric loads longer than 4 hours and with no solar generation.

Sites will require interconnection and transmission work; Evaluations conducted during the EIS indicated an expected duration of eight to nine years, failing to meet the purpose and need.

Alternative B Development

Solar evaluation

- TVA Staff began by replacing the average annual energy output of KIF with solar, with consideration for differences in annual capacity factor.
- Analysis of TVA's system and operation indicated a need for 1,500 MW of additional solar to replace the annual energy of KIF, on top of the 10,000 MW of solar already included in the base plan.

Storage evaluation

- The TVA system is dual-peaking, meaning that it experiences peak loads in both summer (typically late afternoon) and winter (typically early morning, just before dawn).
- Battery storage (typically lithium-ion) is currently the lowest cost option for storage capacity, which would ensure TVA's winter capacity reserves are maintained with the retirement of KIF.
- TVA staff utilized the SERVM model to determine what level of storage would maintain industry standard reliability of one Loss-of-Load-Event (LOLE) in 10 years, with risk spread equally between summer and winter. Analysis indicates that 2,200 MW of battery energy storage, paired with 1,500 MW of additional solar capacity, will maintain an annual 0.1 LOLE with balanced seasonal risk with the retirement of KIF.

Alternatives Considered, but Dismissed

Resource Option	Reasoning
Hydro Pumped Storage	Longer timelines to meet environmental requirements and for construction fail to meet 2027 timeline for the retirement of KIF. Long-duration storage technology is currently being studied by TVA for further evaluation and potential deployment in the early 2030s.
Small Modular Reactors (SMR)	Longer construction timeline and first-of-a-kind deployment risks fail to meet 2027 timeline for the retirement of KIF. Potential to serve cost-effective baseload or load following needs in the future with low fuel costs, carbon-free generation, advanced passive safety systems, and anticipated cost reductions achieved by assembling components in a factory setting.
In- and/or Out-of-Valley Wind	Not selected due to low wind speeds in Tennessee Valley and higher transmission costs for out-of-Valley wind, both of which increase relative costs. Wind can provide dependable capacity in both summer and winter, though intermittent.
Energy Efficiency (EE)	Dismissed as EE programs take time to scale and market, while also facing increasing costs for higher depth and penetration levels. EE cannot provide support in East TN. EE is well-positioned to help TVA absorb load growth resulting from increased electrification of the economy in the future.
Demand Response (DR)	Dismissed as they are limited in the number of calls available and do not provide reliable firm, dispatchable power. DR cannot provide support in East TN. DR can help TVA absorb load growth resulting from increased electrification of the economy and allow TVA to offset physical capacity needs.
Distributed Generation	Cost for distributed generation is generally higher than utility-scale generation for the same type of resource. TVA has therefore determined that the combination solution of utility-scale solar paired with utility-scale storage as presented in Alternative B provides a feasible lower-cost solution.
Alternative Fuels (Hydrogen)	Technology is not viable today but design of Alternative A is such that future implementation of hydrogen fuel blending could result in further significant GHG emissions reductions.

Evaluation Assumptions

Capacity and Resource Planning Process

Capacity and resource planning follows least-cost principles to develop a resource strategy, aligned with TVA's strategic direction, that identifies the power resources needed to meet system demand with appropriate reserve margin.

The process requires key inputs based on TVA's experience and expertise such as electricity demand, fuel and power costs, construction costs, environmental regulations, asset operating characteristics, target planning reserve margin, and transmission considerations.

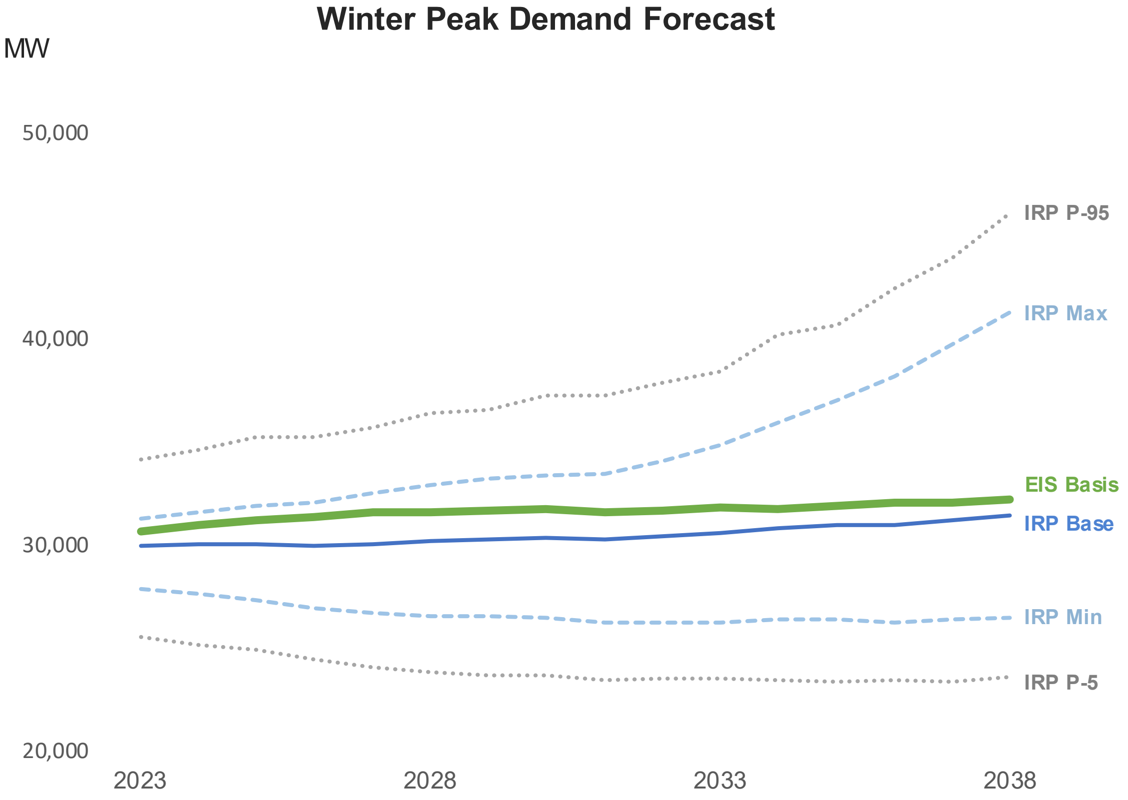
Key assumptions are validated and compared against industry benchmarks, studies, and forecasts, then modeled leveraging commercially available tools including Anchor Power Solution's EnCompass and Energy Exemplar's Aurora.

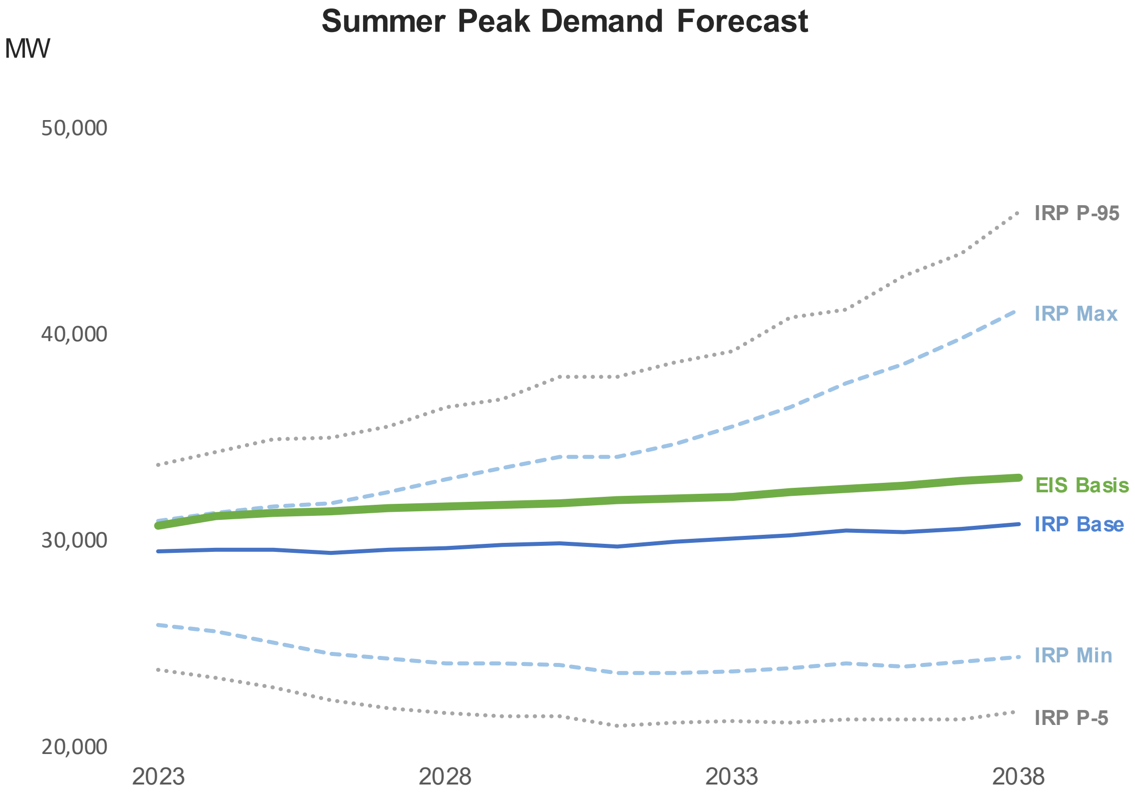
Integrated Resource Plan: Key Signposts

TVA's asset strategy incorporates the strategic direction from the 2019 IRP and inputs are regularly updated. Current assumptions are still aligned with the 2019 IRP.

Demand for electricity	Growth driven by Valley in-migration, energy intensive sectors, and Economic Development momentum
Natural gas prices	Near-term COVID-19 and supply-driven volatility, with lower fundamental prices over the long term
Stakeholder expectations	Increasing customer and stakeholder emphasis on renewable and clean energy; Preference for low cost energy
Regulatory requirements	Biden policy on climate change, pipeline challenges, and pending updates to regulations (ex: Inflation Reduction Act)
Operating costs for existing units	Better understanding of fleet investments needed, helping inform portfolio direction
Solar and wind costs	Competitive solar offers with declining costs, but solar supply chain challenges persisting
Emerging and developmental technologies	Continued advancements in storage; DOE and utilities partnering to advance new clean technologies

Peak Load Forecast within IRP Ranges





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Assumptions for Key Inputs

	Natural Gas CC (1x1)	Natural Gas CT (3x)	Aeroderivative CT (10x)	Solar (50 MW Nameplate)	Storage
Summer Net Dependable Capacity (MW)	673	663	530	25	50
Winter Net Dependable Capacity (MW)	724	693	570	--	50
Capital Cost (2023 $ / kW)	1,022	570	1,209	1,114	1,243
Life (years)	30	30	30	20	20
Capacity Factor (%)	>50	1-10	10-45	25	87 RTE*
Integration Cost ($/MWh)**	--	--	--	3	--

*RTE is the round-trip efficiency ratio of energy output relative to energy consumed to charge

**Intermittent resources require the balance of system resources to absorb sub-hourly fluctuations, driving a cost. Cost increases with greater amounts of solar. See 2019 IRP.

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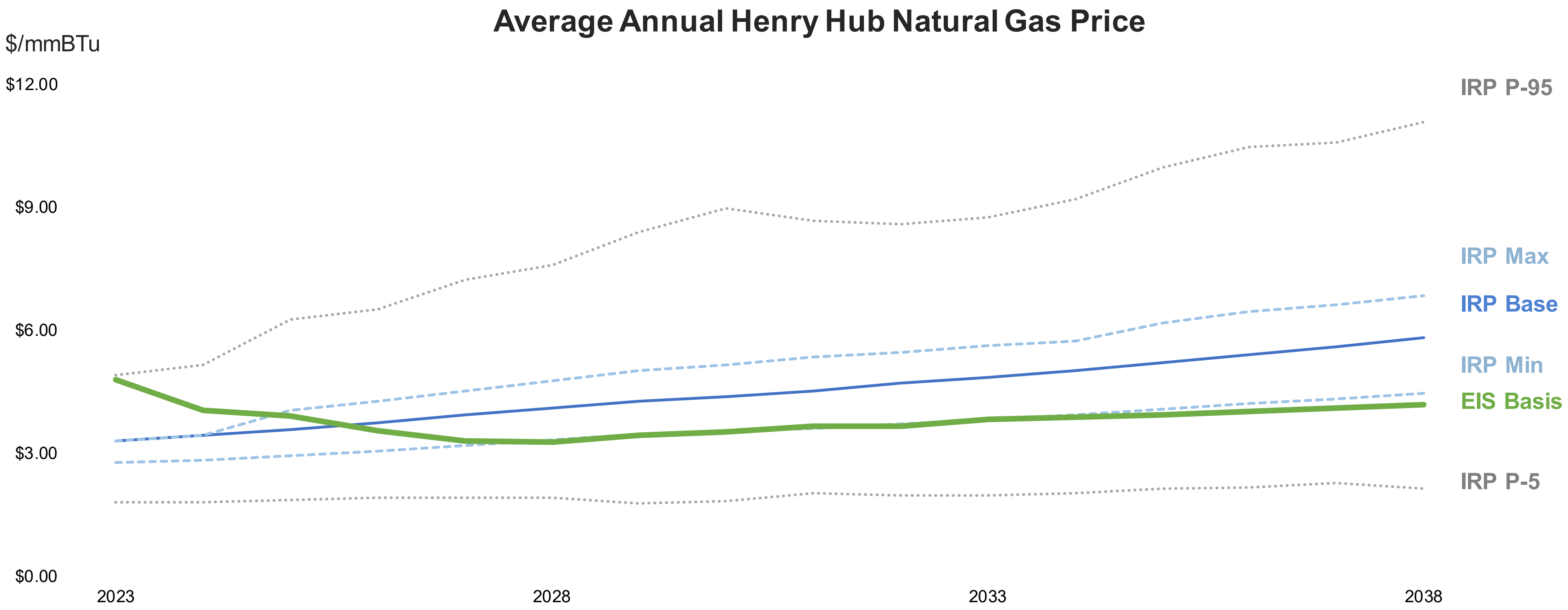
Natural Gas Prices within IRP Ranges



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Natural Gas Resource Costs

TVA has deep experience constructing and operating both simple cycle and combined cycle natural gas plants and cost assumptions are developed using recent project cost experience

Operating characteristics are reviewed twice per year utilizing vendor input

Pipeline costs, if applicable, are included for specific projects and modeled as a generation cost leveraging quotes and pricing from suppliers

Resource	MW	2023$/kW
Frame CT 2x	442	647
Frame CT 3x	663	570
Frame CT 4x	884	535
Aero 2x	106	1,698
Aero 4x	212	1,349
Aero 10x	530	1,209
Aero 20x	1,060	1,162
1x1 CC 7HA.03	673	1,022
2x1 CC 7HA.03	1,348	894

Solar Costs

Cost assumptions developed using recent RFP pricing at the 25th percentile, then transition to the "NREL 2022 – Advanced" price forecast toward the end of the decade

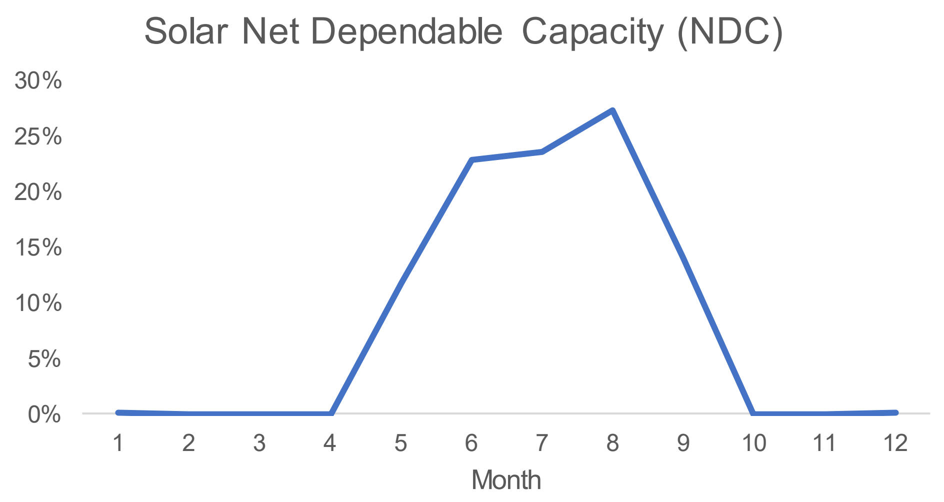
Assumptions reviewed and updated semiannually

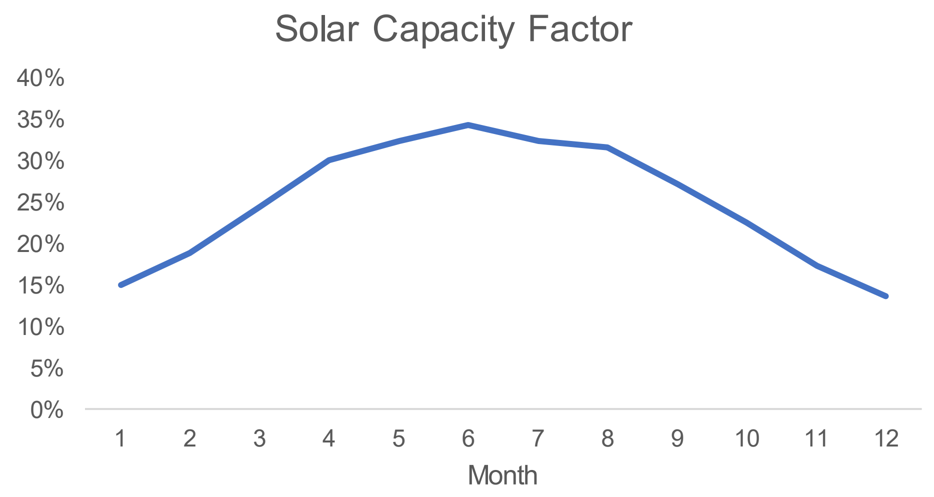
Operating characteristics based on utility-scale, single-axis tracking solar installations in the TN Valley

Net Dependable Capacity is the percent of nameplate capacity that has a 50% confidence level of being available at the time of peak load for the month

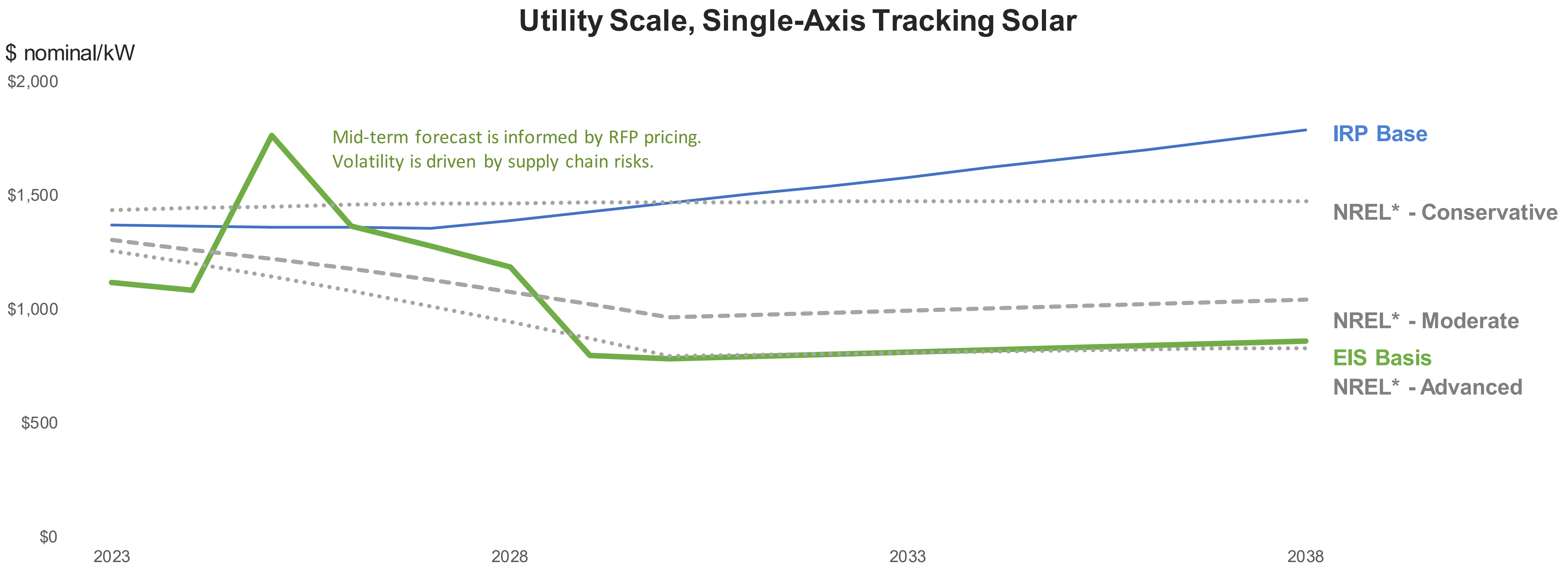
Capacity Factor is the ratio of actual energy generation divided by the theoretical continuous maximum amount over the period

10% investment tax credit assumption for solar beginning in 2024 forward





Solar Resource Costs



*National Renewable Energy Laboratory (NREL) forecasts

TENNESSEE VALLEY AUTHORITY

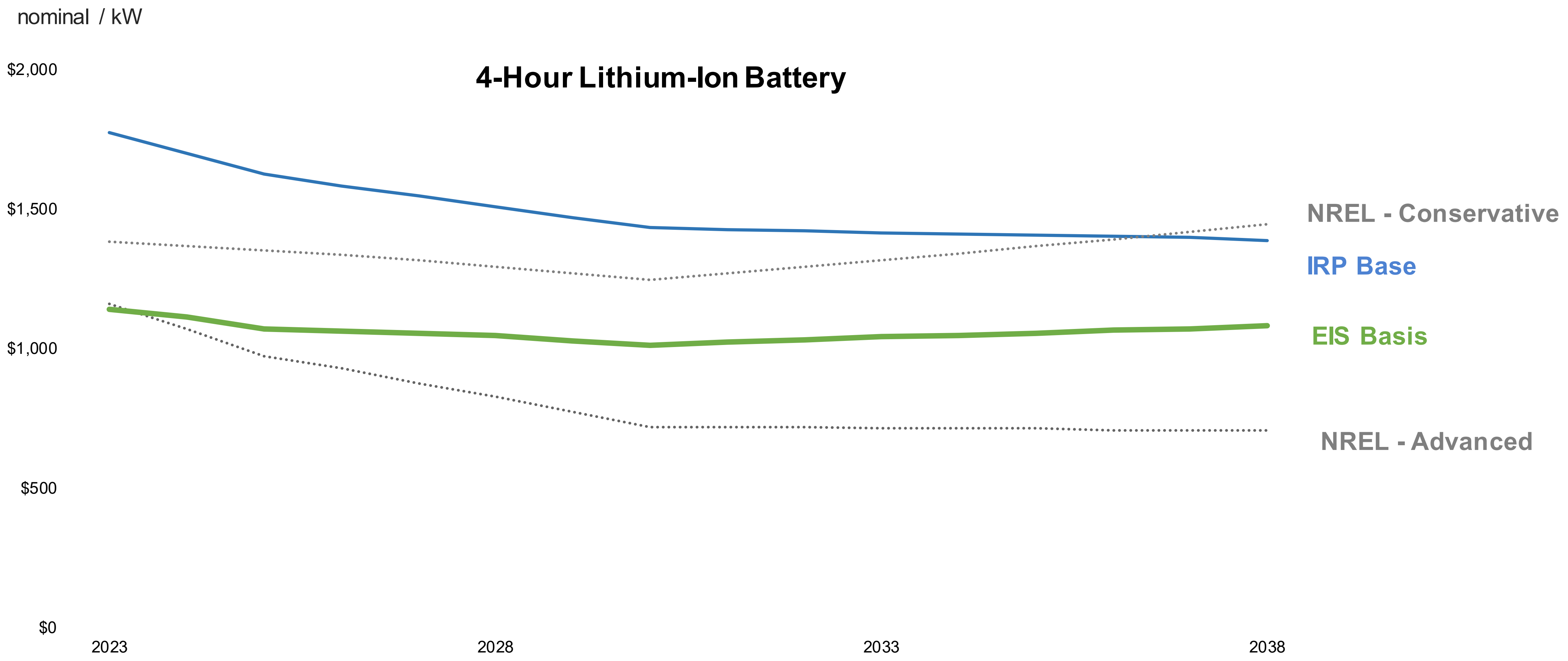
Storage Costs and Projects

Cost assumptions developed based on a combination of EIA capital cost and performance characteristic estimates for four-hour batteries and the “NREL 2022 – Moderate” case.

Assumptions reviewed and updated semiannually.

Moving to a greater volume of inverter-based resources (solar and storage) weakens the transmission system and increases the risk of power quality issues for larger load customers without backstopping those additions with flexible, gas generation. Greater volumes of solar generation will create ramping challenges that are mitigated with flexible, dispatchable gas generation and battery storage.

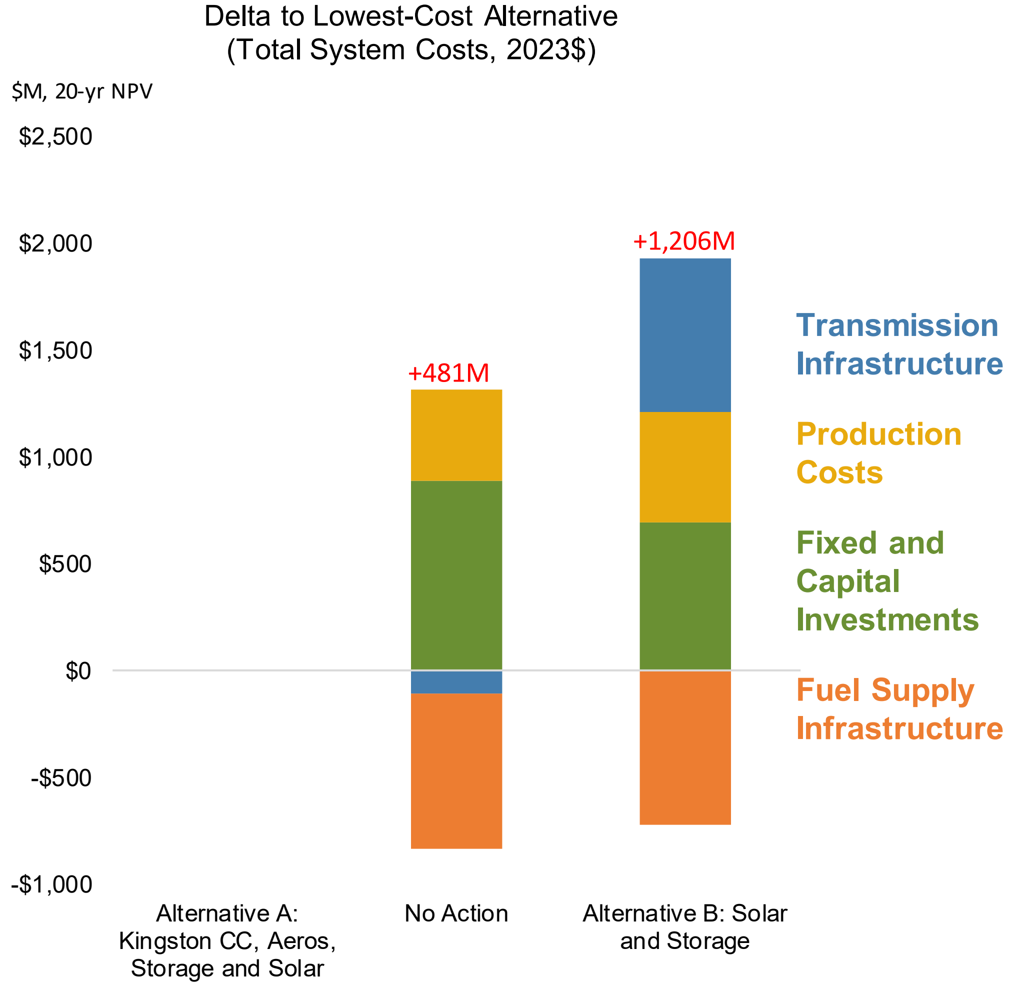
Storage Resource Costs



TENNESSEE VALLEY AUTHORITY

Evaluation Results and Preferred Alternative

Total System Costs Comparison



Total system costs includes all capital, fixed, variable, and fuel costs associated with running the TVA system, as well as spending for requisite pipeline and transmission upgrades in each alternative

Alternative	Production Costs^	Fixed and Capital Costs	Transmission Infrastructure	Fuel Supply Infrastructure
Alternative A: Kingston CC, Aeros, storage, and solar	Lowest	Lowest	Lowest	Lowest
	Included are costs associated with CC and Aero plant construction and operation, transmission upgrades, and pipeline lateral construction.			
No Action Alternative	Higher	Higher	Lower	Lower
	Substantial risks related to evolving and future regulatory requirements such as the ELG* Rule and plant material condition			
Alternative B: Solar and Storage	Higher	Higher	Higher	Lower
	Solar and storage and transmission projects fail to meet 2027 timeline and higher costs for reliability and environmental compliance at KIF			

*Effluent Limitation Guidelines
^Production Costs include ongoing fuel, start, and variable O&M costs

Carbon Rate Comparison

All action alternatives significantly reduce system carbon intensity (lbs/MWh), compared to no action

The highly efficient advanced-class CC and Aero CT plants in Alternative A reduces system carbon emissions by offsetting coal generation and by improving the combined fuel efficiency of the entire TVA gas fleet

Solar facilities in Alternative B reduce system carbon emissions by offsetting coal and gas generation, however this is partially offset as existing coal and gas units increase generation for battery charging or hours when solar is unavailable

Once completed, Alternative B results in the lowest system carbon rate, followed closely by Alternative A

Alternative	FY30 Carbon Rate (lbs/MWh)*	FY30 Rate Reduction (2005 baseline) Compared to Alternative A*
No Action Alternative	469	-3 percentage points (worse)
Alternative A: Kingston CC, Aero CT, Storage, and Solar	433	n/a
Alternative B: Solar and Storage	420	+1 percentage point (better)

*Vintage: FY23 Budget and associated alternative runs

TVA TENNESSEE VALLEY AUTHORITY

Planning is Grounded in Least-cost Principles

In resource planning, TVA applies fundamental least-cost planning principles*:

Low Cost	Risk Informed	Environmentally Responsible
Reliable and Resilient	Diverse	Flexible

Load varies hourly and seasonally, with weather a large driver, and highest peak loads are typically of short duration

Resources have a variety of operational and economic characteristics and constraints, with tradeoffs that contribute to the best portfolio fit overall

*In alignment with the Energy Policy Act of 1992

Least-cost Planning Evaluation

Alternative	Low Cost	Risk Informed	Environmentally Responsible	Reliable and Resilient	Diverse	Flexible
No Action Alternative	Cost risk associated with material condition and environmental compliance	Long-term fuel supply and regulatory risks	Results in highest system carbon rate, continued production of CCRs*	Challenged material condition; dependable year-round capacity	Contributes to balanced portfolio, long-term coal supply chain risks	Supports intra-day load swings, limited by start costs and minimum up/down times
Alternative A: Kingston CC, Aero, Storage, and Solar	Lowest total system cost, most effective at serving large energy needs	Robust fuel supply chain, potential use of alternative fuels or CCS*, fastest online	Substantial system carbon rate reduction, assists in integration of renewables	Dependable year-round capacity; East TN transmission support	Lateral connection to major interstate pipeline with multiple supply sources	CC supports baseload or intermediate needs; Aeros have very fast ramp speeds
Alternative B: Solar and Storage	Highest total system cost; extensive transmission work and large number of solar and storage locations	Fails to meet purpose and need timeline with transmission build-out and land and resource procurement	Substantial system carbon rate reduction, lowest system carbon rate	Dependable year-round capacity; requires upgrades for dynamic/reactive support; batteries are limited in duration (four hours)	Contributes to balanced portfolio, adds to aggressive solar build plans	Batteries support fast peaking needs and have a wide operating range

*CCS = Carbon Capture and Sequestration; CCR = Coal Combustion Residuals

Best	Good	Worse	Worst

TENNESSEE VALLEY AUTHORITY

Additional Considerations

The decision associated with this EIS is a specific, discrete component of TVA's blended asset strategy and consistent with the recommended target power supply mix in the 2019 IRP

New gas contributes to TVA's ~80% carbon reduction by 2035 path by enabling the retirement of the remaining coal plants by 2035, while emitting about 65-70% less CO_2 than aging coal plants

Natural gas represents a highly flexible, reliable fuel source that helps enable high penetration levels of intermittent renewable resources

CC plants are positioned to further contribute to a net-zero future using alternative fuels, such as hydrogen, and/or carbon capture and sequestration (CCS) technology

TVA is exploring partnerships with federal agencies and peer utilities to advance the research and development of both alternative fuels and CCS technology, which could enable their use at existing or future TVA gas facilities

Action alternatives are in addition to TVA's plan to add 10,000 MW of solar by 2035, TVA currently has over 2,500 MW of solar either operating or contracted

TVA is working to gain operational experience with battery storage technology through the deployment of a 20 MW battery storage project near Vonore, TN and nearly 180 MW of storage paired with solar under contract, all planned to be online over the next several years

TVA is also exploring pilot projects for additional short- and long-duration storage use-cases

Preferred Alternative

TVA's financial and system analysis, using the least-cost planning framework along with consideration of the environmental impacts of the two alternatives, indicates that Alternative A, retirement of KIF and replacement with CC, Aero CT, storage, and solar facilities, is the Preferred Alternative.

Key considerations include:

- Alternative A aligns with the 2019 IRP near-term actions to evaluate engineering end-of-life dates for aging fossil units to inform long-term planning and to enhance system flexibility to integrate renewables and distributed resources.
- Alternative A is the lowest-cost alternative and supports high reliability while greatly reducing carbon emissions compared to no action.
- Alternative A can be constructed on a TVA-owned brownfield site, largely leverage existing transmission infrastructure, and supports East Tennessee grid stability.
- Alternative A is a mature technology and can be built and operational sooner than other action alternatives, which reduces economic, reliability, and environmental risks, and is also designed for future implementation of alternative fuels.

Appendix D – Alternative A Pipeline Maps

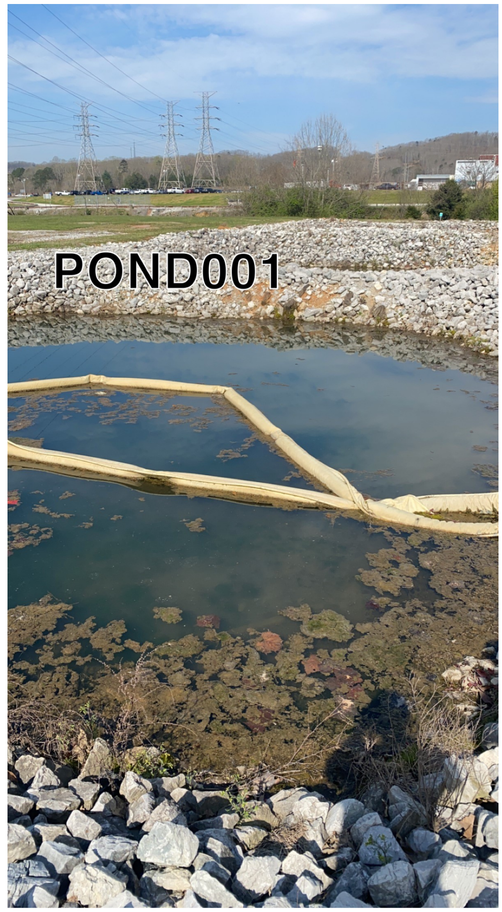
Appendix E – Kingston Surface Waters Survey Photos and HD Forms

Kingston Fossil FS
March 2022

BWA008 & BWAO13
PERENNIAL AND INTERMITTENT

PONDS OF KINGSTON FOSSIL

POND1,2,3 are the same.



KIF WWC's/ Ephemerals

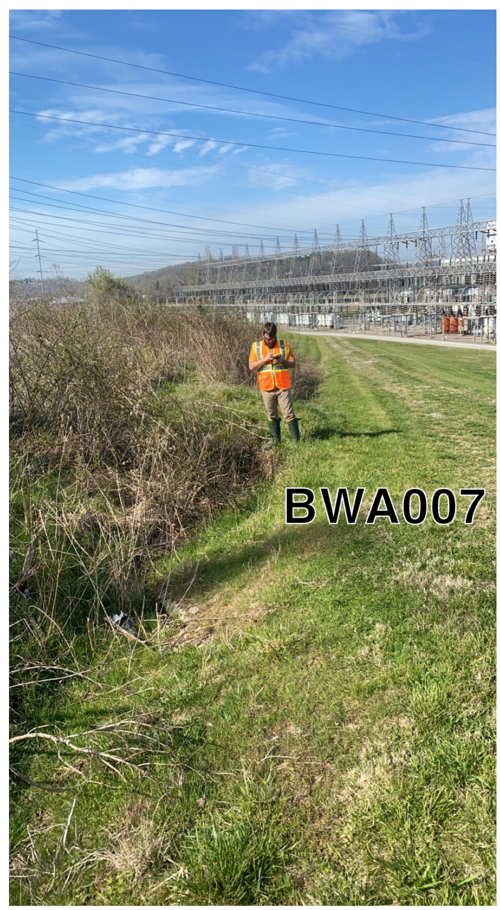
In SEQ ID order according to SMZ table

BWA001

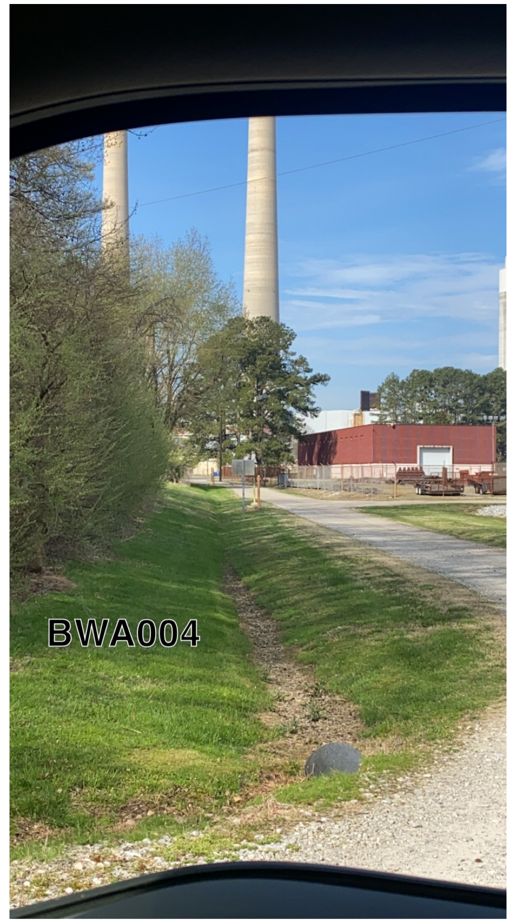
BWA009

BWA003

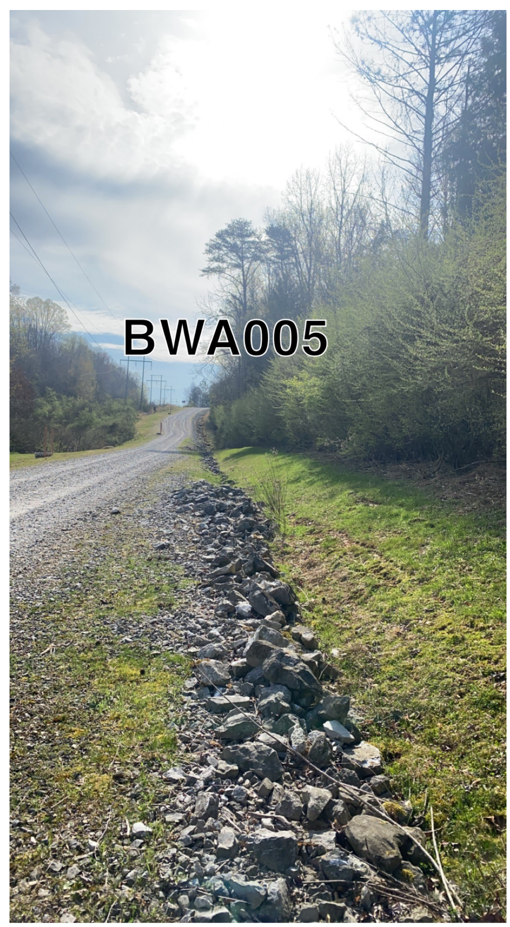
BWA007



BWA004



BWA005



BWA006

BWA018

BWA011

BWA012

BWA015

BWA014

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA001	
Site Location: e001	
HUC (12 digit): Two HUC 12's 060102080408 & 060102070405	Lat/Long: 84.5165089°W 35.8967611°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : First: 40647.238152 acres Second:40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes : BWA001 is a grassy, man-made WWC on the SE side of the switch yard. it is culverted at road and is draining into BWA008

Hydrologic Determination Field Data Sheet
Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA002	
Site Location: e002	
HUC (12 digit): 060102080408	Lat/Long: 84.5148786°W 35.8983066°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40647.238152 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	**NO**	**YES**
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1” in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = “Yes”, then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes : BWA002 is a grassy, bedless/bankless WWC that is culverted under road.

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA003	
Site Location: e006	
HUC (12 digit): 060102080408	Lat/Long: 84.5127186°W 35.9004193°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40647.238152 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes : Bed/bank present, but it met the 3rd primary indicator on the TDEC HD form making it a WWC. 1'Wx<1'Deep. DATOS

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA004	
Site Location: e008	
HUC (12 digit): 060102080408	Lat/Long: 84.5120628°W 35.9003800°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40647.238152 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1” in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = “Yes”, then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes : DATOS, 1'w x <1'Deep, culverted under road

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA005	
Site Location: e009	
HUC (12 digit): 060102080408	Lat/Long: 84.5105413°W 35.9000299°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40647.238152 acres	County: Roane, Tennessee
Soil Type(s) / Geology : Source:	
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes : 1' x 1' man-made WWC, rip-rap along the road.

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA006	
Site Location: e011	
HUC (12 digit): 060102080408	Lat/Long: 84.5105786°W 35.9001492°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40647.238152 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes : 1' x 1' somewhat of a bed/bank present, DATOS, culverted under road

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA007	
Site Location: e007	
HUC (12 digit): 060102080408	Lat/Long: 84.5153064°W 35.8972555°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40647.238152 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes : 1' x 1' man made WWC. DATOS

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA008	
Site Location: 001	
HUC (12 digit): 060102070405	Lat/Long: 84.5194740°W 35.8954959°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

**Overall Hydrologic Determination = ** Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

Man-made/altered with aquatic life, 2'W x 1'Deep. culverted, flows to POND1,POND2,POND3, and then into the Emory river. Snails, eggs, leaches present.

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA009	
Site Location: e003	
HUC (12 digit): 060102070405	Lat/Long: 84.5172189°W 35.8943191°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = Not A Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

6'W man made concrete WWC, culverted to Emory River

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Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA010	
Site Location: e005	
HUC (12 digit): 060102070405	Lat/Long: 84.5159226°W 35.8938820°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = Not A Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

culverted, man-made WWC leading to Emory River

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA011	
Site Location: e015	
HUC (12 digit): 060102070405	Lat/Long: 84.5000428°W 35.8944576°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = Not A Stream

Secondary Indicator Score (if applicable) = 17

Justification / Notes :

TDEC score of 17, 3'w x <1'Deep. ponded water, with no flow, leading to Emory River.

Secondary Field Indicator Evaluation

A. Geomorphology (Subtotal = 6)	**Absent**	**Weak**	**Moderate**	**Strong**
1. Continuous bed and bank	0	1	2	3
2. Sinuous channel	0	1	2	3
3. In-channel structure: riffle-pool sequences	0	1	2	3
4. Sorting of soil textures or other substrate	0	1	2	3
5. Active/relic floodplain	0	0.5	1	1.5
6. Depositional bars or benches	0	1	2	3
7. Braided channel	0	1	2	3
8. Recent alluvial deposits	0	0.5	1	1.5
9. Natural levees	0	1	2	3
10. Headcuts	0	1	2	3
11. Grade controls	0	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	1.5
13. At least second order channel on existing USGS or NRCS map	No = 0		Yes = 3	

B. Hydrology (Subtotal = 5)	**Absent**	**Weak**	**Moderate**	**Strong**
14. Subsurface flow/discharge into channel	0	1	2	3
15. Water in channel and >48 hours since sig. rain	0	1 1.5	2	3
16. Leaf litter in channel (January – September)	1.5	1	0.5	0
17. Sediment on plants or on debris	0	0.5	1	1.5
18. Organic debris lines or piles (wrack lines)	0	0.5	1	1.5
19. Hydric soils in channel bed or sides of channel	No = 0		Yes = 1.5	

C. Biology (Subtotal = 6)	**Absent**	**Weak**	**Moderate**	**Strong**
20. Fibrous roots in channel bed [1]	3	2	1	0
21. Rooted plants in the thalweg [1]	3	2	1	0
22. Crayfish in stream (exclude in floodplain)	0	1	2	3
23. Bivalves/mussels	0	1	2	3
24. Amphibians	0	0.5	1	1.5
25. Macrobenthos (record type & abundance)	0	1	2	3
26. Filamentous algae; periphyton	0	1	2	3
27. Iron oxidizing bacteria/fungus	0	0.5	1	1.5
28.Wetland plants in channel bed [2]	0	0.5	1	1.5

[1] Focus is on the presence of terrestrial plants. [2] Focus is on the presence of aquatic or wetland plants.

Total Points = 17

Under Normal Conditions, Watercourse is a Wet Weather Conveyance if Secondary Indicator Score < 19 points

Notes :

Secondary Field Indicator Evaluation

A. **Geomorphology** (Subtotal = 6)	Absent	Weak	Moderate	Strong
1. Continuous bed and bank	0	1	2	3
2. Sinuous channel	0	1	2	3
3. In-channel structure: riffle-pool sequences	0	1	2	3
4. Sorting of soil textures or other substrate	0	1	2	3
5. Active/relic floodplain	0	0.5	1	1.5
6. Depositional bars or benches	0	1	2	3
7. Braided channel	0	1	2	3
8. Recent alluvial deposits	0	0.5	1	1.5
9. Natural levees	0	1	2	3
10. Headcuts	0	1	2	3
11. Grade controls	0	0.5	1	1.5
12. Natural valley or drainageway	0	0.5	1	1.5
13. At least second order channel on existing USGS or NRCS map	No = 0		Yes = 3	

B. **Hydrology** (Subtotal = 5)	Absent	Weak	Moderate	Strong
14. Subsurface flow/discharge into channel	0	1	2	3
15. Water in channel and >48 hours since sig. rain	0	1	1.5 2	3
16. Leaf litter in channel (January – September)	1.5	1	0.5	0
17. Sediment on plants or on debris	0	0.5	1	1.5
18. Organic debris lines or piles (wrack lines)	0	0.5	1	1.5
19. Hydric soils in channel bed or sides of channel	No = 0		Yes = 1.5	

C. **Biology** (Subtotal = 6)	Absent	Weak	Moderate	Strong
20. Fibrous roots in channel bed [1]	3	2	1	0
21. Rooted plants in the thalweg [1]	3	2	1	0
22. Crayfish in stream (exclude in floodplain)	0	1	2	3
23. Bivalves/mussels	0	1	2	3
24. Amphibians	0	0.5	1	1.5
25. Macrobenthos (record type & abundance)	0	1	2	3
26. Filamentous algae; periphyton	0	1	2	3
27. Iron oxidizing bacteria/fungus	0	0.5	1	1.5
28.Wetland plants in channel bed [2]	0	0.5	1	1.5

[1] Focus is on the presence of terrestrial plants. [2] Focus is on the presence of aquatic or wetland plants.

Total Points = 17

Under Normal Conditions, Watercourse is a Wet Weather Conveyance if Secondary Indicator Score < 19 points

Notes :

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA012	
Site Location: e016	
HUC (12 digit): 060102070405	Lat/Long: 84.5000428°W 35.8944576°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

8'W x 3'D Man-made WWC DATOs

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA013	
Site Location: 002	
HUC (12 digit): 060102070405	Lat/Long: 84.5000428°W 35.8944576°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

Flowing water in channel and greater than 7 days since rain event in watershed. 3' x 1' flowing out of a wetland. silt substrate.

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA014	
Site Location: e018	
HUC (12 digit): 060102070405	Lat/Long: 84.4987931°W 35.8942595°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

steep slopes, running through wetland and into BWA13. Ephemeral DATOS

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA015	
Site Location: e017	
HUC (12 digit): 060102070405	Lat/Long: 84.5005624°W 35.8988104°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

3'x3' Man-made WWC, riprap DATOS

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA016	
Site Location: e014	
HUC (12 digit): 060102070405	Lat/Long: 84.5005624°W 35.8988104°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

3'x3' Man-made WWC, riprap DATOS

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA017	
Site Location: e013	
HUC (12 digit): 060102070405	Lat/Long: 84.5017540°W 35.8991534°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

**Overall Hydrologic Determination = ** NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

3'x3' Man-made WWC, riprap DATOS

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA018	
Site Location: e012	
HUC (12 digit): 060102080408	Lat/Long: 84.5041794°W 35.9018821°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40647.238152 acres	County: Roane, Tennessee
Soil Type(s) / Geology :	Source:
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

Man-made WWC, coming from pond 6, culverted under roadway

Hydrologic Determination Field Data Sheet

Tennessee Division of Water Pollution Control, Version 1.5

Named Waterbody: N/a	Date/Time: 3/30/22
Assessors/Affiliation: Brandon Whitley/Cory Chapman TVA	Project ID : KIF
Site Name/Description: BWA018	
Site Location: e012	
HUC (12 digit): 060102070405	Lat/Long: 84.5133563°W 35.8940884°N
Previous Rainfall (7-days) : 0.00	
Precipitation this Season vs. Normal : abnormally wet elevated average low abnormally dry unknown Source of recent & seasonal precip data :	
Watershed Size : 40176.038528 acres	County: Roane, Tennessee
Soil Type(s) / Geology : Source:	
Surrounding Land Use : Industrial	
Degree of historical alteration to natural channel morphology & hydrology (circle one & describe fully in Notes) : Severe Moderate Slight Absent	

Primary Field Indicators Observed

Primary Indicators	NO	YES
1. Hydrologic feature exists solely due to a process discharge		WWC
2. Defined bed and bank absent, vegetation composed of upland and FACU species		WWC
3. Watercourse dry anytime during February through April 15th, under normal precipitation / groundwater conditions		WWC
4. Daily flow and precipitation records showing feature only flows in direct response to rainfall		WWC
5. Presence of multiple populations of obligate lotic organisms with ≥ 2 month aquatic phase		Stream
6. Presence of fish (except *Gambusia*)		Stream
7. Presence of naturally occurring ground water table connection		Stream
8. Flowing water in channel and 7 days since last precip >0.1" in local watershed		Stream
9. Evidence watercourse has been used as a supply of drinking water		Stream

NOTE: If any Primary Indicators 1-9 = "Yes", then no further investigation is necessary. However, assessors may choose to score secondary indicators as supporting evidence.

In the absence of a primary indicator, or other definitive evidence, complete the secondary indicator table on page 2 of this sheet, and provide score below.

Guidance for the interpretation and scoring of both the primary & secondary indicators is provided in *TDEC-WPC Guidance For Making Hydrologic Determinations, Version 1.5*

Overall Hydrologic Determination = NOT a Stream

Secondary Indicator Score (if applicable) =

Justification / Notes :

Man-made WWC, culverted under roadway

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022-2023

W001 – PFO1E; 0.13 acres. TRAM = (39) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022-2023

W002 – PEM1E; 0.03 acres.

TRAM = (13) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022-2023

W003 – PEM1Hr; 0.11 acres. TRAM = (23) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022-2023

W004 – PEM1E; 0.43 acres.

TRAM = (23) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022-2023

W005 – PFO1E; 0.10 acres.

TRAM = (43) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022-2023

W006 – PEM1E; 0.11 acres. TRAM = (36) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022-2023

W007 – PEM1E; 0.01 acres.

TRAM = (15) Low

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland “buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.	1	
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.50
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.	5	
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3	
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.		2b Avg.= 4.00

KIF Retirement

PID#39170

W001

Metric 2 Total 4.50

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	3
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	1
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	1
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	1
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	1

3d Avg.= 1.00

KIF Retirement

PID#39170

W001

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	7.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
7.00

KIF Retirement

Metric 3 Total 16.00

PID#39170

W001

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.	Examples of substrate/soil disturbance include (circle all that apply): ____filling and grading ____plowing ____grazing (hooves) ____vehicle use (off-road vehicles, construction vehicles) ____sedimentation ____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES	NO	NOT SURE
	Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 4 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	5.0
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
5.00

4c. Habitat alteration. This question evaluates the “intactness” the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to “double check” and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	6.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 6.00

Metric 4 Total 14

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present <u>both vertically and horizontally</u> within the wetland with an area of at least 0.1 hectares or $1000m^2$ (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	0.00
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	3.0
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

W001

PID#39170

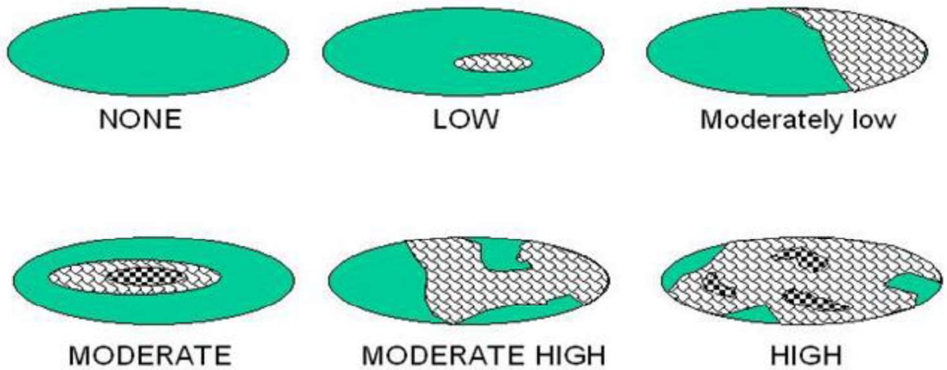

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	Narrative description
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 3

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	4.5
	Metric 3: Hydrology	16
	Metric 4: Habitat	14
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	3
	TOTAL SCORE	39

KIF Retirement

PID#39170

W001

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
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3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland “buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3	
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1	2b Avg.= 2.00

KIF Retirement

PID#39170

W002

Metric 2 Total 2.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located <u>between</u> a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a p other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	1

3d Avg.= 1.00

KIF Retirement

PID#39170

W002

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	<u>YES</u> Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	<u>NO</u> Assign a score of 12 since there are no or no apparent modifications.	<u>NOT SURE</u> Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	1

3e Avg= 1.00

KIF Retirement

Metric 3 Total 4.00

PID#39170

W002

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include (circle all that apply):
____filling and grading
____plowing
____grazing (hooves)
____vehicle use (off-road vehicles, construction vehicles)
____sedimentation
____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	2.0
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
2.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	2.0
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
2.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

X	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	1.00

4c Avg. = 1.00

Metric 4 Total 5

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of “aquatic bed." Aquatic beds often occur as a distinct zone as an “understory” below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are “vernal pools”.	
5)Mudflats The “mudflat” class is equivalent to the “unconsolidated bottom/mud” class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The “open water” class is equivalent to the “open water - unknown bottom” class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and “open”, i.e. there is no “canopy” of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	1.00
0pt NONE Wetland has no plan view interspersion	

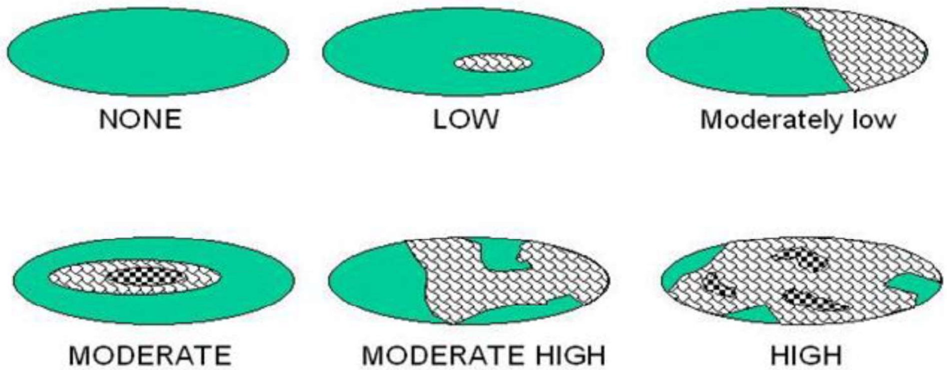

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 1

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	2
	Metric 3: Hydrology	4
	Metric 4: Habitat	5
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	1
	TOTAL SCORE	13

KIF Retirement

PID#39170

W002

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

KIF Retirement

PID#39170

W003
3/30/2022
FPH

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3	
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1	2b Avg.= 2.00

KIF Retirement

PID#39170

W003

Metric 2 Total 2.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	4
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 4.00

KIF Retirement

PID#39170

W003

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

	YES	NO	NOT SURE
Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 12 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		score
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	3
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
3.00

KIF Retirement

Metric 3 Total 9.00

PID#39170

W003

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include (circle all that apply):

____filling and grading
____plowing
____grazing (hooves)
____vehicle use (off-road vehicles, construction vehicles)
____sedimentation
____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	2.0
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.= 2.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	4.0
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.= 4.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants	X	Other (specify): ROW Managed
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	3.0
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 3.00

Metric 4 Total 9

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present <u>both vertically and horizontally</u> within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of “aquatic bed." Aquatic beds often occur as a distinct zone as an “understory” below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are “vernal pools”.	
5)Mudflats The “mudflat” class is equivalent to the “unconsolidated bottom/mud” class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The “open water” class is equivalent to the “open water - unknown bottom” class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and “open”, i.e. there is no “canopy” of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.		Score
5pts	HIGH Wetland has a high degree of interspersion	
4pts	MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts	MODERATE Wetland has a moderate degree of interspersion	
2pts	MODERATELY LOW Wetland has a moderately low degree of interspersion	2.0
1pt	LOW Wetland has a low degree of interspersion.	
0pt	NONE Wetland has no plan view interspersion	

KIF Retirement

W003

PID#39170

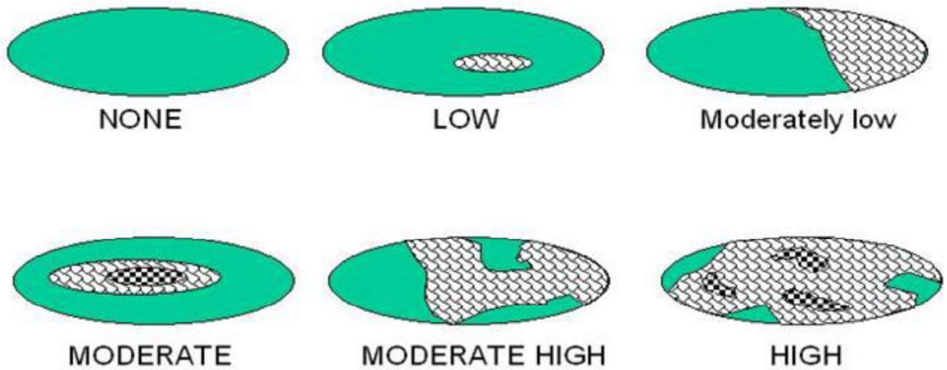

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	Narrative description
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 2

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	2
	Metric 3: Hydrology	9
	Metric 4: Habitat	9
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	2
	TOTAL SCORE	23

KIF Retirement

PID#39170

W003

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland “buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.		
7pts	WIDE. >50m (164ft) or more around perimeter.	
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.	
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.	1
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.		
7pts	VERY LOW. 2^{nd} growth or older forest, prairie, barren, wildlife area, etc.	
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.	
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	

2a Avg.= 0.50

2b Avg.= 3.00

KIF Retirement

PID#39170

W004

Metric 2 Total 3.50

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	1

3d Avg.= 1.00

KIF Retirement

PID#39170

W004

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	3
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg= 3.00

KIF Retirement

Metric 3 Total 6.00

PID#39170

W004

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include (circle all that apply):

____filling and grading

____plowing

____grazing (hooves)

____vehicle use (off-road vehicles, construction vehicles)

____sedimentation

____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.= 3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	4.0
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears <u>not</u> to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.= 4.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants	X	Other (specify): ROW Managed
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES	NO	NOT SURE
	Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 9 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	3.0
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 3.00

Metric 4 Total 10

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	2.0
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

W004

PID#39170

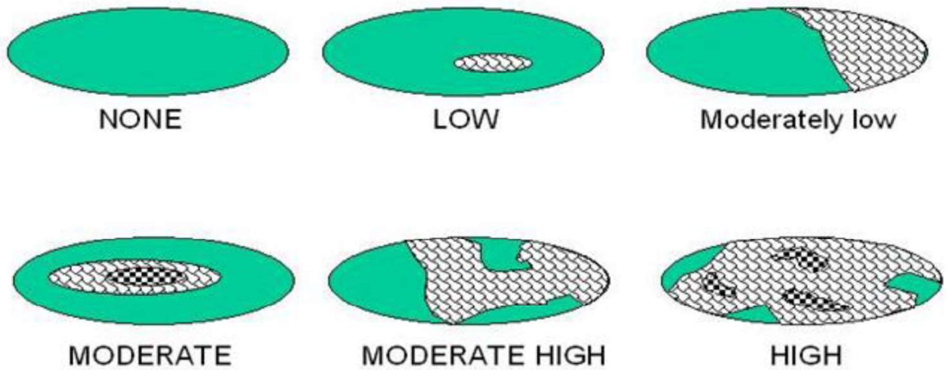

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.	Score
-5pts Extensive >75% areal cover of invasive species	
-3pts Moderate 25-75% areal cover of invasive species	
-1pts Sparse 5-25% areal cover of invasive species	
0pt Nearly absent. <5% areal cover of invasive species	0
1pt Absent	
6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 2

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	3.5
	Metric 3: Hydrology	6
	Metric 4: Habitat	10
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	2
	TOTAL SCORE	23

KIF Retirement

PID#39170

W004

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

Quantitative Rating
Tennessee Rapid Assessment Method

W005
3/30/2022
FPH

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland “buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.	7	
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.		2a Avg.= 7.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.	5	
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.		
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.		2b Avg.= 5.00

KIF Retirement

PID#39170

W005

Metric 2 Total 12.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	1
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	3
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 3.00

KIF Retirement

PID#39170

W005

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	7.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
7.00

KIF Retirement

Metric 3 Total 13.00

PID#39170

W005

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.	Examples of substrate/soil disturbance include (circle all that apply): ____filling and grading ____plowing ____grazing (hooves) ____vehicle use (off-road vehicles, construction vehicles) ____sedimentation ____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.			
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.		
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.		
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.		4a Avg.= 3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.		
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.		
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	5.0	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.		
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.		
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.		
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.		4b Avg.= 5.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	6.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 6.00

Metric 4 Total 14

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	0.00
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	3.0
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

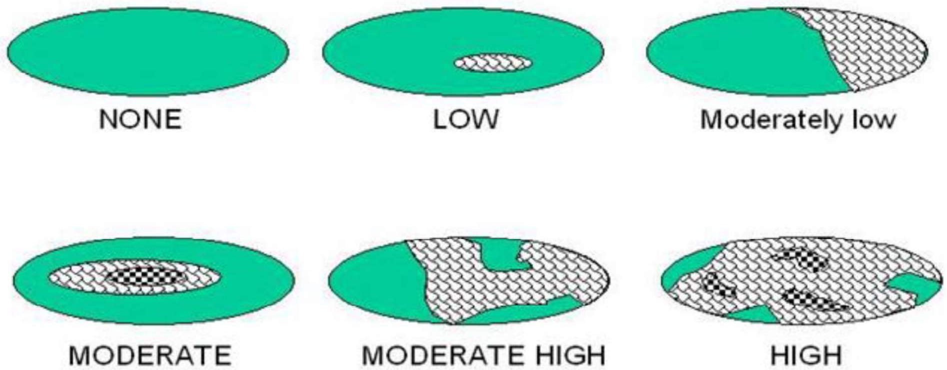

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 3

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	12
	Metric 3: Hydrology	13
	Metric 4: Habitat	14
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	3
	TOTAL SCORE	43

KIF Retirement

PID#39170

W005

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
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3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.		
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1	2b Avg.= 1.00

KIF Retirement

PID#39170

W006

Metric 2 Total 1.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	3
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	1
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	4
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 4.00

KIF Retirement

PID#39170

W006

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

	YES	NO	NOT SURE
Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 12 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		score
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	7.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
7.00

KIF Retirement

Metric 3 Total 17.00

PID#39170

W006

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed “habitat alteration.” In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland’s habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include (circle all that apply):

____filling and grading
____plowing
____grazing (hooves)
____vehicle use (off-road vehicles, construction vehicles)
____sedimentation
____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES	NO	NOT SURE
	Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 4 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	5.0
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
5.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	6.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 6.00

Metric 4 Total 14

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.		Score
5pts	HIGH Wetland has a high degree of interspersion	
4pts	MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts	MODERATE Wetland has a moderate degree of interspersion	3.0
2pts	MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt	LOW Wetland has a low degree of interspersion.	
0pt	NONE Wetland has no plan view interspersion	

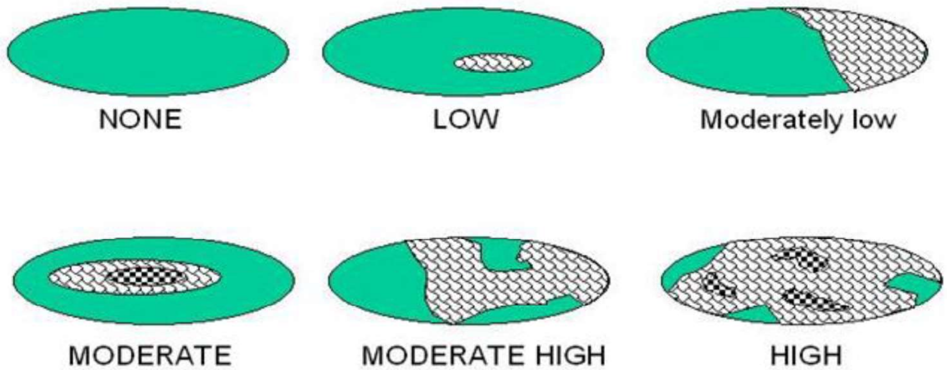

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 3

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	1
	Metric 3: Hydrology	17
	Metric 4: Habitat	14
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	3
	TOTAL SCORE	36

KIF Retirement

PID#39170

W006

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value." (TRAM 2015, pg 2)

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland “buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.		
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1	2b Avg.= 1.00

KIF Retirement

PID#39170

W007

Metric 2 Total 1.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	3
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 3.00

KIF Retirement

PID#39170

W007

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

	YES	NO	NOT SURE
Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 12 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		score	
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.		
7pts	RECOVERED. The wetland appears to have recovered from past modifications.		
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.		3e Avg=
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	1	1.00

KIF Retirement

Metric 3 Total 6.00

PID#39170

W007

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.	Examples of substrate/soil disturbance include (circle all that apply): ____filling and grading ____plowing ____grazing (hooves) ____vehicle use (off-road vehicles, construction vehicles) ____sedimentation ____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	2.0
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.= 2.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	3.0
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears <u>not</u> to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.= 3.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

X	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	<u>YES</u> Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	<u>NO</u> Assign a score of 9 since there are no or no apparent modifications.	<u>NOT SURE</u> Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	1.00

4c Avg. = 1.00

Metric 4 Total 6

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present <u>both vertically and horizontally</u> within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of “aquatic bed." Aquatic beds often occur as a distinct zone as an “understory” below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are “vernal pools”.	
5)Mudflats The “mudflat” class is equivalent to the “unconsolidated bottom/mud” class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The “open water” class is equivalent to the “open water - unknown bottom” class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and “open”, i.e. there is no “canopy” of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	1.00
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

W007

PID#39170

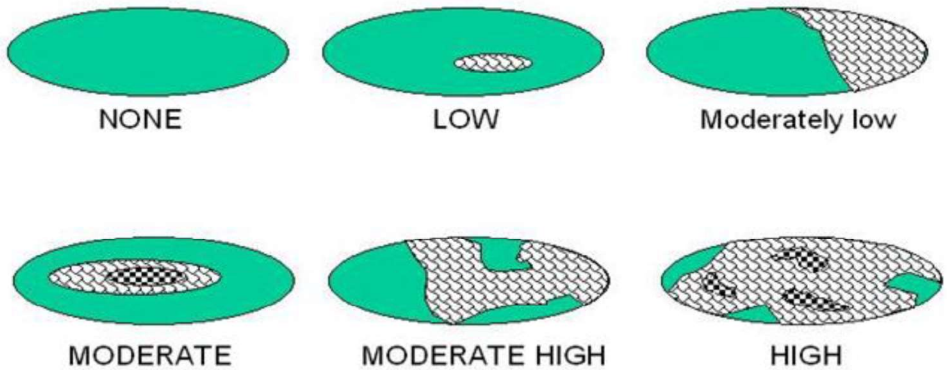

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.	Score
-5pts Extensive >75% areal cover of invasive species	
-3pts Moderate 25-75% areal cover of invasive species	
-1pts Sparse 5-25% areal cover of invasive species	
0pt Nearly absent. <5% areal cover of invasive species	0
1pt Absent	
6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 1

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	1
	Metric 3: Hydrology	6
	Metric 4: Habitat	6
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	1
	TOTAL SCORE	15

KIF Retirement

PID#39170

W007

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

WETLAND DETERMINATION DATA FORM - Eastern Mountains and Piedmont Region

Project/Site: KIF Retirement 39170 **City/County:** ROANE **Sampling Date:** 30-Mar-22

Applicant/Owner: TVA **State:** TN **Sampling Point:** **W001**

Investigator(s): Fallon Parker Hutcheon **Section, Township, Range: S** **T** **R**

Landform (hillslope, terrace, etc.): Shoreline **Local relief (concave, convex, none):** hummocky **Slope:** 0.0% / 0.0 °

Subregion (LRR or MLRA): LRR N **Lat.:** 35.8941708 **Long.:** -84.5002456 **Datum:** NAD83

Soil Map Unit Name: Waynesboro loam **NWI classification:** PFO1E

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ◉ No ○	
Hydric Soil Present? Yes ◉ No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Wetland Hydrology Present? Yes ◉ No ○	

Remarks:

Forested wetland fringe to reservoir. 0.13 acres. FPH_Photo#DSCN5904-05. TRAM score = (39) Low

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☐ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○ No ◉	Depth (inches):	
Water Table Present?	Yes ○ No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ○ No ◉	Depth (inches):	

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five/Four Strata)- Use scientific names of plants.

Sampling Point: W001

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1. Platanus occidentalis	40	☑	50.0%	FACW
2. Salix nigra	10	☐	12.5%	OBL
3. Alnus serrulata	30	☑	37.5%	OBL
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
	80	= Total Cover		
Sapling-Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
	0	= Total Cover		
Shrub Stratum (Plot size:)				
1. Ligustrum sinense	10	☑	100.0%	FACU
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	10	= Total Cover		
Herb Stratum (Plot size:)				
1. Carex vulpinoidea	15	☑	60.0%	OBL
2. Juncus effusus	10	☑	40.0%	FACW
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	25	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
	0	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC:	4	(A)
Total Number of Dominant Species Across All Strata:	5	(B)
Percent of dominant Species That Are OBL, FACW, or FAC:	80.0%	(A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	55	x 1 =	55
FACW species	50	x 2 =	100
FAC species	0	x 3 =	0
FACU species	10	x 4 =	40
UPL species	0	x 5 =	0
Column Totals:	115	(A)	195 (B)

Prevalence Index = B/A = 1.696

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definition of Vegetation Strata:

Four Vegetation Strata:

Tree stratum – Consists of woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub stratum – Consists of woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb stratum – Consists of all herbaceous (non-woody) plants, regardless of size, and all other plants less than 3.28 ft tall.

Woody vines – Consists of all woody vines greater than 3.28 ft in height.

Five Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling stratum – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub stratum – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb stratum – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vines – Consists of all woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: W001

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-2	7.5YR	3/1	100						Loam	
2-12	10YR	4/6	75	10YR	6/4	15	C	M	Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10) (LRR N)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1) (LRR N, MLRA 147, 148)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7)
- ☐ Polyvalue Below Surface (S8) (MLRA 147,148)
- ☐ Thin Dark Surface (S9) (MLRA 147, 148)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Iron-Manganese Masses (F12) (LRR N, MLRA 136)
- ☐ Umbric Surface (F13) (MLRA 136, 122)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 148)
- ☐ Red Parent Material (F21) (MLRA 127, 147)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (MLRA 147)
- ☐ Coast Prairie Redox (A16) (MLRA 147,148)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 136, 147)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

* roots too obstructing after 12 inches

WETLAND DETERMINATION DATA FORM - Eastern Mountains and Piedmont Region

Project/Site: KIF Retirement 39170 **City/County:** ROANE **Sampling Date:** 30-Mar-22

Applicant/Owner: TVA **State:** TN **Sampling Point:** **W002**

Investigator(s): Fallon Parker Hutcheon **Section, Township, Range: S** **T** **R**

Landform (hillslope, terrace, etc.): Swale **Local relief (concave, convex, none):** concave **Slope:** 0.0% / 0.0 °

Subregion (LRR or MLRA): LRR N **Lat.:** 35.8948153 **Long.:** -84.5002172 **Datum:** NAD83

Soil Map Unit Name: Waynesboro loam **NWI classification:** PEM1E

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ○	**Is the Sampled Area within a Wetland?** Yes (●) No ○
Hydric Soil Present?	Yes (●) No ○	
Wetland Hydrology Present?	Yes (●) No ○	

Remarks:
Emergent wetland swale draining to reservoir, mowed. 0.03 acres. FPH_Photo#DSCN5915. TRAM score = (13) Low

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○ No (●)	Depth (inches):	
Water Table Present?	Yes ○ No (●)	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes (●) No ○	Depth (inches):	

Wetland Hydrology Present? Yes (●) No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five/Four Strata)- Use scientific names of plants.

Sampling Point: W002

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
	0	= Total Cover		
Sapling-Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
	0	= Total Cover		
Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size:)				
1. Carex vulpinoidea	30	☑	35.3%	OBL
2. Juncus effusus	20	☑	23.5%	FACW
3. Rumex crispus	5	☐	5.9%	FAC
4. Festuca arundinacea	30	☑	35.3%	FACU
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	85	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
	0	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 66.7% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	30	x 1 =	30
FACW species	20	x 2 =	40
FAC species	5	x 3 =	15
FACU species	30	x 4 =	120
UPL species	0	x 5 =	0
Column Totals:	85 (A)		205 (B)

Prevalence Index = B/A = 2.412

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definition of Vegetation Strata:

Four Vegetation Strata:

Tree stratum – Consists of woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub stratum – Consists of woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb stratum – Consists of all herbaceous (non-woody) plants, regardless of size, and all other plants less than 3.28 ft tall.

Woody vines – Consists of all woody vines greater than 3.28 ft in height.

Five Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling stratum – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub stratum – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb stratum – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vines – Consists of all woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: W002

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-2	7.5YR	3/1	100						Loam	
2-16	10YR	4/6	75	10YR	6/4	15	C	M	Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10) (LRR N)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1) (LRR N, MLRA 147, 148)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7)
- ☐ Polyvalue Below Surface (S8) (MLRA 147,148)
- ☐ Thin Dark Surface (S9) (MLRA 147, 148)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Iron-Manganese Masses (F12) (LRR N, MLRA 136)
- ☐ Umbric Surface (F13) (MLRA 136, 122)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 148)
- ☐ Red Parent Material (F21) (MLRA 127, 147)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (MLRA 147)
- ☐ Coast Prairie Redox (A16) (MLRA 147,148)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 136, 147)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

WETLAND DETERMINATION DATA FORM - Eastern Mountains and Piedmont Region

Project/Site: KIF Retirement 39170 **City/County:** ROANE **Sampling Date:** 30-Mar-22

Applicant/Owner: TVA **State:** TN **Sampling Point:** **W003**

Investigator(s): Fallon Parker Hutcheon **Section, Township, Range: S** **T** **R**

Landform (hillslope, terrace, etc.): Shoreline **Local relief (concave, convex, none):** concave **Slope:** 0.0% / 0.0 °

Subregion (LRR or MLRA): LRR N **Lat.:** 35.8961844 **Long.:** -84.4990040 **Datum:** NAD83

Soil Map Unit Name: Waynesboro loam **NWI classification:** PEM1Hr

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉ No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Hydric Soil Present?	Yes ◉ No ○	
Wetland Hydrology Present?	Yes ◉ No ○	

Remarks:
Emergent wetland fringe in manmade pond, disturbed. 0.11 acres. FPH_Photo#DSCN5930-31. TRAM score = (23) Low

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ◉ No ○	Depth (inches):	10
Water Table Present?	Yes ◉ No ○	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ◉ No ○	Depth (inches):	

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five/Four Strata)- Use scientific names of plants.

Sampling Point: W003

Tree Stratum (Plot size: ______)

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
	0	= Total Cover		

Sapling-Sapling/Shrub Stratum (Plot size: ______)

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1. Salix nigra	5	☑	100.0%	OBL
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
	5	= Total Cover		

Shrub Stratum (Plot size: ______)

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	= Total Cover		

Herb Stratum (Plot size: ______)

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1. Typha latifolia	70	☑	87.5%	OBL
2. Andropogon glomeratus	10	☐	12.5%	FACW
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	80	= Total Cover		

Woody Vine Stratum (Plot size: ______)

	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
	0	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	75	x 1 =	75
FACW species	10	x 2 =	20
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	85 (A)		95 (B)

Prevalence Index = B/A = 1.118

Hydrophytic Vegetation Indicators:

- ☑ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definition of Vegetation Strata:

Four Vegetation Strata:

Tree stratum – Consists of woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub stratum – Consists of woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb stratum – Consists of all herbaceous (non-woody) plants, regardless of size, and all other plants less than 3.28 ft tall.

Woody vines – Consists of all woody vines greater than 3.28 ft in height.

Five Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling stratum – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub stratum – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb stratum – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vines – Consists of all woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: W003

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc[2]	Texture	Remarks
0-5	10YR	4/6	95	10YR	6/4	5	C	M	Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains [2]Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- [ ] Histosol (A1)
- [ ] Histic Epipedon (A2)
- [ ] Black Histic (A3)
- [ ] Hydrogen Sulfide (A4)
- [ ] Stratified Layers (A5)
- [ ] 2 cm Muck (A10) (LRR N)
- [ ] Depleted Below Dark Surface (A11)
- [ ] Thick Dark Surface (A12)
- [ ] Sandy Muck Mineral (S1) (LRR N, MLRA 147, 148)
- [ ] Sandy Gleyed Matrix (S4)
- [ ] Sandy Redox (S5)
- [ ] Stripped Matrix (S6)
- [ ] Dark Surface (S7)
- [ ] Polyvalue Below Surface (S8) (MLRA 147,148)
- [ ] Thin Dark Surface (S9) (MLRA 147, 148)
- [ ] Loamy Gleyed Matrix (F2)
- [x] Depleted Matrix (F3)
- [ ] Redox Dark Surface (F6)
- [ ] Depleted Dark Surface (F7)
- [ ] Redox Depressions (F8)
- [ ] Iron-Manganese Masses (F12) (LRR N, MLRA 136)
- [ ] Umbric Surface (F13) (MLRA 136, 122)
- [ ] Piedmont Floodplain Soils (F19) (MLRA 148)
- [ ] Red Parent Material (F21) (MLRA 127, 147)

Indicators for Problematic Hydric Soils[3]:

- [ ] 2 cm Muck (A10) (MLRA 147)
- [ ] Coast Prairie Redox (A16) (MLRA 147,148)
- [ ] Piedmont Floodplain Soils (F19) (MLRA 136, 147)
- [ ] Very Shallow Dark Surface (TF12)
- [ ] Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes (●) No ( )

Remarks: *Riprap below 5"

WETLAND DETERMINATION DATA FORM - Eastern Mountains and Piedmont Region

Project/Site: KIF Retirement 39170 **City/County:** ROANE **Sampling Date:** 30-Mar-22

Applicant/Owner: TVA **State:** TN **Sampling Point:** **W004**

Investigator(s): Fallon Parker Hutcheon **Section, Township, Range: S** **T** **R**

Landform (hillslope, terrace, etc.): Swale **Local relief (concave, convex, none):** concave **Slope:** 0.0% / 0.0 °

Subregion (LRR or MLRA): LRR N **Lat.:** 35.8951150 **Long.:** -84.4974135 **Datum:** NAD83

Soil Map Unit Name: Waynesboro loam **NWI classification:** PEM1E

Are climatic/hydrologic conditions on the site typical for this time of year? Yes (●) No ( ) **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes (●) No ( )

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes (●) No ( )	**Is the Sampled Area within a Wetland?** Yes (●) No ( )
Hydric Soil Present?	Yes (●) No ( )	
Wetland Hydrology Present?	Yes (●) No ( )	

Remarks:

Emergent wetland swale in TL ROW. 0.43 acres. FPH_Photo#DSCN5934. TRAM score = (23) Low

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes (●) No ( )	Depth (inches):	0.5
Water Table Present?	Yes (●) No ( )	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes (●) No ( )	Depth (inches):	

Wetland Hydrology Present? Yes (●) No ( )

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five/Four Strata)- Use scientific names of plants.

Sampling Point: W004

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
	0	= Total Cover		
Sapling-Sapling/Shrub Stratum (Plot size:)				
1. Salix nigra	5	☑	100.0%	OBL
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
	5	= Total Cover		
Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size:)				
1. Juncus effusus	30	☑	31.6%	FACW
2. Andropogon glomeratus	30	☑	31.6%	FACW
3. Carex vulpinoidea	10	☐	10.5%	OBL
4. Scirpus atrovirens	5	☐	5.3%	OBL
5. Festuca arundinacea	20	☑	21.1%	FACU
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	95	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
	0	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 4 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 75.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	20	x 1 =	20
FACW species	60	x 2 =	120
FAC species	0	x 3 =	0
FACU species	20	x 4 =	80
UPL species	0	x 5 =	0
Column Totals:	100 (A)		220 (B)

Prevalence Index = B/A = 2.200

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definition of Vegetation Strata:

Four Vegetation Strata:

Tree stratum – Consists of woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub stratum – Consists of woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb stratum – Consists of all herbaceous (non-woody) plants, regardless of size, and all other plants less than 3.28 ft tall.

Woody vines – Consists of all woody vines greater than 3.28 ft in height.

Five Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling stratum – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub stratum – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb stratum – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vines – Consists of all woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: W004

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-18	10YR	4/6	95	10YR	6/4	5	C	M	Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10) (LRR N)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1) (LRR N, MLRA 147, 148)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7)
- ☐ Polyvalue Below Surface (S8) (MLRA 147,148)
- ☐ Thin Dark Surface (S9) (MLRA 147, 148)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Iron-Manganese Masses (F12) (LRR N, MLRA 136)
- ☐ Umbric Surface (F13) (MLRA 136, 122)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 148)
- ☐ Red Parent Material (F21) (MLRA 127, 147)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (MLRA 147)
- ☐ Coast Prairie Redox (A16) (MLRA 147,148)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 136, 147)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

WETLAND DETERMINATION DATA FORM - Eastern Mountains and Piedmont Region

Project/Site: KIF Retirement 39170 **City/County:** ROANE **Sampling Date:** 30-Mar-22

Applicant/Owner: TVA **State:** TN **Sampling Point:** **W005**

Investigator(s): Fallon Parker Hutcheon **Section, Township, Range: S** **T** **R**

Landform (hillslope, terrace, etc.): Gulch or Gully **Local relief (concave, convex, none):** concave **Slope:** 0.0% / 0.0 °

Subregion (LRR or MLRA): LRR N **Lat.:** 35.8942878 **Long.:** -84.4989506 **Datum:** NAD83

Soil Map Unit Name: Waynesboro loam **NWI classification:** PFO1E

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉ No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Hydric Soil Present?	Yes ◉ No ○	
Wetland Hydrology Present?	Yes ◉ No ○	

Remarks:

Forested wetland depression surrounding conveyances. 0.10 acres. FPH_Photo#DSCN5936. TRAM score = (43) Low

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☐ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ◉ No ○	Depth (inches):	0.5
Water Table Present?	Yes ◉ No ○	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ◉ No ○	Depth (inches):	

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five/Four Strata)- Use scientific names of plants.

Sampling Point: W005

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1. Acer rubrum	30	☑	37.5%	FAC
2. Liquidambar styraciflua	20	☑	25.0%	FAC
3. Platanus occidentalis	30	☑	37.5%	FACW
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
	80	= Total Cover		
Sapling-Sapling/Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
	0	= Total Cover		
Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	0	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
	0	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 3 (A)

Total Number of Dominant Species Across All Strata: 3 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	0	x 1 =	0
FACW species	30	x 2 =	60
FAC species	50	x 3 =	150
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	80	(A)	210 (B)

Prevalence Index = B/A = 2.625

Hydrophytic Vegetation Indicators:

- ☐ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definition of Vegetation Strata:

Four Vegetation Strata:

Tree stratum – Consists of woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub stratum – Consists of woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb stratum – Consists of all herbaceous (non-woody) plants, regardless of size, and all other plants less than 3.28 ft tall.

Woody vines – Consists of all woody vines greater than 3.28 ft in height.

Five Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling stratum – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub stratum – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb stratum – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vines – Consists of all woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Unidentifiable sedge species

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: W005

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-18	10YR	4/6	95	10YR	6/4	5	C	M	Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10) (LRR N)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1) (LRR N, MLRA 147, 148)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7)
- ☐ Polyvalue Below Surface (S8) (MLRA 147,148)
- ☐ Thin Dark Surface (S9) (MLRA 147, 148)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Iron-Manganese Masses (F12) (LRR N, MLRA 136)
- ☐ Umbric Surface (F13) (MLRA 136, 122)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 148)
- ☐ Red Parent Material (F21) (MLRA 127, 147)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (MLRA 147)
- ☐ Coast Prairie Redox (A16) (MLRA 147,148)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 136, 147)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

WETLAND DETERMINATION DATA FORM - Eastern Mountains and Piedmont Region

Project/Site: KIF Retirement 39170 **City/County:** ROANE **Sampling Date:** 30-Mar-22

Applicant/Owner: TVA **State:** TN **Sampling Point:** **W006**

Investigator(s): Fallon Parker Hutcheon **Section, Township, Range: S** **T** **R**

Landform (hillslope, terrace, etc.): Gulch or Gully **Local relief (concave, convex, none):** concave **Slope:** 0.0% / 0.0 °

Subregion (LRR or MLRA): LRR N **Lat.:** 35.8979714 **Long.:** -84.5008612 **Datum:** NAD83

Soil Map Unit Name: Waynesboro loam **NWI classification:** PEM1E

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉ No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Hydric Soil Present?	Yes ◉ No ○	
Wetland Hydrology Present?	Yes ◉ No ○	

Remarks:

Emergent wetland depression retaining drainage. 0.11 acres. FPH_Photo#DSCN5939-40. TRAM score = (36) Low

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☑ Surface Water (A1)
- ☑ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☑ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ◉ No ○	Depth (inches): 3
Water Table Present?	Yes ◉ No ○	Depth (inches):
Saturation Present? (includes capillary fringe)	Yes ◉ No ○	Depth (inches):

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five/Four Strata)- Use scientific names of plants.

Sampling Point: W006

Tree Stratum (Plot size:)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
	0	= Total Cover		
Sapling-Sapling/Shrub Stratum (Plot size:)				
1. Salix nigra	10	☑	100.0%	OBL
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
	10	= Total Cover		
Shrub Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	= Total Cover		
Herb Stratum (Plot size:)				
1. Typha latifolia	95	☑	90.5%	OBL
2. Scirpus atrovirens	10	☐	9.5%	OBL
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	105	= Total Cover		
Woody Vine Stratum (Plot size:)				
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
	0	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	115	x 1 =	115
FACW species	0	x 2 =	0
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	115 (A)		115 (B)

Prevalence Index = B/A = 1.000

Hydrophytic Vegetation Indicators:

- ☑ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definition of Vegetation Strata:

Four Vegetation Strata:

Tree stratum – Consists of woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub stratum – Consists of woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb stratum – Consists of all herbaceous (non-woody) plants, regardless of size, and all other plants less than 3.28 ft tall.

Woody vines – Consists of all woody vines greater than 3.28 ft in height.

Five Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling stratum – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub stratum – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb stratum – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vines – Consists of all woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Unidentifiable sedge species

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: W006

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-18	10YR	4/6	95	10YR	6/4	5	C	M	Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- ☐ Histosol (A1)
- ☐ Histic Epipedon (A2)
- ☐ Black Histic (A3)
- ☐ Hydrogen Sulfide (A4)
- ☐ Stratified Layers (A5)
- ☐ 2 cm Muck (A10) (LRR N)
- ☐ Depleted Below Dark Surface (A11)
- ☐ Thick Dark Surface (A12)
- ☐ Sandy Muck Mineral (S1) (LRR N, MLRA 147, 148)
- ☐ Sandy Gleyed Matrix (S4)
- ☐ Sandy Redox (S5)
- ☐ Stripped Matrix (S6)
- ☐ Dark Surface (S7)
- ☐ Polyvalue Below Surface (S8) (MLRA 147,148)
- ☐ Thin Dark Surface (S9) (MLRA 147, 148)
- ☐ Loamy Gleyed Matrix (F2)
- ☑ Depleted Matrix (F3)
- ☐ Redox Dark Surface (F6)
- ☐ Depleted Dark Surface (F7)
- ☐ Redox Depressions (F8)
- ☐ Iron-Manganese Masses (F12) (LRR N, MLRA 136)
- ☐ Umbric Surface (F13) (MLRA 136, 122)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 148)
- ☐ Red Parent Material (F21) (MLRA 127, 147)

Indicators for Problematic Hydric Soils[3]:

- ☐ 2 cm Muck (A10) (MLRA 147)
- ☐ Coast Prairie Redox (A16) (MLRA 147,148)
- ☐ Piedmont Floodplain Soils (F19) (MLRA 136, 147)
- ☐ Very Shallow Dark Surface (TF12)
- ☐ Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes ◉ No ○

Remarks:

WETLAND DETERMINATION DATA FORM - Eastern Mountains and Piedmont Region

Project/Site: KIF Retirement 39170 **City/County:** ROANE **Sampling Date:** 30-Mar-22

Applicant/Owner: TVA **State:** TN **Sampling Point:** **W007**

Investigator(s): Fallon Parker Hutcheon **Section, Township, Range: S** **T** **R**

Landform (hillslope, terrace, etc.): Swale **Local relief (concave, convex, none):** concave **Slope:** 0.0% / 0.0 °

Subregion (LRR or MLRA): LRR N **Lat.:** 35.8982769 **Long.:** -84.5007154 **Datum:** NAD83

Soil Map Unit Name: Waynesboro loam **NWI classification:** PEM1E

Are climatic/hydrologic conditions on the site typical for this time of year? Yes ◉ No ○ **(If no, explain in Remarks.)**

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **significantly disturbed?** **Are "Normal Circumstances" present?** Yes ◉ No ○

Are Vegetation ☐ **, Soil** ☐ **, or Hydrology** ☐ **naturally problematic?** **(If needed, explain any answers in Remarks.)**

Summary of Findings - Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ◉ No ○	**Is the Sampled Area within a Wetland?** Yes ◉ No ○
Hydric Soil Present?	Yes ◉ No ○	
Wetland Hydrology Present?	Yes ◉ No ○	

Remarks:

Emergent wetland depression, saturated. 0.01 acres. FPH_Photo#W007. TRAM score = (15) Low

Hydrology

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ☐ Surface Water (A1)
- ☐ High Water Table (A2)
- ☑ Saturation (A3)
- ☐ Water Marks (B1)
- ☐ Sediment Deposits (B2)
- ☐ Drift deposits (B3)
- ☐ Algal Mat or Crust (B4)
- ☑ Iron Deposits (B5)
- ☐ Inundation Visible on Aerial Imagery (B7)
- ☐ Water-Stained Leaves (B9)
- ☐ Aquatic Fauna (B13)
- ☐ True Aquatic Plants (B14)
- ☐ Hydrogen Sulfide Odor (C1)
- ☐ Oxidized Rhizospheres along Living Roots (C3)
- ☐ Presence of Reduced Iron (C4)
- ☐ Recent Iron Reduction in Tilled Soils (C6)
- ☐ Thin Muck Surface (C7)
- ☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

- ☐ Surface Soil Cracks (B6)
- ☐ Sparsely Vegetated Concave Surface (B8)
- ☐ Drainage Patterns (B10)
- ☐ Moss Trim Lines (B16)
- ☐ Dry Season Water Table (C2)
- ☐ Crayfish Burrows (C8)
- ☐ Saturation Visible on Aerial Imagery (C9)
- ☐ Stunted or Stressed Plants (D1)
- ☑ Geomorphic Position (D2)
- ☐ Shallow Aquitard (D3)
- ☐ Microtopographic Relief (D4)
- ☑ FAC-neutral Test (D5)

Field Observations:

Surface Water Present?	Yes ○ No ◉	Depth (inches):	
Water Table Present?	Yes ○ No ◉	Depth (inches):	
Saturation Present? (includes capillary fringe)	Yes ◉ No ○	Depth (inches):	

Wetland Hydrology Present? Yes ◉ No ○

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION (Five/Four Strata)- Use scientific names of plants.

Sampling Point: W007

Tree Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
	0	= Total Cover		

Sapling-Sapling/Shrub Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
	0	= Total Cover		

Shrub Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
	0	= Total Cover		

Herb Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1. Typha latifolia	40	☑	50.0%	OBL
2. Juncus effusus	20	☑	25.0%	FACW
3. Carex vulpinoidea	10	☐	12.5%	OBL
4. Eleocharis acicularis	10	☐	12.5%	OBL
5.	0	☐	0.0%	
6.	0	☐	0.0%	
7.	0	☐	0.0%	
8.	0	☐	0.0%	
9.	0	☐	0.0%	
10.	0	☐	0.0%	
11.	0	☐	0.0%	
12.	0	☐	0.0%	
	80	= Total Cover		

Woody Vine Stratum (Plot size: ______)	Absolute % Cover	Dominant Species?	Rel.Strat. Cover	Indicator Status
1.	0	☐	0.0%	
2.	0	☐	0.0%	
3.	0	☐	0.0%	
4.	0	☐	0.0%	
5.	0	☐	0.0%	
6.	0	☐	0.0%	
	0	= Total Cover		

Dominance Test worksheet:

Number of Dominant Species That are OBL, FACW, or FAC: 2 (A)

Total Number of Dominant Species Across All Strata: 2 (B)

Percent of dominant Species That Are OBL, FACW, or FAC: 100.0% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species	60	x 1 =	60
FACW species	20	x 2 =	40
FAC species	0	x 3 =	0
FACU species	0	x 4 =	0
UPL species	0	x 5 =	0
Column Totals:	80 (A)		100 (B)

Prevalence Index = B/A = 1.250

Hydrophytic Vegetation Indicators:

- ☑ **Rapid Test for Hydrophytic Vegetation**
- ☑ **Dominance Test is > 50%**
- ☑ **Prevalence Index is ≤3.0** [1]
- ☐ **Morphological Adaptations** [1] **(Provide supporting data in Remarks or on a separate sheet)**
- ☐ **Problematic Hydrophytic Vegetation** [1] **(Explain)**

[1] **Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.**

Definition of Vegetation Strata:

Four Vegetation Strata:

Tree stratum – Consists of woody plants, excluding vines, 3 in. (7.6 cm) or more in diameter at breast height (DBH), regardless of height.

Sapling/shrub stratum – Consists of woody plants, excluding vines, less than 3 in. DBH and greater than 3.28 ft (1 m) tall.

Herb stratum – Consists of all herbaceous (non-woody) plants, regardless of size, and all other plants less than 3.28 ft tall.

Woody vines – Consists of all woody vines greater than 3.28 ft in height.

Five Vegetation Strata:

Tree - Woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and 3 in. (7.6 cm) or larger in diameter at breast height (DBH).

Sapling stratum – Consists of woody plants, excluding woody vines, approximately 20 ft (6 m) or more in height and less than 3 in. (7.6 cm) DBH.

Shrub stratum – Consists of woody plants, excluding woody vines, approximately 3 to 20 ft (1 to 6 m) in height.

Herb stratum – Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size, and woody species, except woody vines, less than approximately 3 ft (1 m) in height.

Woody vines – Consists of all woody vines, regardless of height.

Hydrophytic Vegetation Present? Yes ◉ No ○

Remarks: (Include photo numbers here or on a separate sheet.)

Unidentifiable sedge species

*Indicator suffix = National status or professional decision assigned because Regional status not defined by FWS.

Soil

Sampling Point: W007

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix Color (moist)		Matrix %	Redox Features Color (moist)		Redox %	Type[1]	Loc²	Texture	Remarks
0-18	10YR	4/6	95	10YR	6/4	5	C	M	Sandy Loam	

[1] Type: C=Concentration. D=Depletion. RM=Reduced Matrix, CS=Covered or Coated Sand Grains ²Location: PL=Pore Lining. M=Matrix

Hydric Soil Indicators:

- [ ] Histosol (A1)
- [ ] Histic Epipedon (A2)
- [ ] Black Histic (A3)
- [ ] Hydrogen Sulfide (A4)
- [ ] Stratified Layers (A5)
- [ ] 2 cm Muck (A10) (LRR N)
- [ ] Depleted Below Dark Surface (A11)
- [ ] Thick Dark Surface (A12)
- [ ] Sandy Muck Mineral (S1) (LRR N, MLRA 147, 148)
- [ ] Sandy Gleyed Matrix (S4)
- [ ] Sandy Redox (S5)
- [ ] Stripped Matrix (S6)
- [ ] Dark Surface (S7)
- [ ] Polyvalue Below Surface (S8) (MLRA 147,148)
- [ ] Thin Dark Surface (S9) (MLRA 147, 148)
- [ ] Loamy Gleyed Matrix (F2)
- [x] Depleted Matrix (F3)
- [ ] Redox Dark Surface (F6)
- [ ] Depleted Dark Surface (F7)
- [ ] Redox Depressions (F8)
- [ ] Iron-Manganese Masses (F12) (LRR N, MLRA 136)
- [ ] Umbric Surface (F13) (MLRA 136, 122)
- [ ] Piedmont Floodplain Soils (F19) (MLRA 148)
- [ ] Red Parent Material (F21) (MLRA 127, 147)

Indicators for Problematic Hydric Soils[3]:

- [ ] 2 cm Muck (A10) (MLRA 147)
- [ ] Coast Prairie Redox (A16) (MLRA 147,148)
- [ ] Piedmont Floodplain Soils (F19) (MLRA 136, 147)
- [ ] Very Shallow Dark Surface (TF12)
- [ ] Other (Explain in Remarks)

[3] Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if observed):

Type:

Depth (inches):

Hydric Soil Present? Yes (●) No ( )

Remarks:

Appendix F – HDR Survey of Waters of the U.S. for Transmission Line Upgrades Memo

Appendix G – TVA Wetlands Field Survey Memo

TVA INPUT – WETLANDS

DATE: April, 11 2022

REQ /PSO#: 39170/537599

PROJECT TITLE: KINGSTON FOSSIL PLANT RETIREMENT EIS

CUSTOMER: Chevales Williams, NEPA

PREPARED BY: Fallon Parker Hutcheon, Biological Compliance-Wetlands

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Field surveys were conducted March 30, 2022, to map wetlands on the proposed on-site KIF Retirement Alternative A CC/CT project area. Seven wetlands were mapped on the KIF on-site potential project area. This wetland report does not include any associated off site transmission line or pipeline project area for KIF retirement CC/CT project area. Wetland boundaries were mapped with a Trimble ProHX geographic positioning system and ESRI ArcGIS Pro mapping software.

Activities in wetlands are regulated by state and federal agencies to ensure no net loss of wetland resources. Under the Clean Water Act (CWA) §404, activities resulting in the discharge of dredge, fill, and potential secondary impacts resulting in degradation to waters of the U. S., including wetlands, must be authorized by the U.S. Army Corps of Engineers (USACE) through a Nationwide, Regional, or Individual Permit. CWA §401 of the Clean Water Act requires state water quality certification for projects requiring USACE approval. In Tennessee, the Department of Environment and Conservation (TDEC) is responsible for issuance of water quality certifications pursuant to Section 401. Lastly, Executive Order 11990 requires federal agencies to avoid construction in wetlands and minimize wetland degradation to the extent practicable. Wetland determinations were performed according to the USACE standards, which require documentation of hydrophytic (wet-site) vegetation, hydric soil, and wetland hydrology (Environmental Laboratory 1987; Lichvar et al. 2016; USACE 2012).

Using the Tennessee Rapid Assessment Method (TRAM) wetlands were evaluated by their functions and classified into three categories: low, moderate quality, or exceptional resource value (TDEC 2015). Low quality wetlands are degraded aquatic resources which may exhibit low species diversity, minimal hydrologic input and connectivity, recent or on-going disturbance regimes, and/or predominance of non-native species. These wetlands provide low functionality and are considered of low value. Moderate quality wetlands provide functions at a greater value due to a lesser degree of degradation and/or due to their habitat, landscape position, or hydrologic input. Moderate quality wetlands are considered healthy water resources of value. Disturbance to hydrology, substrate and/or vegetation may be present to a degree at which valuable functional capacity is sustained and there is reasonable potential for restoration. Exceptional resource value wetlands offer high functions and values within a watershed or are of regional/statewide concern. These wetlands may exhibit little, if any, recent disturbance, provide essential and/or large scale stormwater storage, sediment retention, and toxin absorption, contain mature vegetation communities, and/or offer habitat to rare species.

Conditions found in superior quality wetlands often represent restoration goals for wetlands functioning at a lower capacity.

Table X. Wetlands within the on-site KIF Retirement Alternative A CC/CT project area.

Wetland ID	Type[1]	TRAM Category (score)	Location	Wetland Acreage in Review Area	Wetland Impacts
W001	PFO1E	Low (39)	35.8941708, -84.5002456	0.13	Specific Impacts TBD
W002	PEM1E	Low (13)	35.8948153, -84.5002172	0.03	Specific Impacts TBD
W003	PEM1Hr	Low (23)	35.8961844, -84.4990040	0.11	Specific Impacts TBD
W004	PEM1E	Low (23)	35.8951150, -84.4974135	0.17	Specific Impacts TBD
W005	PFO1E	Low (43)	35.8942878 -84.4989506	0.10	Specific Impacts TBD
W006	PEM1E	Low (36)	35.8979714, -84.5008612	0.11	Specific Impacts TBD
W007	PEM1E	Low (15)	35.8982769, -84.5007154	0.01	Specific Impacts TBD
			TOTAL	**0.66 Acres**	

[1]Classification codes as defined in Cowardin et al. (1979): PEM1 = Palustrine emergent, persistent vegetation; E = Seasonally flooded/saturated; FO1=Forested broadleaf deciduous; H= Permanently flooded; r= Artificial substrate

W001 is a forested wetland fringe to Watts bar reservoir on the south side of the KIF plant property. This wetland exhibited soil profile coloration that is grey and mottled, indicating the presence of hydric conditions. This wetland was dominated by hydrophytic vegetation including tag alder, sycamore, and soft rush. W001 scored as low value wetland resource due primarily to its small size and lack of hydrologic influence seasonally.

W002 is a mowed emergent wetland swale draining to Watts bar reservoir. This wetland exhibited saturated soils, which has resulted in soil profile coloration that is grey and mottled, indicating sustained hydric conditions. This wetland was dominated by hydrophytic vegetation including fox sedge and soft rush. W002 scored as low value wetland resource due to surrounding land use and lack of buffer.

W003 is an emergent wetland fringe in a manmade pond within a transmission line right-of-way. This wetland exhibited standing water and saturated soils, which has resulted in soil profile coloration that is grey and mottled, indicating sustained hydric conditions. This wetland was dominated by hydrophytic vegetation including cattails and black willow. W003 scored as low value wetland resource due to surrounding land use and lack of buffer.

W004 is an emergent wetland swale within a transmission line right-of-way; W004 extends outside of the project area to the east within the transmission line right-of-way. This wetland exhibited standing water and saturated soils, which has resulted in soil profile coloration that is grey and mottled, indicating sustained hydric conditions. This wetland was dominated by hydrophytic vegetation including soft rush and bushy bluestem. W004 scored as low value wetland resource due to size and lack of buffer.

W005 is a forested wetland depression surrounding conveyances. This wetland exhibited standing water and saturated soils, which has resulted in soil profile coloration that is grey and mottled, indicating sustained hydric conditions. This wetland was dominated by hydrophytic vegetation including sycamore and sedge species. W005 scored as low value wetland resource due to size.

W006 is an emergent man-made depression retaining drainage. This wetland exhibited standing water and saturated soils, which has resulted in soil profile coloration that is grey and mottled, indicating sustained hydric conditions. This wetland was dominated by hydrophytic vegetation including cattails and black willow. W006 scored as low value wetland resource due to size and surrounding land use.

W007 is a saturated emergent wetland depression. This wetland exhibited saturated soils, which has resulted in soil profile coloration that is grey and mottled, indicating sustained hydric conditions. This wetland was dominated by hydrophytic vegetation including cattails and soft rush. W007 scored as low value wetland resource due to size and surrounding land use.

During this site survey 0.66 acres of wetland (0.23 acres of forested wetland; 0.43 acre emergent wetland) were identified within the on-site KIF Retirement Alternative A CC/CT project area. This wetland report does not include any associated off site transmission line or pipeline project area for KIF retirement CC/CT project area.

Specific wetland disturbances within the larger on-site KIF Retirement Alternative A CC/CT project area have not yet been determined. Any proposed impacts will be permitted and in compliance with TDEC/USACE CWA 404/401 regulations, including any necessary mitigation. TVA BMPs will be instituted for work associated with on-site KIF Retirement Alternative A CC/CT.

<u>Literature Cited</u>

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. *Classification of Wetland and Deepwater Habitats of the United States*. Washington, D.C.: U.S. Fish and Wildlife Publication FWS/OBS-79/31.

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual*. Vicksburg, Miss.: U.S. Army Corps of Engineers Waterways Experiment Station. Technical Report Y-87-1

Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. *The National Wetland Plant List*: 2016 wetland ratings. Phytoneuron 2016-30: 1-17. Published 28 April 2016. ISSN 2153 733X.

Tennessee Valley Authority. 2017. A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Construction and Maintenance Activities, Revision 3. Edited by G. Behel, S. Benefield, R. Brannon, C. Buttram, G. Dalton, C. Ellis, C. Henley, T. Korth, T. Giles, A. Masters, J. Melton, R. Smith, J.Turk, T. White, R. Wilson. Chattanooga, TN.

U.S. Army Corps of Engineers. 2012. *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Eastern Mountains and Piedmont Region Version 2.0*, ed. J. F. Berkowitz, J. S. Wakeley, R. W.Lichvar, C. V. Noble. ERDC/EL TR-12-9. Vicksburg, MS: U.S. Army Engineer Research and Development Center.

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022

W001 – PFO1E; 0.13 acres. TRAM = (39) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022

W002 – PEM1E; 0.03 acres.

TRAM = (13) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022

W003 – PEM1Hr; 0.11 acres. TRAM = (23) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022

W004 – PEM1E; 0.17 acres.

TRAM = (23) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022

W005 – PFO1E; 0.10 acres.

TRAM = (43) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022

W006 – PEM1E; 0.11 acres. TRAM = (36) Low

KIF (onsite) Fossil Retirement ESCS 39170

Wetland Photolog 2022

W007 – PEM1E; 0.01 acres.

TRAM = (15) Low

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.	1	
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.50
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.	5	
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3	
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.		2b Avg.= 4.00

KIF Retirement

PID#39170

W001

Metric 2 Total 4.50

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	3
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	1
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located <u>between</u> a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	1
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	1
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	1

3d Avg.= 1.00

KIF Retirement

PID#39170

W001

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	7.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
7.00

KIF Retirement

Metric 3 Total 16.00

PID#39170

W001

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed “habitat alteration.” In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland’s habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include (circle all that apply):
____filling and grading
____plowing
____grazing (hooves)
____vehicle use (off-road vehicles, construction vehicles)
____sedimentation
____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	5.0
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears <u>not</u> to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
5.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

	YES	NO	NOT SURE
Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 9 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	6.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 6.00

Metric 4 Total 14

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	0.00
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	3.0
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

PID#39170

W001

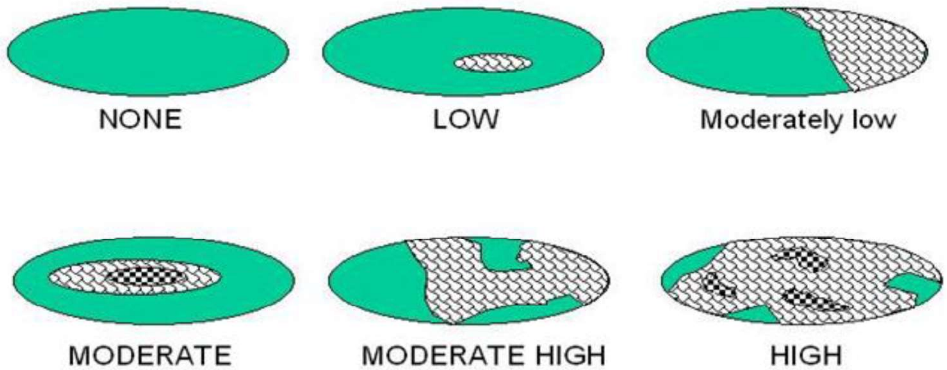

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 3

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	4.5
	Metric 3: Hydrology	16
	Metric 4: Habitat	14
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	3
	TOTAL SCORE	39

KIF Retirement

PID#39170

W001

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

KIF Retirement

PID#39170

W002

Quantitative Rating

3/30/2022

FPH

Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland “buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.		
7pts	WIDE. >50m (164ft) or more around perimeter.	
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.	
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.	
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.		
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.	
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.	
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1

2a Avg.= 0.00

2b Avg.= 2.00

KIF Retirement

PID#39170

W002

Metric 2 Total 2.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	1

3d Avg.= 1.00

KIF Retirement

PID#39170

W002

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	1

3e Avg=
1.00

KIF Retirement

Metric 3 Total 4.00

PID#39170

W002

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include (circle all that apply):

____filling and grading
____plowing
____grazing (hooves)
____vehicle use (off-road vehicles, construction vehicles)
____sedimentation
____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	2.0
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.= 2.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	2.0
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.= 2.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

X	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	1.00

4c Avg. = 1.00

Metric 4 Total 5

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.		Score
5pts	HIGH Wetland has a high degree of interspersion	
4pts	MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts	MODERATE Wetland has a moderate degree of interspersion	
2pts	MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt	LOW Wetland has a low degree of interspersion.	1.00
0pt	NONE Wetland has no plan view interspersion	

KIF Retirement

PID#39170

W002

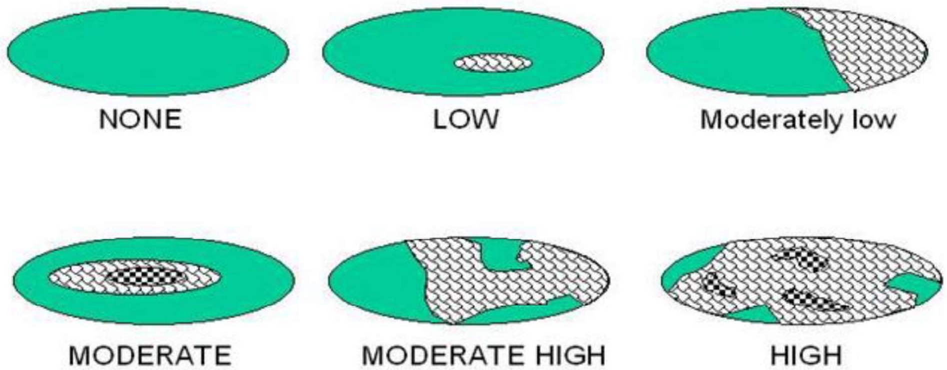

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.	Score
-5pts Extensive >75% areal cover of invasive species	
-3pts Moderate 25-75% areal cover of invasive species	
-1pts Sparse 5-25% areal cover of invasive species	
0pt Nearly absent. <5% areal cover of invasive species	0
1pt Absent	
6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	Narrative description
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 1

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	2
	Metric 3: Hydrology	4
	Metric 4: Habitat	5
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	1
	TOTAL SCORE	13

KIF Retirement

PID#39170

W002

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

KIF Retirement

PID#39170

W003
3/30/2022
FPH

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3	
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1	2b Avg.= 2.00

KIF Retirement

PID#39170

W003

Metric 2 Total 2.00

<u>Metric 3. Hydrology (Max 30 points).</u> This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located <u>between</u> a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	4
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 4.00

KIF Retirement

PID#39170

W003

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	3
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
3.00

KIF Retirement

Metric 3 Total 9.00

PID#39170

W003

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.	Examples of substrate/soil disturbance include (circle all that apply): ____filling and grading ____plowing ____grazing (hooves) ____vehicle use (off-road vehicles, construction vehicles) ____sedimentation ____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	2.0
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
2.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	4.0
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
4.00

KIF Retirement

W003

PID#39170

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants	X	Other (specify): ROW Managed
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	3.0
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 3.00

Metric 4 Total 9

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.			
	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of “aquatic bed." Aquatic beds often occur as a distinct zone as an “understory” below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are “vernal pools”.	
5)Mudflats The “mudflat” class is equivalent to the “unconsolidated bottom/mud” class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The “open water” class is equivalent to the “open water - unknown bottom” class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and “open”, i.e. there is no “canopy” of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	2.0
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

W003

PID#39170

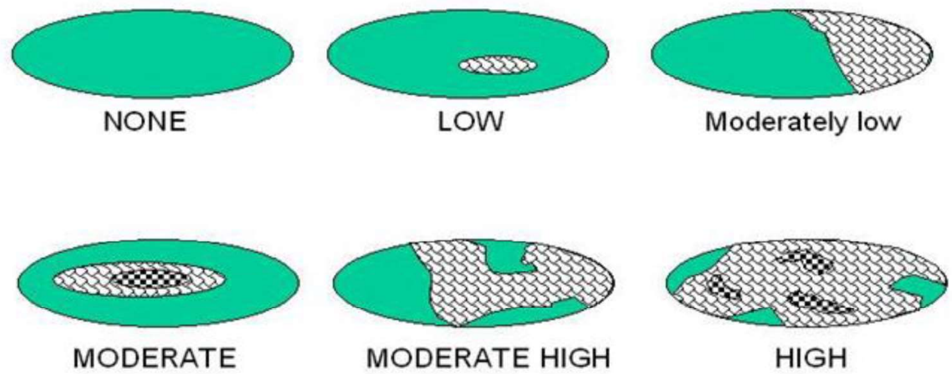

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	
6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.		Score
Vegetated hummocks and tussocks		
Coarse woody debris >15cm (6in) in diameter		
Standing dead trees >25cm (10in) diameter at breast height		
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction		

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	Narrative description
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 2

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	2
	Metric 3: Hydrology	9
	Metric 4: Habitat	9
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	2
	TOTAL SCORE	23

KIF Retirement

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W003

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

KIF Retirement

PID#39170

Quantitative Rating
Tennessee Rapid Assessment Method

W004
3/30/2022
FPH

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
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10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.	1	
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.50
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.	3	
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.		2b Avg.= 3.00

KIF Retirement

PID#39170

W004

Metric 2 Total 3.50

<u>Metric 3. Hydrology (Max 30 points).</u> This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located <u>between</u> a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	1

3d Avg.= 1.00

KIF Retirement

PID#39170

W004

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	3
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
3.00

KIF Retirement

Metric 3 Total 6.00

PID#39170

W004

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed “habitat alteration.” In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland’s habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.	Examples of substrate/soil disturbance include (circle all that apply): ____filling and grading ____plowing ____grazing (hooves) ____vehicle use (off-road vehicles, construction vehicles) ____sedimentation ____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	YES Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 4 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.= 3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	4.0
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears <u>not</u> to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.= 4.00

KIF Retirement PID#39170 W004

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants	X	Other (specify): ROW Managed
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	3.0
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 3.00

Metric 4 Total 10

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	2.0
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

W004

PID#39170

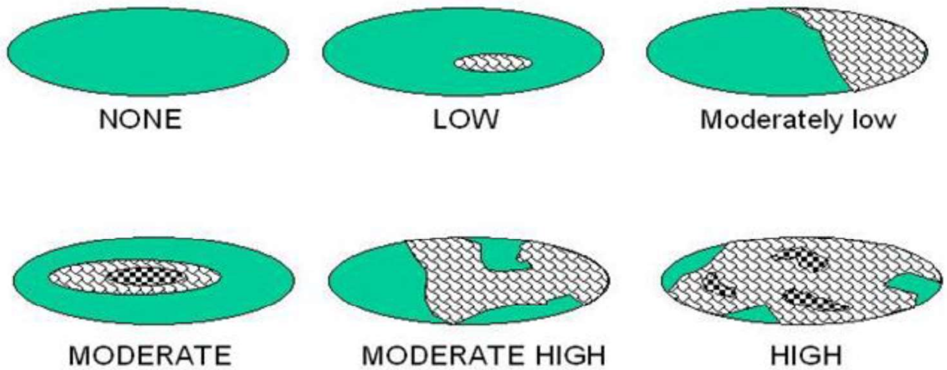

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 2

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	3.5
	Metric 3: Hydrology	6
	Metric 4: Habitat	10
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	2
	TOTAL SCORE	23

KIF Retirement

PID#39170

W004

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.	7	
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.		2a Avg.= 7.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.	5	
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.		
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.		2b Avg.= 5.00

KIF Retirement

PID#39170

W005

Metric 2 Total 12.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	1
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	3
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 3.00

KIF Retirement

PID#39170

W005

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES	NO	NOT SURE
	Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 12 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	7.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
7.00

KIF Retirement

Metric 3 Total 13.00

PID#39170

W005

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.	Examples of substrate/soil disturbance include (circle all that apply): ____filling and grading ____plowing ____grazing (hooves) ____vehicle use (off-road vehicles, construction vehicles) ____sedimentation ____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	<u>YES</u> Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	<u>NO</u> Assign a score of 4 since there are no or no apparent modifications.	<u>NOT SURE</u> Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	5.0
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears <u>not</u> to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
5.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES	NO	NOT SURE
	Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 9 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	6.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 6.00

Metric 4 Total 14

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present both vertically and horizontally within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	0.00
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	3.0
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

W005

PID#39170

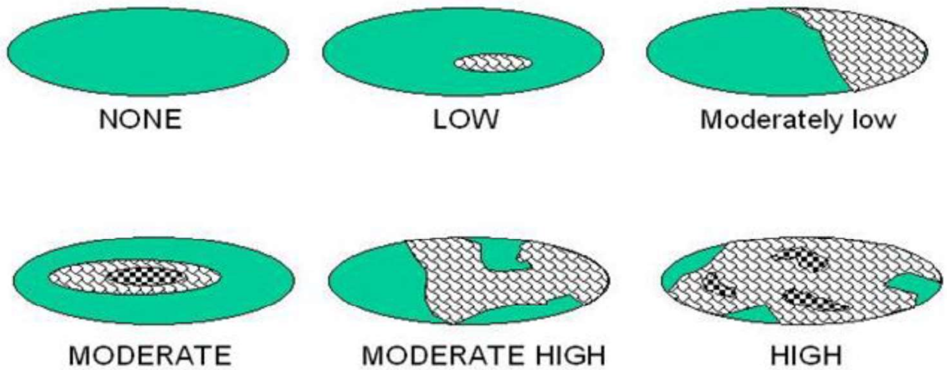

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	

6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 3

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	12
	Metric 3: Hydrology	13
	Metric 4: Habitat	14
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	3
	TOTAL SCORE	43

KIF Retirement

PID#39170

W005

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

Quantitative Rating
Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland "buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2nd growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.		
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1	2b Avg.= 1.00

KIF Retirement

PID#39170

W006

Metric 2 Total 1.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	3
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	1
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	4
3pts	Regularly inundated or saturated	
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 4.00

KIF Retirement

PID#39170

W006

3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the "intactness" of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	YES Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 12 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.	
7pts	RECOVERED. The wetland appears to have recovered from past modifications.	7.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.	
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	

3e Avg=
7.00

KIF Retirement

Metric 3 Total 17.00

PID#39170

W006

Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed “habitat alteration.” In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland’s habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.

Examples of substrate/soil disturbance include (circle all that apply):
____filling and grading
____plowing
____grazing (hooves)
____vehicle use (off-road vehicles, construction vehicles)
____sedimentation
____dredging, and other mechanical disturbances to the soil

	YES	NO	NOT SURE
Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 4 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	3.0
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
3.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	5.0
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears not to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
5.00

4c. Habitat alteration. This question evaluates the “intactness” the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to “double check” and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	6.00
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	

4c Avg. = 6.00

Metric 4 Total 14

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present <u>both vertically and horizontally</u> within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	3.0
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	
0pt NONE Wetland has no plan view interspersion	

KIF Retirement

W006

PID#39170

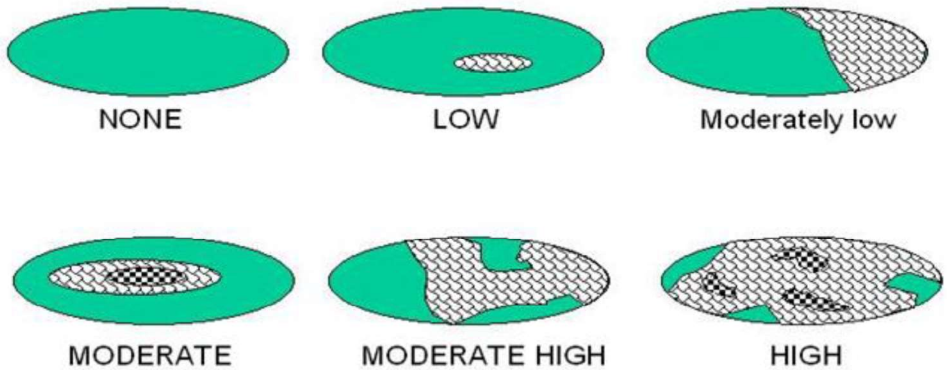

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.	Score
-5pts Extensive >75% areal cover of invasive species	
-3pts Moderate 25-75% areal cover of invasive species	
-1pts Sparse 5-25% areal cover of invasive species	
0pt Nearly absent. <5% areal cover of invasive species	0
1pt Absent	
6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.	Score
Vegetated hummocks and tussocks	
Coarse woody debris >15cm (6in) in diameter	
Standing dead trees >25cm (10in) diameter at breast height	
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction	

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 3

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	1
	Metric 3: Hydrology	17
	Metric 4: Habitat	14
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	3
	TOTAL SCORE	36

KIF Retirement

PID#39170

W006

Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

KIF Retirement

PID#39170

W007

3/30/2022

FPH

Quantitative Rating

Tennessee Rapid Assessment Method

Metric 1. Wetland area (max 6 pts). Estimate the area of wetland and select the appropriate size class and assign score. Estimated areas should clearly place the wetland within the appropriate class.

6pts	>50 acres (west TN)	>25 acres (middle TN)	>10 acres (east TN *)	
5pts	25 - <50 acres (west TN)	10- 25 acres (middle TN)	7-<10 acres (east TN*)	
4pts	10 - <25 acres (west TN)	7-< 25acres (middle TN)	3-<7 acres (east TN*)	
3pts	3 - <10 acres(west TN)	3< 7 acres (middle TN)	1-<3 acres (east TN)	
2pts	0.3 - <3 acres (west TN)	0.5- <3 acres (middle TN)	0.5-<1 acres (east TN)	
1pt	0.1 - <0.3 acres(west TN)	<0.5 acres (middle TN)	<0.5 acres (east TN)	1

*More applicable to West Tennessee; use with discretion in Middle Tennessee, Consult TDEC-DWR Natural Resources Unit for use in East Tennessee.

Table 2. Metric to English conversion table with visual estimation sizes.

acres	ft^2	yd^2	ft on side	yd on side	ha	m^2	m on side
50	2,177,983	241,998	1476	492	20.2	202,000	449
25	1,088,992	120,999	1044	348	10.1	101,000	318
10	435,596	48,340	660	220	4.1	41,000	203
3	130,679	14,520	362	121	1.2	12,000	110
0.3	13,067	1,452	114	38	0.12	1,200	35
0.1	4,356	484	66	22	0.04	400	20

Metric 1 Total 1

Metric 2. Upland buffers and intensity of surrounding land uses (Max 14 points). Wetlands without upland “buffers", or that are located where human land use is more intensive, are often, but not always, more degraded and often have lower wildlife habitat resource value.

2a. Average Buffer Width (ABW). Calculate the average buffer width and select only one score. To calculate ABW, estimate buffer width on each side (max of 50m) and divide by the number of sides. Example: ABW of a wetland with buffers of 100m, 25m, 10m and 0m would be calculated as follows: ABW = (50m + 25m + 10m + 0m)/4 = 21.25m. Intensive land uses are not buffers, e.g. active row cropping, paved areas, housing developments, etc.			
7pts	WIDE. >50m (164ft) or more around perimeter.		
4pts	MEDIUM. 25m to <50m (82 to <164ft) around the perimeter.		
1pt	NARROW. 10m to <25m (32 to <82ft) around the perimeter.		
0pts	VERY NARROW. <10m (<32ft) around perimeter.	0	2a Avg.= 0.00
2b. Intensity of predominant surrounding land use(s) Select one, or choose up to two and average score, for the intensity of the predominant land use(s) outside the wetland's buffer zone.			
7pts	VERY LOW. 2^{nd} growth or older forest, prairie, barren, wildlife area, etc.		
5pts	LOW. Old fallow field, shrub land, early successional young forest, etc.		
3pts	MODERATELY HIGH. Residential, pasture, orchard, park, conservation tillage, mowed field, etc.		
1pt	HIGH. urban, industrial, row cropping, mining, construction, etc.	1	2b Avg.= 1.00

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Metric 2 Total 1.00

Metric 3. Hydrology (Max 30 points). This metric evaluates the wetland's water budget, hydroperiod, the hydrologic connectivity of the wetland to other surface waters, and the degree to which the wetland's hydrology has been altered by human activity**. A wetland can receive no more than 30 points for Metric 3 even though it is possible to score more than 30 points.**

3a. Sources of Water. Select all that apply and sum the score. This question relates to a wetland's water budget. It also is reflective that wetlands with certain types of water sources, or multiple water sources, e.g. high pH groundwater or perennial surface water connections, can be very high quality wetlands or can have high functions and values.		
5pts	High pH groundwater (7.5-9.0)	
3pts	Other groundwater	
1pts	Precipitation	1
3pts	Seasonal surface water	
5pts	Perennial surface water (lake or stream)	
3b. Connectivity. Select all that apply and sum score		
1pt	**100 year floodplain.** "Floodplain" is defined as "...the relatively level land next to a stream or river channel that is periodically submerged by flood waters. It is composed of alluvium deposited by the present stream or river when it floods." Where they are available, flood insurance rate maps (FIRMs) and flood boundary and floodway maps may be used.	
1pt	**Between stream/lake and other human land use.** This question asks whether the wetland is located between a surface water and a different adjacent land use, such that run-off from the adjacent land use could flow through wetland before it discharges into the surface water buffering it. "Different adjacent land uses" include agricultural, commercial, industrial, mining, or residential uses.	
1pt	**Part of a larger wetland or upland complex.** This question asks whether the wetland is in physical proximity to, or a other nearby wetland or upland habitat areas.	
1pt	**Part of riparian corridor**.	
3c. Maximum water depth. Select only one and assign score. The evaluator *does not* need to actually observe the wetland when its water depth is greatest in order to award the maximum points for this question. The use of secondary indicators, as outlined in the 1987 Manual will be useful in answering this question.		
3 pts	>0.7m (27.6in)	
2pts	0.4 to 0.7m (15.7 to 27.6in)	
1pt	<0.4m (<15.7in)	1
3d. Duration of inundation/saturation. Select one or double check and average the scores if duration is uncertain. The use of ACOE 1987 Manual secondary indicators is necessary and expected in order to properly answer this question.		
4pts	Semi-permanently to permanently inundated or saturated	
3pts	Regularly inundated or saturated	3
2pts	Seasonally inundated	
1pt	Seasonally saturated in the upper 30cm (12in) of soil	

3d Avg.= 3.00

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3e. Modifications to natural hydrologic regime. Check all observable modifications from list below. Score by selecting the most appropriate description of the wetland. Scores may be double checked and averaged. This question asks the evaluator to assess the “intactness” of, or lack of disturbance to, the natural hydrologic regime of the type of wetland that is being evaluated.

Once the evaluator has listed all possible past and ongoing disturbances, the evaluator should check the most appropriate category to describe the present state of the wetland. In instances where the evaluator believes that a wetland falls between two categories, or where the evaluator is uncertain as to which category is appropriate, it is appropriate to choose more than one and average the score.

The evaluator may check one or several of these possible disturbances, yet still determine that the natural hydrologic regime is intact. However, see Metric 4 where these same disturbances may be habitat alterations.

Check all that are observed present in or near the wetland.

	ditch(es), in or near the wetland		point source discharges to the (non-stormwater)
	tile(s), in or near the wetland		filling/grading activities in or near the wetland
	dike(s), in or near the wetland		road beds/RR beds in or near the wetland
	weir(s), in or near the wetland		dredging activities in or near the wetland
	stormwater inputs (addition of water)		other (specify)

	YES	NO	NOT SURE
Have any of the disturbances identified above caused or appear to have caused more than trivial alterations to the wetland's natural hydrologic regime.	Assign a score 1, 3 or 7, or an intermediate score, depending on degree of recovery from the disturbance.	Assign a score of 12 since there are no or no apparent modifications.	Choose "recovered" and assign a score of 9.5.

Select one or double check adjoining numbers and average the score.		**score**	
12pts	NONE OR NONE APPARENT. There are no modifications or no modifications that are apparent to the evaluator.		
7pts	RECOVERED. The wetland appears to have recovered from past modifications.		
3pts	RECOVERING. The wetland appears to be in the process of recovering from past modifications.		3e Avg=
1pt	RECENT OR NO RECOVERY. The modifications have occurred recently occurred, and/or the wetland has not recovered from past modifications, and/or the modifications are ongoing.	1	1.00

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Metric 3 Total 6.00

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Metric 4. Habitat Alteration and Development (Max 20 points). While hydrology may be the single most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes, there is a range of other factors and activities which affect wetland quality and cause disturbances to wetlands that are unrelated to hydrology. These disturbances are termed "habitat alteration." In many instances, items checked as hydrologic disturbances in Question 3e will present as alterations to a wetland's habitat or disruptions in its development (successional state). In some instances, a disturbance may be appropriately considered under both Metric 3 and Metric 4. To determine the appropriate metric scores, the evaluator should carefully determine the actual cause of the disturbance to the wetland.

4a. Substrate/Soil Disturbance. Select one or double check and average. This question evaluates physical disturbances to the soil and surface substrates of the wetland. Note also that the labels on the scoring categories are intended to be descriptive but not controlling. In some instances, it may be more appropriate to consider the scoring categories as fixed locations on a disturbance continuum, from very high to very low or no disturbance.	Examples of substrate/soil disturbance include (circle all that apply): ____filling and grading ____plowing ____grazing (hooves) ____vehicle use (off-road vehicles, construction vehicles) ____sedimentation ____dredging, and other mechanical disturbances to the soil

Have any of soil or substrate disturbances caused or appear to have caused more than trivial alterations to the wetland's natural soils	<u>YES</u> Assign a score 1, 2 or 3, or an intermediate score, depending on degree of recovery from the disturbance.	<u>NO</u> Assign a score of 4 since there are no or no apparent modifications.	<u>NOT SURE</u> Choose "recovered" and assign a score of 3.5.

Select one or double check adjoining numbers and average the score.		
4pts	NONE OR NONE APPARENT. There are no disturbances or no disturbances apparent to the evaluator.	
3pts	RECOVERED. The wetland appears to have recovered from past disturbances.	
2pts	RECOVERING. The wetland appears to be in the process of recovering from past disturbances.	2.0
1pt	RECENT OR NO RECOVERY. The disturbances have occurred recently, and/or the wetland has not recovered from past disturbances, and/or the disturbances are ongoing.	

4a Avg.=
2.00

4b. Habitat development. Select only one and assign score. This question asks the evaluator to assign an overall qualitative rating of how well-developed the wetland is in comparison to other ecologically and/or hydrogeomorphically similar wetlands. This question presumes knowledge of the types of wetlands and the range in quality typical of the region or access to data from reference standard examples. If unsure, score as GOOD or MODERATELY GOOD.

7pts	EXCELLENT. Wetland appears to represent the best of its type or class.	
6pts	VERY GOOD. Wetland appears to be a very good example of its type or class but is lacking in characteristics which would make it excellent.	
5pts	GOOD. Wetland appears to be a good example of its type or class but because of past or present disturbances, successional state, or other reasons, is not excellent.	
4pts	MODERATELY GOOD. Wetland appears to be a fair to good example of its type or class.	
3pts	FAIR. Wetland appears to be a moderately good example of its type or class but because of past or present disturbances, successional state, etc. is not good.	3.0
2pts	POOR TO FAIR. Wetland appears to be a poor to fair example of its type or class.	
1pt	POOR. Wetland appears <u>not</u> to be a good example of its type or class because of past or present disturbances, successional state, etc.	

4b Avg.=
3.00

4c. Habitat alteration. This question evaluates the "intactness" the natural habitat of the type of wetland that is being evaluated. This question does not discriminate between wetlands with different types of habitat. Check all possible alterations that are observed. All available information, field visits, aerial photos, maps, etc. can be used to identify possible alterations. Evaluate whether the alteration is trivial in relation to the wetlands overall habitat. Select the most appropriate score that best describes the present state of the wetland. It is appropriate to "double check" and average scores. **The evaluator may check one or several of these possible disturbances, yet still determine that the natural habitat is intact.**

Check all that are observed present in or near the wetland

X	Mowing		Herbaceous layer/aquatic bed removal
	Grazing (cattle, horses, etc.)		Sedimentation
	Clearcutting		Dredging
	Selective cutting		Row-crop or orchard farming
	Woody debris removal		Nutrient enrichment, e.g. nuisance algae
	Toxic pollutants		Other (specify):
	Shrub/sapling removal		Other (specify):

Have any of the disturbances identified above caused or appeared to cause more than trivial alterations to the wetland's natural habitat.	YES Assign a score 1, 3 or 6, or an intermediate score, depending on degree of recovery from the disturbance.	NO Assign a score of 9 since there are no or no apparent modifications.	NOT SURE Choose "recovered" and assign a score of 6.

Select one score or double check adjoining numbers and average the score.		Score
9pts	NONE OR NONE APPARENT. There are no past or current alterations that are apparent to the evaluator.	
6pts	RECOVERED. The wetland appears to have recovered from past alterations.	
3pts	RECOVERING. The wetland appears to be in the process of recovering from past alterations.	
1pt	RECENT OR NO RECOVERY. The alterations have occurred recently, and/or the wetland has not recovered from past alterations, and/or the alterations are ongoing.	1.00

4c Avg. = 1.00

Metric 4 Total 6

Metric 5. Special wetland communities. Assign points in left column if the wetland meets the associated criteria below. Refer to Narrative Rating for guidance. If wetland scores over 30 points within Metric 5 further determination needed to assess if the wetland exhibits outstanding ecological or recreational values as discussed in the Narrative Rating Section.

	5pts - >10m sq sphagnum or other moss or other vernal pools		5 pts - Superior fish, waterfowl, bat, or amphibian breeding habitat
	Ecological community with global rank (NatureServe): G1 (10pts), G2 (5pts), G2/G3 (3pts) or uncommon ecological resource in the ecoregion (habitat and/or species diversity, geology, wetland type, distribution/ occurrence) (10 pts)		5 pts - Wetland contains and is a buffer for a headwater stream or wetland contributes significantly to the water water quality of 303(d) listed stream and/or to surface or and/or to ground water
	10 pts - Older-aged mature forested wetland avg. DBH >= 30 inches		10 pts - Supports species Deemed in Need of Management by TWRA or TN Special Concern by TDEC

Metric 5 Total 0

Metric 6. Vegetation, Interspersion, and Microtopography (Max 20 points). **6a. Wetland Vegetation Communities** Check each community present <u>both vertically and horizontally</u> within the wetland with an area of at least 0.1 hectares or 1000m^2 (0.2471 acres). Assign a score of 0 to 3 using Table 3 for 1-4 or Table 5 for 5-6. Sum the scores for the classes present.	Score
1)Aquatic Bed Includes areas of wetlands dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years. Floating aquatic species like duckweed (*Lemna* spp., *Spirodela* spp.) are excluded from definition of "aquatic bed." Aquatic beds often occur as a distinct zone as an "understory" below shrubs or trees.	
2)Emergent Includes areas of wetlands dominated by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens. This vegetation is present for most of the growing season in most years. Common names for emergent communities include marsh, wet meadow, wet prairie, sedge meadow, and fens.	0.00
3)Shrub Includes areas of wetlands dominated by woody vegetation less than 1m (3ft.) - 6m (20 ft) tall with a dbh of <3in. The plant species include true shrubs, young trees, or trees or shrubs that are small or stunted because of environmental conditions. Shrub wetlands may represent a successional stage leading to a forested wetland or they may be relatively stable plant communities.	
4)Forested Includes wetlands or areas of wetlands characterized by woody vegetation greater than 6m (20ft) or taller. Forested wetlands have an overstory of trees and often contain an understory of young trees and shrubs and an herbaceous layer, although the young tree/shrub and herbaceous layers can be largely missing from some types of forested wetlands. Some forested wetlands are "vernal pools".	
5)Mudflats The "mudflat" class is equivalent to the "unconsolidated bottom/mud" class/subclass (PUB_3) described in Cowardin et al. (1979) and includes areas of wetlands characterized by exposed or shallowly inundated substrates with vegetative cover less than 30%.	
6)Open water The "open water" class is equivalent to the "open water - unknown bottom" class in Cowardin et al. (1979) and includes areas that are 1) inundated, 2) un-vegetated, and 3) and "open", i.e. there is no "canopy" of any type of vegetation.	

Table 3. Use this table to assign a cover score for Metric 6a to each of the vegetation communities identified on the preceding page. Refer to Table 4 for narrative description of "low," "moderate," and "high" quality.

Cover Scale	Description
0	The vegetation community is either 1) absent from wetland or 2) Comprises less than 0.1 ha (.2471 acres) of contiguous area within the wetland
1	Vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of low or moderate quality, or 2) if it comprises a significant part of the wetland's vegetation and is of low quality
2	Thee vegetation community is present and either, 1) comprises a significant part of the wetland's vegetation and is of moderate quality, or 2) the vegetation community comprises a small part of the wetland's vegetation but is of high quality
3	The vegetation community is of high quality and comprises a significant part, or more, of the wetland's vegetation

Table 4. Use this table in conjunction with Table 3 to determine what is a "low", "moderate," or " high" quality community.

Narrative	Description
Low	Low species richness and a predominance of invasive, non-native, or disturbance tolerant "weedy" species.
Moderate	Native species are the dominant component of the vegetation, although non-native or disturbance tolerant "weedy" species can also be present, and species richness is moderate to moderately high, but generally without the presence of rare, threatened, or endangered species.
High	A predominance of native species, with non-native species absent or virtually absent, and high species diversity and/or the presence of rare, threatened or endangered species.

Table 5. Mudflat and open water community cover scale.

0	Absent <0.1 ha (0.247 acres)
1	Low 0.1 to <1ha (0.247 to 2.47 acres)
2	Moderate 1 ha to < 4 ha (2.47 to 9.88 acres)
3	High 4 ha (9.88 acres) or more

6b. Horizontal (plan view) interspersion. Evaluate the wetland from a "plan view," i.e. as if the looking down upon it. See Figure 1.	Score
5pts HIGH Wetland has a high degree of interspersion	
4pts MODERATELY HIGH Wetland has a moderately high degree of interspersion	
3pts MODERATE Wetland has a moderate degree of interspersion	
2pts MODERATELY LOW Wetland has a moderately low degree of interspersion	
1pt LOW Wetland has a low degree of interspersion.	1.00
0pt NONE Wetland has no plan view interspersion	

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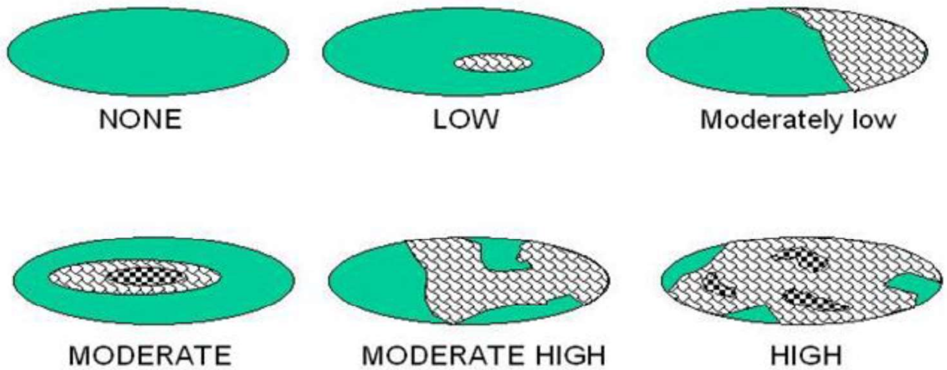

Figure 1. Hypothetical Wetlands for estimating degree of interspersion

6c. Coverage of Invasive Plant Species. Refer to Tennessee Exotic Pest Plant Council (http://www.tneppc.org/) for official list. Select only one and assign score.		Score
-5pts	Extensive >75% areal cover of invasive species	
-3pts	Moderate 25-75% areal cover of invasive species	
-1pts	Sparse 5-25% areal cover of invasive species	
0pt	Nearly absent. <5% areal cover of invasive species	0
1pt	Absent	
6d. Microtopography. Check each feature present in the wetland. Assign cover score of 0 to 3 using Table 6. Evaluate various microtopograhic habitat features often present in wetlands.		Score
Vegetated hummocks and tussocks		
Coarse woody debris >15cm (6in) in diameter		
Standing dead trees >25cm (10in) diameter at breast height		
Amphibian breeding habitat, e.g. vernal pools with standing water of sufficient duration and depth to support reproduction, or habitat for frog reproduction		

Table 6. Cover scale for microtopographic habitat features

Microtopographic habitat quality	**Narrative description**
0	Feature is absent or functionally absent from the wetland
1	Feature is present in the wetland in very small amounts or if more common, of low quality
2	Feature is present in moderate amounts, but not of highest quality or in small amounts of highest quality
3	Present in moderate or greater amounts and of the highest quality

Metric 6 Total 1

NON-HGM TRAM Summary Worksheet

Non-HGM Quantitative Rating	Metric 1: Size	1
	Metric 2: Buffers and surrounding land use	1
	Metric 3: Hydrology	6
	Metric 4: Habitat	6
	Metric 5: Special Wetland Communities	0
	Metric 6: Plant communities, interspersion, microtopography	1
	TOTAL SCORE	15

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Rank = Low

"Wetland Conditions with an overall score of 100-75 are considered Exceptional Tennessee Waters. Wetlands with a score of 74-45 are considered to have moderate resource value, and wetland with a score of 44 and below have a low resource value."
(TRAM 2015, pg 2)

Appendix H – Estimated Total System Social Cost of Life Cycle GHG Emissions for Action Alternatives Compared to the No Action Alternative, by Life Cycle Phase (See Separate Microsoft Excel File)

Appendix I – Greenhouse Gas Emissions Life Cycle Analyses of Kingston Retirement Alternatives

APPENDIX I GREENHOUSE GAS EMISSIONS LIFE CYCLE ANALYSES OF KINGSTON RETIREMENT ALTERNATIVES

I.1. Introduction

This appendix explains the methodology and provides the emissions calculations and results of the Life Cycle Analyses (LCAs) of greenhouse gases (GHGs) emissions for each of the three alternative actions, on both an individual replacement resource by alternative basis (henceforth "individual") and a TVA system-wide portfolio basis with simulated generation dispatch (henceforth "system-wide"). The GHGs included in this analysis are carbon dioxide (CO_2), methane (CH_4), and nitrous dioxide (N_2O) as these are the GHGs of concern in association with the Proposed Action. Additionally, these three GHGs are specifically emphasized in the January 2021 Executive Order 13990 regarding capturing the social costs of GHGs. The life cycle GHG emissions results were used to calculate the social cost of carbon (SCC), social cost of methane (SCM), and social cost of nitrous oxide (SCN) values for each alternative, as well as the total social cost of the three GHGs for each alternative (SC-GHG). Social costs were calculated and presented in nominal dollars and in terms of Net Present Value (NPV) in 2023 dollars.

The life cycle emissions and SC-GHG emissions for each alternative, calculated as described in this Appendix for both the individual replacement resource by alternative basis and the TVA system-wide portfolio basis, are summarized in Section 3.7.2 of this EIS.

All tables referenced below are provided in Section I.6 of this Appendix, except for four summary tables provided in Section I.4 for the total SC-GHGs for each alternative for both the individual basis LCA and TVA system-wide basis LCA.

I.2. Methodology/Basis

The basis for these LCAs is National Renewable Energy Laboratory (NREL) publications that provide harmonized CO_2-equivalent (CO_2-e) life cycle emission factors for each of the different life cycle segments of the generating technologies being considered. The NREL's LCA harmonization process included reviews of approximately 3,000 published LCA studies of a variety of utility-scale electrical generation and storage technologies. The NREL harmonization process included three rounds of screening by multiple experts to select references that met strict criteria for quality, relevance, and transparency. The NREL references provided a range of life cycle emission factors for each technology; the median published life cycle emission factors were used in the calculations described here. These NREL references were considered the most appropriate and complete references currently available for calculating emissions from all life cycle segments for the electricity generation technologies in this EIS.

The life cycle segments included in the NREL publications include the following with their descriptions:

- One-Time Upstream includes GHG emissions from resource extraction/production, processing/conversion, material manufacturing, component manufacturing, delivery to site, and construction for plant/technology components. This LCA assumes One-Time Upstream costs are all for the year 2027.
- Ongoing Annual Combustion includes GHG emissions from combustion of fuels at the proposed facilities over the entire operational life cycle of the technology.[1]
- Ongoing Annual Non-Combustion includes GHG emissions from plant operations activities other than fuel combustion, plant maintenance activities, and the fuel cycle

[1] The Ongoing Annual Combustion emission factors in the NREL references were not used because those combustion emissions were calculated using alternative-specific design, operational, and regulatory information. These emission factors were instead based on the specifications of the proposed CC and CT plants.

GHG emissions, i.e., fuel extraction/processing/distribution/transport (including pipelines) and coal bed methane.

- One-Time Downstream includes dismantling, decommissioning, disposal, and recycling of the plant/technology. This LCA assumes One-Time Downstream costs are all in 2058 for Alternative A and 2048 for Alternative B.

Although data on methane leaks from natural gas technologies is provided in the NREL publications, this parameter was not harmonized by NREL. However, the natural gas LCAs reviewed by NREL that passed their strict criteria included methane leakage in terms of a percent of total natural gas production and use. These values for LCAs conducted in the U.S. were averaged to obtain a representative cumulative methane leakage rate of 1.6 percent over the life cycle of the proposed CC and CT plants. This 1.6 percent of total natural gas flow leakage rate was used to calculate methane emissions from the natural gas technologies in Alternative A. A separate line item for methane leak emissions from natural gas technologies is provided in this LCA because it is not included in the Ongoing Annual Non-Combustion emission factor per interpretation of the natural gas NREL LCA harmonization publication.

The life cycle emission factors in the NREL publications were only provided in terms of CO_2-equivalent emissions (in grams) per kilowatt-hour of electricity production. To disaggregate the CO_2-e emission factors into emission factors for each of the three individual GHGs, the individual GWP-weighted contributions of CO_2, CH_4, and N_2O to their total CO_2-e emission factors are prorated based on their relative contribution from the *USEPA Emission Factors for GHG Inventories, Table 6 - Electricity under Total Output Emission Factors for the eGRID Subregion of SERC Tennessee Valley*. These emission factors are 834.2 lb/MW-hr for CO_2, 0.075 lb/MW-hr for CH_4, and 0.011 lb/MW-hr for N_2O. Using these values, the percent contribution of CO_2, CH_4, and N_2O to the CO_2-e emission factor is 99.99%, 0.009%, and 0.001%, respectively. For the coal technology, this prorating was not necessary as the NREL coal LCA publication provided the mean GWP-weighted contribution of CH_4 and N_2O to CO_2-e as approximately 5% and <1% (assumed 0.9%), respectively, so that the CO_2 contribution is 94.1%. The emission factors used for the LCAs are provided in Tables I.6.1 through I.6.4 for CO_2-e, CO_2, CH_4 and N_2O emissions, respectively.

None of the emission factors in the NREL LCA harmonization publications include transmission and distribution (T&D) electricity losses as they were outside the scope of the NREL studies and are not considered appreciably different for each EIS alternative.

I.2.1. Assumptions and Conditions Defining Generation Rates for LCAs of Alternatives

The assumptions and conditions defining the electricity generation rates for supporting each alternative's life cycle emissions calculations for the individual LCA are provided below. These generation rates are based on the projected average annual lifetime electricity generation. Table I.6.5 provides the assumptions, conditions, and projected average annual electricity generation lifetime rates in kw-hours per year. The maximum capacity annual electricity generation rates are provided for coal and natural gas technologies only to show the basis for calculating the average annual lifetime rates.

- No Action Alternative – Coal Technology
    - Plant size – 1,298 Megawatts (MW)
    - Projected average annual lifetime generation – assumed approximately 55% capacity factor based on U.S. Energy Information Administration (EIA) industry averages over the last 10 years; obtained from EIA website:

https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a

- Alternative A – Natural Gas Combined Cycle Combustion Turbine Technology
  - Plant size – 673 MW
  - Projected average annual lifetime generation – assumed approximately 55% capacity factor based on EIA industry averages over the last 10 years; obtained from EIA website: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a. Based on TVA's experience and industry knowledge, actual CC capacity factors for any given plant in any given year may vary between about 35% and about 90% depending on factors such as load growth, natural gas prices, composition of the balance of TVA's generating fleet in any given year, outages, or other unforeseen circumstances.

- Alternative A – Natural Gas Simple Cycle Aeroderivative Combustion Turbine Technology
  - Plant size – 848 MW
  - Projected average annual lifetime generation – assumed approximately 10% capacity factor based on EIA industry averages over the last 10 years; obtained from EIA website: https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_6_07_a. Based on TVA's experience and industry knowledge, actual Aeroderivative CT capacity factors for any given plant in any given year may vary between about 1% and about 40 % depending on factors such as load growth, natural gas prices, composition of the balance of TVA's generating fleet in any given year, outages, or other unforeseen circumstances.

- Alternative A – On-Site Solar Panel/Battery Storage Technology
  - Facility sizes – 4 MW solar; 100 MW battery storage
  - See assumptions below for Alternative B solar/battery storage technology

- Alternative B – Solar Panel/Battey Storage Technology
  - Plant sizes – 1,500 MW Solar; 2,200 MW battery storage
  - Projected average annual lifetime generation and battery storage/discharge – assumed 25% capacity factor for solar and 16.7% capacity factor for battery storage. Solar basis is based on typical responses to recent TVA RFPs for utility-scale, single axis tracking solar facilities. Battery basis is from an NREL publication on 4-hour duration utility scale battery energy storage systems: https://atb.nrel.gov/electricity/2021/utility-scale_battery_storage
  - Additional assumptions – battery storage calculations assume 1 full cycle/day (5 hours to charge from the grid and 4 hours to discharge to grid = 9 hours/cycle). Battery efficiency is assumed to be 85% based on typical responses to recent TVA RFPs for utility-scale battery storage systems.[2]

[2] It is practically impossible to accurately determine what grid charging sources will be used over the lifespan of the battery storage system. As the system evolves (coal retirements, solar/gas additions), the charging power will come from increasingly lower emitting sources. The system wide LCA will account for forecasted charging generation and associated emissions.[3] The social cost values in the Technical Support Document were converted to nominal values using a 2% per year inflation rate.

Life cycle operational time for CC and CT turbines under Alternative A is 30 years. TVA typically models solar and battery storage as 20-year Power Purchase Agreements and assumes operational time for solar panels/battery storage under Alternative B is 20 years. However, to provide a consistent life cycle comparison across all alternatives, the solar/battery storage alternative was prorated to 30 years by scaling up 20-year emissions by a factor of 1.5; 20 x 1.5 = 30. The life cycle operational time for the No Action Alternative was extended to the same 30-year period as the other alternatives but only for obtaining an equivalent comparison. It is expected the coal plant would be retired by the end of 2027, which includes all nine boiler units.

The individual GHG LCA provides one comparison of GHG effects for each alternative; however, the TVA system-wide LCA provides a more thorough and accurate view of overall GHG effects when comparing each alternative. The system-wide view provides critical context into how the specific resource retirements and replacements, underpinning the assumptions of each of the Proposed Action Alternatives, integrates into the system overall. Developing a TVA system-wide LCA reflects TVA's broader asset strategy and target power supply mix set by the 2019 IRP. A TVA system-wide comparison of emissions is the most effective way to accurately identify incremental emission differences between the alternatives because it illustrates how the entire TVA system is expected to operate with each alternative.

The system-wide LCA builds off the assumptions presented above for the individual LCA, while also considering net changes in generation supplied by the remaining TVA fleet on an ongoing basis as compared to the No Action Alternative for 20 years. Carbon dioxide emissions are pulled directly from TVA models, while nitrous oxide and methane emissions use factors are based on annual electricity generation by resource type. One-time upstream emissions are assumed to occur in 2027, while one-time downstream emissions occur in 2058 (the first year following the 30-year asset life) and are discounted to the year 2042, which is the end of the 20-year study period. Ongoing annual combustion and non-combustion emissions are accounted for in the year emitted.

I.3. GHG Life Cycle Emissions for Each Alternative

On an individual basis, the estimated life cycle CO_2 emissions for each alternative are provided in Table I.6.6. The estimated life cycle CH_4 emissions for each alternative are provided in Tables I.6.7. The estimated methane leakage emissions for Alternative A are provided in Table I.6.8 and I.6.9, respectively. The estimated life cycle N_2O emissions for each alternative are provided in Table I.6.10. Tables I.6.6, I.6.7, and I.6.10 also show the emissions for each life cycle segment.

On a system-wide basis, as a delta compared to the No Action Alternative, the estimated change in life cycle CO_2 emissions for each alternative are provided in Table I.6.25. The estimated change in life cycle CH_4 emissions, including methane leakage, for each alternative are provided in Tables I.6.26. The estimated life cycle N_2O emissions for each alternative are provided in Table I.6.27.

I.4. Life Cycle Social Costs of GHGs for Each Alternative

The GHG life cycle emissions described above were multiplied by social cost values[3], in dollars per short ton (converted from dollars per metric ton), under the following Biden Administration Interagency Working Group on Social Cost of GHGs document (IWG 2021): Technical Support Document, Social Cost of Carbon - Interim Estimates under Biden Administration Executive

[3] The social cost values in the Technical Support Document were converted to nominal values using a 2% per year inflation rate.

Order 13990, February 2021 (Appendix A, Table A-1, 3% discount rates). The social costs for each of the three GHGs were calculated in this manner using their individual values for the years covering the life cycle period. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, on an individual basis, Table I.6.11 provides the estimated life cycle social costs of CO_2 emissions, including for each life cycle segment. Tables I.6.13 and I.6.15 provide the same information for CH_4 and N_2O, respectively and on an individual basis. Table I.6.17 provides the summary of life cycle GHG social costs (based on IWG 2021 social cost values) for each of the alternatives, on an individual basis. Tables I.6.12, I.6.14, and I.6.16 provide the Biden Administration social cost value tables by year for CO_2, CH_4, and N_2O respectively, on an individual basis. The main information in Table I.6.17 is summarized below in Table I.4.1.

Table I.4-1 – Individual Basis Total Life Cycle Social Cost of GHG Emissions under Biden Administration SC-GHG Values

Electricity Power Technology	Total Life Cycle Social Cost of GHG Emissions, Nominal $	NPV of Total Life Cycle Social Costs of GHG Emissions, 2023 $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency in comparing alternatives	**$11,790,149,438**	**$3,134,936,802**
Alternative A - Natural Gas – CC (30-year Life Cycle)	$5,314,566,334	$1,414,598,695
Alternative A - Natural Gas (ULSD backup) – Aero. CTs (30-year Life Cycle)	$1,707,330,531	$454,036,638
Alternative A – On-Site Solar (on-site service only)	$2,071,278	$1,441,551
Alternative A – On-Site Li-Ion Battery Storage (on-site service only)	$12,293,542	$7,411,046
Alternative A - Total Life Cycle Social Cost of GHG Emissions	**$7,036,261,686**	**$1,877,487,931**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$776,729,269	$540,581,811
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$270,457,928	$163,051,924
Alternative B - Total Life Cycle Social Cost of GHG Emissions, $	**$1,047,187,197**	**$703,633,735**

Due to legal uncertainties surrounding the use of social cost values for GHGs, TVA has decided to provide a range for GHG life cycle social costs using the current and previous presidential administration's social cost values for GHGs. Presenting social costs as a range of values, as estimated by two different Administrations, provides decisionmakers and the public with better information to make an informed decision. Under the prior Administration, federal estimates of the SCC were originally reported in 2016 U.S. dollars in the USEPA's regulatory impact analysis for the 2019 Affordable Clean Energy Rule. The Government Accountability Office (GAO) adjusted the values for inflation and expressed them in 2018 U.S. dollars at a 3% discount rate using the United States Gross Domestic Product Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis. In a similar manner, federal estimates of the SCM were originally reported in 2016 U.S. dollars in the Bureau of Land Management's (BLM's) regulatory impact analysis for the 2018 Final Rule to Rescind or Revise Certain Requirements of the 2016 Waste Prevention Rule. The GAO adjusted the values for inflation and expressed them in 2018 U.S. dollars at a 3% discount rate in the same manner as for CO_2; however, the estimates were only provided to 2030. These values were then interpolated through the life cycle period, which is to 2058. The GAO did not find a recent rulemaking that used monetary estimates for N_2O that were based directly on the SCC approach. Instead, GAO used a National Highway Traffic Safety Administration (NHTSA) rulemaking where the N_2O Global Warming Potential factor, i.e., 298, was used to convert USEPA's SCC value estimates to monetary value estimates for N_2O.

Using the prior Administration values, the social costs for each of the three GHGs were calculated using their individual values for the years covering the life cycle period. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, Table I.6.18 provides the estimated life cycle SCC emissions, on an individual basis. Tables I.6.20 and I.6.22 provide the same information but for SCM and SCN, respectively, and on an individual basis. Tables I.6.18, I.6.20, and I.6.22 also show the SCC, SCM, and SCN, respectively, for each life cycle segment, on an individual basis. Table I.6.24 provides the summary of SC-GHG (based on prior Administration cost values) for each of the alternatives on an individual basis. The main information in Table I.6.24 is summarized below in Table I.4.2. Tables I.6.19, I.6.21, and I.6.23 provide the prior Administration social cost value tables by year for CO_2, CH_4, and N_2O, respectively.

The one-time upstream SC-GHGs conservatively assumed they were all incurred in the year 2027. The one-time downstream SC-GHGs assumed they were all incurred in the year 2058 for all alternatives.

Table I.4-2 – Individual Basis Total Life Cycle Social Cost of GHG Emissions under Prior Administration SC-GHG Values

Electricity Power Technology	Total Life Cycle Social Cost of GHG Emissions, Nominal $	NPV of Total Life Cycle Social Costs of CHG Emissions, 2023 $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency in comparing alternatives	**$937,489,373**	**$272,952,177**
Alternative A - Natural Gas - CC (30-year Life Cycle)	$421,583,735	$122,559,755
Alternative A - Natural Gas (ULSD backup) – Aero. CTs (30-year Life Cycle)	$135,634,685	$39,358,995
Alternative A – On-Site Solar (on-site service only)	$165,010	$114,842
Alternative A – On-Site Li-Ion Battery Storage (on-site service only)	$1,228,775	$827,566

Electricity Power Technology	Total Life Cycle Social Cost of GHG Emissions, Nominal $	NPV of Total Life Cycle Social Costs of CHG Emissions, 2023 $
Alternative A - Total Life Cycle Social Cost of GHG Emissions	**$558,612,205**	**$162,861,159**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$61,878,732	$43,065,864
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years for consistency in comparing alternatives)	$27,033,060	$18,206,450
Alternative B - Total Life Cycle Social Cost of GHG Emissions	**$88,911,792**	**$61,272,314**

ULSD = ultra-low sulfur diesel

As stated in Section 3.7, a system-wide view provides critical context into how the specific resource retirements and replacements, underpinning the assumptions of each proposed action alternative, integrates to the system overall, and completes the overall characterization of total system impact and performance. Developing a system-wide life cycle analysis reflects TVA's broader asset strategy and target power supply mix set by the 2019 IRP. A TVA system-wide comparison of emissions, shown as a delta compared to No Action Alternative, is the most effective way to accurately identify incremental emission differences between the alternatives because it illustrates how the entire TVA system is expected to operate with each alternative. Using the same Biden Administration costs described previously for each emission type, the social costs for each of the three GHGs were calculated using their individual values for the years covering the 20-year life cycle period modeled. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, Table I.6.28 provides the estimated life cycle SCC emissions, including for each life cycle segment. Tables I.6.29 and I.6.30 provides the same information for SCM and SCN, respectively. Table I.4.3 below provides the summary of life cycle SC-GHG (based on IWG 2021 social cost values) for each of the alternatives.

Using the prior Administration values, the social costs of the system-wide delta compared to the No Action Alternative for each of the three GHGs were calculated for the years covering the 20-year life cycle period. The social costs for each GHG were summed to obtain a total GHG life cycle social cost. For each alternative, Table I.6.31 provides the estimated life cycle SCC emissions on a system-wide delta compared to the No Action Alternative basis. Tables I.6.32 and I.6.33 provide the same information but for SCM and SCN, respectively, and on a system-wide delta compared to No Action Alternative basis. Table I.4.4 below provides the summary of life cycle GHG social costs (based on prior Administration estimates) for each of the alternatives.

Table I.4-3 – TVA System-Wide Estimated Social Cost of Life Cycle GHG Emissions for Action Alternatives Compared to the No Action Alternative, by Life Cycle Phase (Current Administration)

Proposed Action Alternatives	One-Time Upstream (Nominal $)	Ongoing Combustion (Nominal $)	Ongoing Non-Combustion (Nominal $)	Methane Leakage (Nominal $)	One-Time Downstream (Nominal $)	Total (Nominal $)	NPV (2023 $)
Alternative A							
CO_2	5,486,517	(4,336,013,433)	357,222,165	NA	385,283	(3,972,919,469)	(1,704,499,984)
CH_4	603	4	(14,703)	119	51	(13,926)	(5,767)
N2O	66	0	(100,218,383)	NA	5	(100,218,313)	(42,614,234)
Alternative A Total	**5,487,185**	**(4,336,013,429)**	**256,989,078**	**119**	**385,339**	**(4,073,151,708)**	**(1,747,119,986)**
Alternative B							
CO_2	521,945,210	(5,357,969,807)	105,516,275	NA	162,573,650	(4,567,934,672)	(1,928,209,351)
CH_4	57,331	2	(49,829,438)	140	101,738	(49,670,227)	(21,046,183)
N2O	6,235	0	(101,139,679)	NA	2,135	(101,131,309)	(43,016,766)
Alternative B Total	**522,008,776**	**(5,357,969,806)**	**(45,452,842)**	**140**	**162,677,523**	**(4,718,736,208)**	**(1,992,272,300)**

Table I.4-4 – TVA System-Wide Estimated Social Cost of Life Cycle GHG Emissions for Action Alternatives Compared to the No Action Alternative, by Life Cycle Phase (Prior Administration)

Proposed Action Alternatives	One-Time Upstream (Nominal $)	Ongoing Combustion (Nominal $)	Ongoing Non-Combustion (Nominal $)	Methane Leakage (Nominal $)	One-Time Downstream (Nominal $)	Total (Nominal $)	NPV (2023 $)
Alternative A							
CO_2	624,487	(399,720,227)	32,847,241	NA	26,616	(366,221,883)	(161,166,263)
CH_4	65	0	(1,295)	10	3	(1,216)	(514)
N2O	6	0	(7,297,005)	NA	0	(7,296,999)	(3,207,107)
Alternative A Total	**624,558**	**(399,720,227)**	**25,548,941**	**10**	**26,619**	**(373,520,098)**	**(164,373,884)**
Alternative B							
CO_2	59,408,876	(498,495,872)	9,072,711	NA	11,231,010	(418,783,275)	(178,196,858)
CH_4	43,901	0	(4,375,473)	12	5,732	(4,325,827)	(1,869,998)
N2O	4,752	0	(7,366,243)	NA	109	(7,361,382)	(3,235,163)
Alternative B Total	**59,457,530**	**(498,495,872)**	**(2,669,005)**	**12**	**11,236,851**	**(430,470,484)**	**(183,302,019)**

I.5. LCA References

Hsu D., P. O'Donoughue, V. Fthenakis, G. Heath, H. C. Kim, P. Sawyer, J.-K. Choi, and D. Turney. 2012. Life Cycle Greenhouse Gas Emissions of Crystalline Silicon Photovoltaic Electricity Generation: Systematic Review and Harmonization. Journal of Industrial Ecology. DOI: 10.1111/j.1530-9290.2011.00439.x.

Interagency Working Group (IWG) 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide, Interim Estimates under Executive Order 13990. Interagency Working Group on Social Cost of Greenhouse Gases, United States Government. (Appendix A, Table A-1, 3% Discount Rate)

Nicholson, S., and G. Heath. 2021. Life Cycle Emissions Factors for Electricity Generation Technologies. National Renewable Energy Laboratory (NREL). 10.7799/1819907. Accessed online: <https://data.nrel.gov/submissions/171>. File name: EF_Table_FINAL.xls. Accessed on 15 August 2022.

O'Donoghue, P., G. A. Heath, S. L. Dolan, and M. Vorum. 2014. Life Cycle Greenhouse Gas Emissions of Electricity Generated from Conventionally Produced Natural Gas, Systematic Review and Harmonization. Journal of Industrial Ecology. https://doi.org/10.1111/jiec.12084.

U.S. Government Accountability Office (USGAO). 2020. Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020. Available at [URL]: https://www.gao.gov/assets/gao-20-254.pdf.

Whitaker, M., G. A. Heath, P. O'Donoughue, and M. Vorum. 2012. Life Cycle Greenhouse Gas Emissions of Coal-Fired Electricity Generation, Systematic Review and Harmonization. Journal of Industrial Ecology. https://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2012.00465.x.

I.6. Tables with Estimated LCA GHG Emission Factors, GHG Emissions, and Social Cost of GHG Emissions for Individual and System-Wide Analyses

Table I.6-1. Median Published Life Cycle CO_2 Equivalent Emission Factors for Electricity Generation Technologies by Life Cycle Phase

Electric Power Technology	One-Time Upstream GHG (CO_2 equivalent), g/kW-hr	Ongoing Annual Combustion GHG (CO_2 equivalent), g/kW-hr	Ongoing Annual Non-Combustion GHG (CO_2 equivalent), g/kW-hr	One-Time Downstream GHG (CO_2 equivalent), g/kW-hr	Total Life Cycle (CO_2 equivalent), g/kW-hr
Coal (Supercritical pulverized)(1)	4.9	NU	4.9	4.9	NA1
Natural Gas - CC	0.8	NU	62	0.02	NA1
Natural Gas - CTs	0.14	NU	70	0.003	NA1
Solar Panels (2)	NR	NA2	NR	NR	64
Li-Ion Battery Storage	31.5	NA2	NR	3.4	34.9

Sources: Nicholson et al. 2021, Whitaker et al. 2012, O'Donoughue et al. 2014, and Hsu et al. 2012.

Acronyms:
g = grams; kW = kilowatts; hr = hours
CC = Combined Cycle Gas Turbine Plant
CT = Simple-Cycle Aeroderivative Gas Turbine Plant
NU = Emission factors in NREL references were not used; GHG emissions from ongoing annual combustion were calculated separately using proposed action alternatives and existing coal plant specific design/operating information.
NA1 = Not Applicable; emission factors/rates for each applicable life cycle segment were used instead of the total life cycle emission factor in the NREL reference.
NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.
NR = Not Reported in the NREL references.

NOTES:
None of the emission factors in the NREL LCA harmonization reference documents include Transmission and Distribution (T&D) electricity losses as they were outside the scope of the NREL studies and are not considered appreciably different for each Alternative.
(1) = Assumed <5 g/kW-hr values in the source document table are 4.9 g/kW-hr
(2) = Assumed Solar panels are Mono-Silicon type technology.

Table I.6-2. Estimated Life Cycle CO_2 Emission Factors for Electricity Generation Technologies by Life Cycle Phase

Electric Power Technology	One-Time Upstream CO_2, g/kW-hr	Ongoing Annual Combustion CO_2, g/kW-hr	Ongoing Annual Non-Combustion CO_2, g/kW-hr	One-Time Downstream CO_2, g/kW-hr	Total Life Cycle CO_2, g/kW-hr
Coal (Supercritical pulverized)	4.61	NU	4.61	4.61	NA1
Natural Gas - CC	7.999E-01	NU	6.199E+01	1.9998E-02	NA1
Natural Gas - CTs	1.3999E-01	NU	6.9993E+01	2.9997E-03	NA1
Solar	NR	NA2	NR	NR	63.99
Li-Ion Battery Storage	31.4969	NA2	NR	3.3997	34.8965

Source: Calculated based on sources footnoted in Table I.6-1

Acronyms:
g = grams; kW = kilowatts; hr = hours
CC = Combined Cycle Gas Turbine Plant
CT = Simple-Cycle Aeroderivative Gas Turbine Plant
NU = Emission factors in NREL references were not used; GHG emissions from ongoing annual combustion were calculated separately using proposed action alternatives and existing coal plant specific design/operating information.
NA1 = Not Applicable; emission factors/rates for each applicable life cycle segment were used instead of the total life cycle emission factor in the NREL reference.
NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.
NR = Not Reported in the NREL references.

NOTES:
See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6-3. Estimated Life Cycle CH_4 Emission Factors for Electricity Generation Technologies, by Life Cycle Phase

Electric Power Technology	One-Time Upstream CH_4, g/kW-hr (GWP-weighted)	Ongoing Annual Combustion CH_4, g/kW-hr (GWP-weighted)	Ongoing Annual Non-Combustion CH_4, g/kW-hr (GWP-weighted)	One-Time Downstream CH_4, g/kW-hr (GWP-weighted)	Total Life Cycle CH_4, g/kW-hr (GWP-weighted)	Methane Leakage (% of NG Production)
Coal (Supercritical pulverized)	0.25	NU	0.25	0.25	NA1	NA3
Natural Gas - CC	7.200E-05	NU	5.580E-03	1.800E-06	NA1	1.6
Natural Gas - CTs	1.260E-05	NU	6.300E-03	2.700E-07	NA1	1.6
Solar	NR	NA2	NR	NR	0.01	NA3
Li-Ion Battery Storage	2.84E-03	NA2	NR	3.06E-04	3.14E-03	NA3

Source: Calculated based on sources footnoted in Table I.6-1

NA3 = Not Applicable: methane leakage due to direct natural gas use is not applicable to coal, solar, and battery storage; coal bed methane releases is accounted for under the ongoing annual non-combustion emission factor.

The Natural Gas NREL reference above lists Methane Leakage rates in percent of natural gas production for various Life Cycle Analyses (LCAs) in the U.S. and their average value, based on 21 LCAs, is rounded to 1.6 based on data in Table 1. Assumed this leakage is not included in the Ongoing Annual Non-Combustion emission factor per interpretation of the Natural Gas NREL LCA harmonization reference.

Table I.6-4. Estimated Life Cycle N_2O Emission Factors for Electricity Generation Technologies, by Life Cycle Phase

Electric Power Technology	One-Time Upstream N_2O, g/kW-hr (GWP-weighted)	Ongoing Annual Combustion N_2O, g/kW-hr (GWP-weighted)	Ongoing Annual Non-Combustion N_2O, g/kW-hr (GWP-weighted)	One-Time Downstream N_2O, g/kW-hr (GWP-weighted)	Total Life Cycle N_2O, g/kW-hr (GWP-weighted)
Coal (Supercritical pulverized)	0.04	NU	0.04	0.04	NA1
Natural Gas - CC	8.000E-06	NU	6.200E-04	2.000E-07	NA1
Natural Gas - CTs	1.400E-06	NU	7.000E-04	3.000E-08	NA1
Solar	NR	NA2	NR	NR	6.40E-04
Li-Ion Battery Storage	3.15E-04	NA2	NR	3.40E-05	3.49E-04

Source: Calculated based on sources footnoted in Table I.6-1

Table I.6-5. Electricity Generation Assumptions for Each Alternative

Electricity Generation Technology	Electricity Generation Annual Rate (kW-hr/year)	Plant Size (MW)	Alternative
Coal kW-hr/year (max. capacity generation)	11,370,480,000	1298	No Action
Coal kW-hr/year (projected average annual lifetime generation)	6,253,764,000		
CC kW-hr/year (max. capacity generation)	5,895,480,000	673	A
CC kW-hr/year (projected average annual lifetime generation)	3,242,514,000		
16x Aeroderivative CT kW-hr/year (max. capacity generation)	2,971,392,000	848	A
16x Aeroderivative CT kW-hr/year (projected average annual lifetime generation)	742,848,000		
On-site Solar kW-hr/year (projected average annual lifetime generation)	8,760,000	4	A
On-site Battery Storage kW-hr/year (projected average annual lifetime generation discharged)	146,000,000	100	A
Solar kW-hr/year (projected average annual lifetime generation)	3,285,000,000	1500	B
Li-Ion Battery Storage kW-hr/year (projected average annual lifetime generation discharged)	3,212,000,000	2200	B

Supporting Information: Conversion, Acronyms, Capacity Factors

grams to lbs conversion: 0.00220462

CC = Natural Gas Turbine Combined Cycle

CF = Capacity Factor

CT = Natural Gas Turbine Simple Cycle Aeroderivative

Max. Generation for CC/Coal @ 100% CF, CTs @ 38% CF, Solar/Battery @ 30% CF

Projected Average Annual Lifetime Generation CC/Coal @ 55% CF, CTs @ 10% CF, Solar @ 25% CF, Battery @ 16.7% CF

Batteries assume max. of 2 full cycles/day (5 hours to charge from the grid and 4 hours to discharge to grid = 9 hours/cycle). 1 cycle/day is assumed to be the predicted actual operation. Battery efficiency is assumed to be 85% based on TVA historical model data.

Table I.6-6. Estimated Life Cycle CO_2 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production

Electricity Generation Technology	One-Time Upstream CO_2 Emissions, tons	Ongoing Annual Combustion CO_2 Emissions, tons/yr	Ongoing Annual Non-Combustion CO_2 Emissions, tons/yr	One-Time Downstream CO_2 Emissions, tons	Total Life Cycle CO_2 Emissions, tons
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	953,569	3,386,667	31,786	953,569	**104,460,708**
Alternative A - Natural Gas - CC (30-year Life Cycle)	85,774	1,294,181	221,582	2,144	45,560,807
Alternative A - Natural Gas – Aero. CTs (30-year Life Cycle)	3,439	441,804	57,314	74	14,977,030
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	18,538
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	152,071	NA2	NC	16,414	168,484
Alternative A - Total Life Cycle CO_2 Emissions, tons					**60,724,860**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	6,951,794
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	3,345,551	NA2	NC	361,107	3,706,658
Alternative B - Total Life Cycle CO_2 Emissions, tons					**10,658,453**

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.
NC = Not calculated separately; incorporated in the total life cycle emissions.
See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6-7. Estimated Life Cycle CH_4 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production

Electricity Generation Technology	One-Time Upstream CH_4 Emissions, tons	Ongoing Annual Combustion CH_4 Emissions, tons/yr	Ongoing Annual Non-Combustion CH_4 Emissions, tons/yr	One-Time Downstream CH_4 Emissions, tons	Methane Life Cycle Leakage, tons	Total Life Cycle CH_4 Emissions, tons
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	2,026.7	35	67.6	2,026.7	NA3	**7,115**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	0.3	83	0.8	0.01	46,407	48,923
Alternative A - Natural Gas – Aero CTs (30-year Life Cycle)	0.01	32	0.2	2.653E-04	4,182	5,138
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	NA3	0
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	1	NA2	NC	0.1	NC2	1
Alternative A - Total Life Cycle CH_4 Emissions, tons					50,589	**54,062**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	NA3	25
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	12	NA2	NC	1.3	NC2	13
Alternative B - Total Life Cycle CH_4 Emissions, tons						**38**

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.

NA3 = Not Applicable: methane leakage due to natural gas use is not applicable to coal and solar; coal bed methane releases is accounted for under the ongoing annual non-combustion emissions.

NC = Not calculated separately; incorporated in the total life cycle emissions.

NC2 = Not calculated separately; Methane leak emissions due to grid power generation from natural gas plants for charging the batteries is incorporated into TVA system wide GHG emissions analysis.

See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6-8. Estimated Methane Leak Emissions, Average Annual Lifetime - Alternative A, CC Plant

13,769,462	NG scf/day use at Kingston CC
94	Estimated Methane portion of NG (percent)
12,943,295	Methane scf/day use at Kingston CC
0.657	Methane density (kg/m^3)
0.0283168	conversion, 1 cubic foot = 0.0283168 cubic meters
3,093,783	Methane Release Emissions (lbs/yr) from NG use at Kingston CC
1,547	**Methane Release Emissions (tons/yr) from NG use at Kingston CC**

NG = natural gas
Scf/day = standard cubic feet per day

Table I.6-9. Estimated Methane Leak Emissions, Average Annual Lifetime - Alternative A, Aero. CTs

52	NG MMBtu/hr at Kingston Aero CTs
1,240,800	NG scf/day use for Kingston Aero. CTs
94	Estimated Methane portion of NG (percent)
1,166,352	Methane scf/day use for Kingston Aero CTs
0.657	Methane density (kg/m^3)
0.0283168	conversion, 1 cubic foot = 0.0283168 cubic meters
278,788	Methane Release Emissions (lbs/yr) from NG use at Kingston Aero. CTs
139	**Methane Release Emissions (tons/yr) from NG use at** Kingston **Aero. CTs**

NG = natural gas
Scf/day = standard cubic feet per day
MMBtu/hr = Millions of British Thermal Units per hour

Table I.6-10. Estimated Life Cycle N_2O Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production

Electricity Generation Technology	One-Time Upstream N_2O Emissions, tons	Ongoing Annual Combustion N_2O Emissions, tons/yr	Ongoing Annual Non-Combustion N_2O Emissions, tons/yr	One-Time Downstream N_2O Emissions, tons	Total Life Cycle N_2O Emissions, tons
No Action Alternative -Coal(Supercritical pulverized); assumed 30-years remaining life for consistency	30.60	55	1.02	31	**1,736**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	2.88E-03	29	0.01	7.20E-05	862
Alternative A - Natural Gas – Aero. CTs (30-year Life Cycle)	1.15E-04	11	1.92E-03	2.47E-06	331
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	0
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	0.0	NA2	NC	0.00	0
Alternative A - Total Life Cycle N_2O Emissions, tons					**1,193**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	0.2
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	0.1	NA2	NC	0.01	0.1
Alternative B - Total Life Cycle N_2O Emissions, tons					**0.4**

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.

NC = Not calculated separately; incorporated in the total life cycle emissions.

See text for assumptions on GSP-weighted contributions of CO_2, CH_4, and N_2O to CO_2-e.

Table I.6-11. Estimated Social Cost of Life Cycle CO_2 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electricity Generation Technology	One-Time Upstream Social Cost of CO_2 Emissions, $	Ongoing Combustion Social Cost of CO_2 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CO_2 Emissions, $/LC	One-Time Downstream Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CO_2 Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$58,644,031	$11,350,263,656	$106,528,161	$170,789,070	**$11,686,224,919**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$5,275,031	$4,337,391,296	$742,621,225	$384,062	$5,085,671,614
Alternative A - Natural Gas – Aero CTs (30-year Life Cycle)	$211,486	$1,480,685,167	$192,084,272	$13,198	$1,672,994,123
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	$2,070,989
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$9,352,261	NA2	NC	$2,939,823	$12,292,084
Alternative A Total Life Cycle Social Cost of CO_2 Emissions, $					**$6,773,028,810**
Alternative B- Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	$776,621,047
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$205,749,733	NA2	NC	$64,676,112	$270,425,845
Alternative B Total Life Cycle Social Cost of CO_2 Emissions, $					**$1,047,046,892**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.

NC = Not calculated separately; incorporated in the total life cycle emissions.

NPV = Net Present Value

Assumed One-Time Upstream costs are all in 2027.

Assumed One-Time Downstream costs are all in 2058 for Alt. A and 2048 for Alt. B.

For Solar NPV calculations, assumed 90% of total life cycle costs are the Upstream costs and 10% are the Downstream costs based on approximate relative comparison in emissions for these segments under Battery Storage.

Table I.6-12. Technical Support Document: Social Cost of Carbon - Interim Estimates under Biden Administration Executive Order 13990 - Feb. 2021 (Appendix A, Table A-1, 3% Discount Rate)

Year	2% Inflation Adjustor	Real SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/ton)
2020	1.00	$ 51	$ 51	$ 46
2021	1.02	$ 52	$ 53	$ 48
2022	1.04	$ 53	$ 55	$ 50
2023	1.06	$ 54	$ 57	$ 52
2024	1.08	$ 55	$ 60	$ 54
2025	1.10	$ 56	$ 62	$ 56
2026	1.13	$ 57	$ 64	$ 58
2027	1.15	$ 59	$ 68	$ 61
2028	1.17	$ 60	$ 70	$ 64
2029	1.20	$ 61	$ 73	$ 66
2030	1.22	$ 62	$ 76	$ 69
2031	1.24	$ 63	$ 78	$ 71
2032	1.27	$ 64	$ 81	$ 74
2033	1.29	$ 65	$ 84	$ 76
2034	1.32	$ 66	$ 87	$ 79
2035	1.35	$ 67	$ 90	$ 82
2036	1.37	$ 69	$ 95	$ 86
2037	1.40	$ 70	$ 98	$ 89
2038	1.43	$ 71	$ 101	$ 92
2039	1.46	$ 72	$ 105	$ 95
2040	1.49	$ 73	$ 108	$ 98
2041	1.52	$ 74	$ 112	$ 102
2042	1.55	$ 75	$ 116	$ 105
2043	1.58	$ 77	$ 121	$ 110
2044	1.61	$ 78	$ 125	$ 114
2045	1.64	$ 79	$ 130	$ 118
2046	1.67	$ 80	$ 134	$ 121

Year	2% Inflation Adjustor	Real SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/mt)	Nominal SC-CO_2 ($/ton)
2047	1.71	$ 81	$ 138	$ 125
2048	1.74	$ 82	$ 143	$ 130
2049	1.78	$ 84	$ 149	$ 135
2050	1.81	$ 85	$ 154	$ 140
2051	1.85	$ 86	$ 159	$ 144
2052	1.88	$ 87	$ 164	$ 149
2053	1.92	$ 88	$ 169	$ 153
2054	1.96	$ 89	$ 175	$ 158
2055	2.00	$ 90	$ 180	$ 163
2056	2.04	$ 91	$ 186	$ 168
2057	2.08	$ 92	$ 191	$ 174
2058	2.12	$ 92	$ 191	$ 174

Converted to Nominal Dollars using 2% inflation annual rate approximation; then converted those values to $/short ton (ton)

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide; SC-CH_4 = Social Cost of Methane; SC-N_2O = Social Cost of Nitrous Oxide

Real CO_2 values for years 2051 through 2058 were assumed to increase $1/mt per year based on a similar rate of increase in previous years.

Table I.6-13. Estimated Social Cost of Life Cycle CH_4 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Values, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of CH_4 Emissions, $	Ongoing Combustion Social Cost of CH_4 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CH_4 Emissions, $/LC	One-Time Downstream Social Cost of CH_4 Emissions, $	Methane Leakage Social Cost of CH_4, $	Total Life Cycle Social Cost of CH_4 Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$3,802,635	$4,062,755	$7,955,597	$13,661,096	NA3	**$29,482,083**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$579	$9,782,229	$93,947	$52	$182,163,516	$192,040,323
Alternative A- Natural Gas – Aero. CTs (30-year Life Cycle)	$23	$3,728,618	$24,300	$2	$16,415,201	$20,168,144
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	NA3	$262
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$1,027	NA2	NC	$280	NC2	$1,307
Alternative A Total Life Cycle Social Cost of CH_4 Emissions, $						**$212,210,037**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	NA3	$98,248
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$22,600	NA2	NC	$6,162	NC2	$28,762
Alternative B Total Life Cycle Social Cost of CH_4 Emissions, $						**$127,010**

LC = Life Cycle period
NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.
NA3 = Not Applicable: methane leakage due to natural gas use is not applicable to coal and solar; coal bed methane releases is accounted for under the ongoing annual non-combustion emissions.
NC = Not calculated separately; incorporated in the total life cycle emissions.
NC2 = Not calculated separately; Methane leak emissions due to grid power generation from natural gas plants for charging the batteries is incorporated into TVA system wide GHG emissions analysis.
Assumed One-Time Upstream costs are all in 2027.
Assumed One-Time Downstream costs are all in 2058 for Alt. A and 2048 for Alt. B.
For Solar NPV calculations, assumed 90% of total life cycle costs are the Upstream costs and 10% are the Downstream costs based on approximate relative comparison in emissions for these segments under Battery Storage.

Table I.6-14. Technical Support Document: Social Cost of Methane - Interim Estimates under Biden Administration Executive Order 13990 - Feb. 2021 (Appendix A, Table A-2, 3% Discount Rate)

Year	2% Inflation Adjustor	Real SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/ton)
2020	1.00	$1,500	$ 1,500	$ 1,361
2021	1.02	$1,500	$ 1,530	$ 1,388
2022	1.04	$1,600	$ 1,665	$ 1,511
2023	1.06	$1,600	$ 1,698	$ 1,541
2024	1.08	$1,700	$ 1,840	$ 1,670
2025	1.10	$1,700	$ 1,877	$ 1,703
2026	1.13	$1,800	$ 2,027	$ 1,839
2027	1.15	$1,800	$ 2,068	$ 1,876
2028	1.17	$1,900	$ 2,226	$ 2,020
2029	1.20	$1,900	$ 2,271	$ 2,061
2030	1.22	$2,000	$ 2,438	$ 2,212
2031	1.24	$2,000	$ 2,487	$ 2,257
2032	1.27	$2,100	$ 2,663	$ 2,417
2033	1.29	$2,100	$ 2,717	$ 2,465
2034	1.32	$2,200	$ 2,903	$ 2,634
2035	1.35	$2,200	$ 2,961	$ 2,687
2036	1.37	$2,300	$ 3,157	$ 2,865
2037	1.40	$2,300	$ 3,221	$ 2,922
2038	1.43	$2,400	$ 3,428	$ 3,111
2039	1.46	$2,500	$ 3,642	$ 3,305
2040	1.49	$2,500	$ 3,715	$ 3,371
2041	1.52	$2,600	$ 3,941	$ 3,576
2042	1.55	$2,600	$ 4,020	$ 3,648
2043	1.58	$2,700	$ 4,258	$ 3,864
2044	1.61	$2,700	$ 4,343	$ 3,941
2045	1.64	$2,800	$ 4,594	$ 4,169
2046	1.67	$2,800	$ 4,686	$ 4,252

Year	2% Inflation Adjustor	Real SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/mt)	Nominal SC-CH_4 ($/ton)
2047	1.71	$2,900	$ 4,950	$ 4,492
2048	1.74	$3,000	$ 5,223	$ 4,740
2049	1.78	$3,000	$ 5,328	$ 4,834
2050	1.81	$3,100	$ 5,615	$ 5,095
2051	1.85	$3,100	$ 5,728	$ 5,197
2052	1.88	$3,200	$ 6,031	$ 5,472
2053	1.92	$3,200	$ 6,151	$ 5,582
2054	1.96	$3,300	$ 6,470	$ 5,871
2055	2.00	$3,300	$ 6,600	$ 5,989
2056	2.04	$3,400	$ 6,936	$ 6,294
2057	2.08	$3,400	$ 7,074	$ 6,420
2058	2.12	$3,500	$ 7,428	$ 6,741

Converted to Nominal Dollars using 2% inflation annual rate approximation; then converted those values to $/short ton (ton)

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide; SC-CH_4 = Social Cost of Methane; SC-N_2O = Social Cost of Nitrous Oxide

Real CH_4 values for years 2051 through 2058 were assumed to increase by $100/mt every two years based on a similar rate of increase in previous years.

Table I.6-15. Estimated Social Cost of Life Cycle N_2O Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Values, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of N_2O Emissions, $/LC	Ongoing Combustion Social Cost of N_2O Emissions, $/LC	Ongoing Non-Combustion Social Cost of N_2O Emissions, $/LC	One-Time Downstream Social Cost of N_2O Emissions, $/LC	Total Life Cycle Social Cost of N_2O Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$669,927	$70,283,315	$1,308,396	$2,180,798	**$74,442,437**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$63	$36,844,792	$9,537	$5	$36,854,397
Alternative B - Natural Gas - CTs (30-year Life Cycle)	$3	$14,165,794	$2,467	$0	$14,168,264
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	$27
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$112	NA2	NC	$39	$151
Alternative B Total Life Cycle Social Cost of N_2O Emissions, $					**$51,022,839**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	$9,974
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$2,458	NA2	NC	$864	$3,321
Alternative B Total Life Cycle Social Cost of N_2O Emissions, $					**$13,295**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.

NC = Not calculated separately; incorporated in the total life cycle emissions.

Assumed One-Time Upstream costs are all in 2027.

Assumed One-Time Downstream costs are all in 2058 for Alt. A and 2048 for Alt. B.
For Solar NPV calculations, assumed 90% of total life cycle costs are the Upstream costs and 10% are the Downstream costs based on approximate relative comparison in emissions for these segments under Battery Storage.

Table I.6-16. Technical Support Document: Social Cost of Nitrous Oxide - Interim Estimates under Biden Administration Executive Order 13990 - Feb. 2021 (Appendix A, Table A-3, 3% Discount Rate)

Year	2% Inflation Adjustor	Real SC-N_2O ($/mt)	Nominal SC-N_2O ($/mt)	Nominal SC-N_2O ($/ton)
2020	1.00	$18,000	$18,000	$16,334
2021	1.02	$19,000	$19,380	$17,586
2022	1.04	$19,000	$19,768	$17,938
2023	1.06	$20,000	$21,224	$19,260
2024	1.08	$20,000	$21,649	$19,645
2025	1.10	$21,000	$23,186	$21,040
2026	1.13	$21,000	$23,649	$21,460
2027	1.15	$21,000	$24,122	$21,890
2028	1.17	$22,000	$25,777	$23,391
2029	1.20	$22,000	$26,292	$23,858
2030	1.22	$23,000	$28,037	$25,442
2031	1.24	$23,000	$28,598	$25,951
2032	1.27	$24,000	$30,438	$27,621
2033	1.29	$24,000	$31,047	$28,173
2034	1.32	$25,000	$32,987	$29,934
2035	1.35	$25,000	$33,647	$30,532
2036	1.37	$26,000	$35,692	$32,389
2037	1.40	$26,000	$36,406	$33,037
2038	1.43	$27,000	$38,563	$34,993
2039	1.46	$27,000	$39,334	$35,693
2040	1.49	$28,000	$41,607	$37,755
2041	1.52	$28,000	$42,439	$38,511
2042	1.55	$29,000	$44,833	$40,684
2043	1.58	$29,000	$45,730	$41,497
2044	1.61	$30,000	$48,253	$43,787
2045	1.64	$30,000	$49,218	$44,663
2046	1.67	$31,000	$51,876	$47,074

Year	2% Inflation Adjustor	Real SC-N_2O ($/mt)	Nominal SC-N_2O ($/mt)	Nominal SC-N_2O ($/ton)
2047	1.71	$31,000	$52,913	$48,016
2048	1.74	$32,000	$55,713	$50,556
2049	1.78	$32,000	$56,827	$51,567
2050	1.81	$33,000	$59,775	$54,242
2051	1.85	$33,000	$60,970	$55,327
2052	1.88	$34,000	$64,074	$58,144
2053	1.92	$34,000	$65,356	$59,307
2054	1.96	$35,000	$68,624	$62,272
2055	2.00	$35,000	$69,996	$63,517
2056	2.04	$36,000	$73,436	$66,639
2057	2.08	$36,000	$74,905	$67,972
2058	2.12	$37,000	$78,525	$71,257

Converted to Nominal Dollars using 2% inflation annual rate approximation; then converted those values to $/short ton (ton)

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide; SC-CH_4 = Social Cost of Methane; SC-N_2O = Social Cost of Nitrous Oxide

Real N_2O values for years 2051 through 2058 were assumed to increase by $1,000/mt every two years based on a similar rate of increase in previous years.

Table I.6-17. Estimated Social Cost of Life Cycle GHG Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Biden Administration EO 13990 Interim Values, 3% Discount Rates)

Electricity Power Technology	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHG Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	**$11,686,224,919**	**$29,482,083**	**$74,442,437**	**$11,790,149,438**
Alternative A - Natural Gas - CC (30-year Life Cycle)	$5,085,671,614	$192,040,323	$36,854,397	$5,314,566,334
Alternative A - Natural Gas – Aero CTs (30-year Life Cycle)	$1,672,994,123	$20,168,144	$14,168,264	$1,707,330,531
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	$2,070,989	$262	$27	$2,071,278
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$12,292,084	$1,307	$151	$12,293,542
Alternative A Total Life Cycle Social Cost of GHG Emissions, $	**$6,773,028,810**	**$212,210,037**	**$51,022,839**	**$7,036,261,686**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	$776,621,047	$98,248	$9,974	$776,729,269
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$270,425,845	$28,762	$3,321	$270,457,928
Alternative B Total Life Cycle Social Cost of GHG Emissions, $	**$1,047,046,892**	**$127,010**	**$13,295**	**$1,047,187,197**

Table I.6-18. Estimated Social Cost of Life Cycle CO_2 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of CO_2 Emissions, $	Ongoing Combustion Social Cost of CO_2 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CO_2 Emissions, $/LC	One-Time Downstream Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CO_2 Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$6,674,984	$904,240,009	$8,486,765	$11,442,830	**$930,844,588**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$600,415	$346,546,400	$59,162,311	$25,732	$405,334,857
Alternative A - Natural Gas – Aero. CTs (30-year Life Cycle)	$24,072	$117,961,557	$15,302,753	$884	$133,289,266
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	$164,989
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$1,064,494	NA2	NC	$164,140	$1,228,633
Alternative A Total Life Cycle Social Cost of CO_2 Emissions, $					**$540,017,746**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	$61,870,970
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$23,418,857	NA2	NC	$3,611,071	$27,029,920
Alternative B Total Life Cycle Social Cost of CO_2 Emissions, $					**$88,900,898**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.

NC = Not calculated separately; incorporated in the total life cycle emissions.

Assumed One-Time Upstream costs are all in 2027.

Assumed One-Time Downstream costs are all in 2058 for Alt. A and 2048 for Alt. B.

Table I.6-19. Federal Government's Social Cost of Carbon - Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate)

Year	Nominal SC-CO_2 [1] ($/mt)	Nominal SC-CO_2 ($/ton)
2020	$7.0	$ 6
2021	$7.1	$ 6
2022	$7.2	$ 7
2023	$7.3	$ 7
2024	$7.4	$ 7
2025	$7.5	$ 7
2026	$7.6	$ 7
2027	$7.7	$ 7
2028	$7.8	$ 7
2029	$7.9	$ 7
2030	$8.0	$ 7
2031	$8.1	$ 7
2032	$8.2	$ 7
2033	$8.3	$ 8
2034	$8.4	$ 8
2035	$8.5	$ 8
2036	$8.6	$ 8
2037	$8.7	$ 8
2038	$8.8	$ 8
2039	$8.9	$ 8
2040	$9.0	$ 8
2041	$9.2	$ 8
2042	$9.4	$ 9
2043	$9.6	$ 9
2044	$9.8	$ 9
2045	$10.0	$ 9
2046	$10.2	$ 9

Year	Nominal SC-CO_2 [1] ($/mt)	Nominal SC-CO_2 ($/ton)
2047	$10.4	$ 9
2048	$10.6	$ 10
2049	$10.8	$ 10
2050	$11.0	$ 10
2051	$11.2	$ 10
2052	$11.5	$ 10
2053	$11.7	$ 11
2054	$12.0	$ 11
2055	$12.3	$ 11
2056	$12.5	$ 11
2057	$12.8	$ 12
2058	$13.1	$ 12

$ = U.S. Dollars; mt = metric tons; SC-CO_2 = Social Cost of Carbon Dioxide

1 Under the prior Administration, federal estimates of the social cost of carbon dioxide were originally reported in 2016 U.S. dollars in EPA's regulatory impact analysis for the 2019 Affordable Clean Energy Rule. The GAO adjusted the values for inflation and expressed them in 2018 U.S. dollars using the United States Gross Domestic Product Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis. The GAO source document is cited as: U.S. Government Accountability Office, Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020.

CO_2 values for years between 2020 and 2030, between 2030 and 2040, and between 2040 and 2050 were interpolated as only 2020, 2030, 2040, and 2050 values were provided in the reference.

Table I.6-20. Estimated Social Cost of Life Cycle CH_4 Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of CH_4 Emissions, $	Ongoing Combustion Social Cost of CH_4 Emissions, $/LC	Ongoing Non-Combustion Social Cost of CH_4 Emissions, $/LC	One-Time Downstream Social Cost of CH_4 Emissions, $	Methane Leakage Social Cost of CH_4, $	Total Life Cycle Social Cost of CH_4 Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$413,067	$295,379	$578,404	$743,742	NA3	**$2,030,592**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$63	$711,208	$6,830	$3	$13,244,032	$13,962,136
Alternative A - Natural Gas – Aero CTs (30-year Life Cycle)	$3	$271,086	$1,767	$0	$1,193,452	$1,466,307
Alternative A – On-Site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	NA3	$19
Alternative A – On-Site Li-ion Battery Storge (20-year Life Cycle, prorated to 30 years)	$112	NA2	NC	$19	NC2	$130
Alternative A Total Life Cycle Social Cost of CH_4 Emissions, $						**$15,428,593**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	NA3	$7,143
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$2,455	NA2	NC	$409	NC2	$2,864
Alternative B Total Life Cycle Social Cost of CH_4 Emissions, $						**$10,007**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.

NA3 = Not Applicable: methane leakage due to natural gas use is not applicable to coal and solar; coal bed methane releases is accounted for under the ongoing annual non-combustion emissions.

NC = Not calculated separately; incorporated in the total life cycle emissions.

NC2 = Not calculated separately; Methane leak emissions due to grid power generation from natural gas plants for charging the batteries is incorporated into TVA system wide GHG emissions analysis.

Assumed One-Time Upstream costs are all in 2027.

Assumed One-Time Downstream costs are all in 2058 for Alt. A and 2048 for Alt. B.

Table I.6-21. Federal Government's Social Cost of Methane - Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate)

Year	Nominal SC-CH4 [1] ($/mt)	Nominal SC-CH4 ($/ton)
2020	$ 184	$ 167
2021	$ 190	$ 172
2022	$ 196	$ 177
2023	$ 201	$ 183
2024	$ 207	$ 188
2025	$ 213	$ 193
2026	$ 219	$ 199
2027	$ 225	$ 204
2028	$ 230	$ 209
2029	$ 236	$ 214
2030	$ 242	$ 220
2031	$ 248	$ 225
2032	$ 254	$ 230
2033	$ 259	$ 235
2034	$ 265	$ 241
2035	$ 271	$ 246
2036	$ 277	$ 251
2037	$ 283	$ 256
2038	$ 288	$ 262
2039	$ 294	$ 267
2040	$ 300	$ 272
2041	$ 306	$ 277
2042	$ 312	$ 283
2043	$ 317	$ 288
2044	$ 323	$ 293
2045	$ 329	$ 299
2046	$ 335	$ 304

Year	Nominal SC-CH4 [1] ($/mt)		Nominal SC-CH4 ($/ton)	
2047	$	341	$	309
2048	$	346	$	314
2049	$	352	$	320
2050	$	358	$	325
2051	$	364	$	330
2052	$	370	$	335
2053	$	375	$	341
2054	$	381	$	346
2055	$	387	$	351
2056	$	393	$	356
2057	$	399	$	362
2058	$	404	$	367

1 Under the prior Administration, federal estimates of the social cost of methane were originally reported in 2016 U.S. dollars in BLM's regulatory impact analysis for the 2018 Final Rule to Rescind or Revise Certain Requirements of the 2016 Waste Prevention Rule. The GAO adjusted the values for inflation and expressed them in 2018 U.S. dollars using the United States Gross Domestic Product Price Index from the U.S. Department of Commerce, Bureau of Economic Analysis. Unlike EPA, BLM included estimates only to 2030. The GAO source document is cited as: U.S. Government Accountability Office, Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020.

$ = U.S. Dollars; mt = metric tons; SC-CH_4 = Social Cost of Methane

CH_4 values for years between 2020 and 2030 and thereafter were interpolated based on the change in rates between the 2020 and 2030 rates provided.

Table I.6-22. Estimated Social Cost of Life Cycle N_2O Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	One-Time Upstream Social Cost of N_2O Emissions, $/LC	Ongoing Combustion Social Cost of N_2O Emissions, $/LC	Ongoing Non-Combustion Social Cost of N_2O Emissions, $/LC	One-Time Downstream Social Cost of N_2O Emissions, $/LC	Total Life Cycle Social Cost of N_2O Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	$63,726	$4,360,935	$81,183	$108,349	**$4,614,193**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$6	$2,286,144	$592	$0	$2,286,742
Alternative A - Natural Gas – Aero CTs (30-year Life Cycle)	$0	$878,958	$153	$0	$879,112
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	NC	NA2	NC	NC	$2
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	$11	NA2	NC	$2	$12
Alternative A Total Life Cycle Social Cost of N_2O Emissions, $					**$3,165,867**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	NC	NA2	NC	NC	$619
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$234	NA2	NC	$35	$269
Alternative B Total Life Cycle Social Cost of N_2O Emissions, $					**$887**

LC = Life Cycle period

NA2 = Not Applicable; no direct ongoing annual combustion emissions are generated directly from Alternative B solar and battery operations.

NC = Not calculated separately; incorporated in the total life cycle emissions.

Assumed One-Time Upstream costs are all in 2027.

Assumed One-Time Downstream costs are all in 2058 for Alt. A and 2048 for Alt. B.

Table I.6-23. Federal Government's Social Cost of Nitrous Oxide - Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate)

Year	Nominal SC-N_2O [1] ($/mt)		Nominal SC-N_2O ($/ton)	
2020	$	2,086	$	1,893
2021	$	2,116	$	1,920
2022	$	2,146	$	1,947
2023	$	2,175	$	1,974
2024	$	2,205	$	2,001
2025	$	2,235	$	2,028
2026	$	2,265	$	2,055
2027	$	2,295	$	2,082
2028	$	2,324	$	2,109
2029	$	2,354	$	2,136
2030	$	2,384	$	2,163
2031	$	2,414	$	2,190
2032	$	2,444	$	2,217
2033	$	2,473	$	2,244
2034	$	2,503	$	2,272
2035	$	2,533	$	2,299
2036	$	2,563	$	2,326
2037	$	2,593	$	2,353
2038	$	2,622	$	2,380
2039	$	2,652	$	2,407
2040	$	2,682	$	2,434
2041	$	2,742	$	2,488
2042	$	2,801	$	2,542
2043	$	2,861	$	2,596
2044	$	2,920	$	2,650
2045	$	2,980	$	2,704
2046	$	3,040	$	2,758

Year	Nominal SC-N_2O [1] ($/mt)		Nominal SC-N_2O ($/ton)	
2047	$	3,099	$	2,812
2048	$	3,159	$	2,866
2049	$	3,218	$	2,921
2050	$	3,278	$	2,975
2051	$	3,350	$	3,040
2052	$	3,424	$	3,107
2053	$	3,499	$	3,175
2054	$	3,576	$	3,245
2055	$	3,655	$	3,317
2056	$	3,735	$	3,389
2057	$	3,817	$	3,464
2058	$	3,901	$	3,540

1 Under the prior Administration, the GAO did not find a recent rulemaking that used monetary estimates for nitrous oxide that were based on the social cost of carbon approach. Instead, the NHTSA used a Global Warming Potential factor to convert EPA's social cost carbon dioxide estimates to monetary estimates for nitrous oxide. Monetary estimates the agency used in sensitivity analyses involving nitrous oxide were estimated by applying the 100-year Global Warming Potential factor for nitrous oxide (which is 298) to the central estimates of the social cost of carbon dioxide for each future year. The source document for this information is: U.S. Government Accountability Office, Report to Congressional Requesters, Social Cost of Carbon, Identifying a Federal Entity to Address the National Academies' Recommendations Could Strengthen Regulatory Analysis (GAO-20-254), June 2020.

$ = U.S. Dollars; mt = metric tons; SC-N_2O = Social Cost of Nitrous Oxide

Table I.6-24. Estimated Social Cost of Life Cycle GHG Emissions for Electricity Generation Technologies, by Life Cycle Phase - Based on Projected Average Annual Lifetime Electricity Production (Prior Administration Values, 2020, 3% Discount Rates)

Electricity Power Technology	Total Life Cycle Social Cost of CO_2 Emissions, $	Total Life Cycle Social Cost of CH_4 Emissions, $	Total Life Cycle Social Cost of N_2O Emissions, $	Total Life Cycle Social Cost of GHG Emissions, $
No Action Alternative - Coal (Supercritical pulverized); assumed 30-years remaining life for consistency	**$930,844,588**	**$2,030,592**	**$4,614,193**	**$937,489,373**
Alternative A - Natural Gas - CCs (30-year Life Cycle)	$405,334,857	$13,962,136	$2,286,742	$421,583,735
Alternative A - Natural Gas - CTs (30-year Life Cycle)	$133,289,266	$1,466,307	$879,112	$135,634,685
Alternative A - On-site Solar (20-year Life Cycle, prorated to 30 years)	$164,989	$19	$2	$165,010
Alternative A - On-site Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$1,228,633	$130	$12	$1,228,775
Alternative B Total Life Cycle Social Cost of GHG Emissions, $	**$540,017,746**	**$15,428,593**	**$3,165,867**	**$558,612,205**
Alternative B - Solar (20-year Life Cycle, prorated to 30-years)	$61,870,970	$7,143	$619	$61,878,732
Alternative B - Li-Ion Battery Storage (20-year Life Cycle, prorated to 30-years)	$27,029,928	$2,864	$269	$27,033,060
Alternative B Total Life Cycle Social Cost of GHG Emissions, $	**$88,900,898**	**$10,007**	**$887**	**$88,911,792**

Table I.6-25. TVA System-Wide Estimated 20-Year Life Cycle CO_2 Emissions Compared to the No Action Alternative, by Life Cycle Phase

Electric Power Technology	One-Time Upstream CO_2 Emissions, tons	Cumulative Combustion CO_2 Emissions, tons	Cumulative Non-Combustion CO_2 Emissions, tons	One-Time Downstream CO_2 Emissions, tons	Life Cycle CO_2 Emissions, tons	Total CO_2 Emissions, tons
Alternative A Total						**-47,091,844**
Coal		-77,376,884	-334,060			**-77,710,944**
Natural Gas - Combined Cycle	85,774	23,048,409	4,065,499	2,144		**27,201,826**
Natural Gas - Simple Cycle	3,439	3,172,373	516,062	74		**3,691,947**
Hydroelectric		0	-1			**-1**
Nuclear		0	0			**0**
Wind & Solar		0	NR			**0**
Battery Storage (Generation)		0	NR			**0**
Pumped Hydro (Generation)		0	664			**664**
Market Purchases		-242,175	-33,161			**-275,336**
Alternative B Total						**-56,371,327**
Coal		-77,607,210	-335,174			**-77,942,384**
Natural Gas - Combined Cycle		-1,418,252	-274,885			**-1,693,137**
Natural Gas - Simple Cycle		14,685,053	1,728,580			**16,413,632**
Hydroelectric		0	-2			**-2**
Nuclear		0	0			**0**
Wind & Solar		0	NR		4,634,530	**4,634,530**
Battery Storage (Generation)	2,230,367	0	NR	240,738		**2,471,105**
Pumped Hydro (Generation)		0	-13,398			**-13,398**
Market Purchases		-312,200	70,527			**-241,674**

Table I.6-26. TVA System-Wide Estimated 20-Year Life Cycle CH_4 Emissions Compared to the No Action Alternative, by Life Cycle Phase

Electric Power Technology	One-Time Upstream CH_4 Emissions, tons	Cumulative Combustion CH_4 Emissions, tons	Cumulative Non-Combustion CH_4 Emissions, tons	One-Time Downstream CH_4 Emissions, tons	Life Cycle CH_4 Emissions, tons	Natural Gas Related Methane Life Cycle Leakage, tons	Total CH_4 Emissions, tons
Alternative A Total							**-3,152**
Coal		-0.0004	-3,195				**-3,195**
Natural Gas - Combined Cycle	0.3	0.0015	41	0.01		-	**41**
Natural Gas - Simple Cycle	0.0	0.0003	5.2	0		-	**5**
Hydroelectric		0	0				**0**
Nuclear		0	0				**0**
Wind & Solar		0	NR				**0**
Battery Storage (Generation)		0	NR				**0**
Pumped Hydro (Generation)		0	5.97E-02				**0**
Market Purchases		0	-2.98			-	**-3**
Alternative B Total							**-3,160**
Coal		-0.0004	-3,206				**-3,206**
Natural Gas - Combined Cycle		-0.0001	-3			-	**-3**
Natural Gas - Simple Cycle		0.0010	17.3			-	**17**
Hydroelectric		0	0				**0**
Nuclear		0	0				**0**
Wind & Solar		0	NR		17		**17**
Battery Storage (Generation)	8	0	NR	0.9			**9**
Pumped Hydro (Generation)		0	-1.21E+00				**-1**
Market Purchases		0	6.35			-	**6**

Table I.6-27. TVA System-Wide Estimated 20-Year Life Cycle N_2O Emissions Compared to the No Action Alternative, by Life Cycle Phase

Electric Power Technology	One-Time Upstream N_2O Emissions, tons	Cumulative Combustion N_2O Emissions, tons	Cumulative Non-Combustion N_2O Emissions, tons	One-Time Downstream N_2O Emissions, tons	Life Cycle N_2O Emissions, tons	Total N_2O Emissions, tons
Alternative A Total						**-3,150**
Coal		-0.0006	-3,195			**-3,195**
Natural Gas - Combined Cycle	0.003	0.00	40.7	0.0001		**41**
Natural Gas - Simple Cycle	0.000	0.00	5.16	0.0000		**5**
Hydroelectric		0	-8.97E-06			**0**
Nuclear		0	0			**0**
Wind & Solar		0	NR			**0**
Battery Storage (Generation)		0	NR			**0**
Pumped Hydro (Generation)		0	6.64E-03			**0**
Market Purchases		0	-0.332			**0**
Alternative B Total						**-3,190**
Coal		-0.0006	-3,206			**-3,206**
Natural Gas - Combined Cycle		0.00	-2.7			**-3**
Natural Gas - Simple Cycle		0.00	17.29			**17**
Hydroelectric		0	-8.97E-06			**0**
Nuclear		0	0			**0**
Wind & Solar		0	NR		0.2	**0**
Battery Storage (Generation)	0.1	0	NR	0.008		**0**
Pumped Hydro (Generation)		0	-1.34E-01			**0**
Market Purchases		0	0.705			**1**

Table I.6-28. TVA System-Wide Estimated 20-Year Life Cycle CO_2 Costs, Biden Administration, Compared to the No Action Alternative, by Life Cycle Phase (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electric Power Technology	One-Time Upstream CO_2 Cost	Yearly Ongoing Combustion and Non-Combustion CO2 Cost										
	2027	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Alternative A	5,486,517	0	0	0	0	3,495,970	-168,242,516	-180,396,063	-190,239,258	-195,965,255	-213,216,347	-230,362,251
Alternative B	521,945,210	0	0	0	-13,694,538	-82,342,197	-252,812,541	-265,000,456	-279,639,091	-285,450,602	-294,568,656	-307,727,482

Electric Power Technology	Yearly Ongoing Combustion and Non-Combustion CO2 Cost (cont'd)									Downstream CO_2 Cost	Total Cost (Nominal $)	NPV (2023 $)
	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057		
Alternative A	-253,295,116	-265,901,584	-288,661,224	-296,241,350	-313,130,258	-315,674,783	-338,301,253	-357,728,969	-374,931,011	385,283	**-3,972,919,469**	**-1,704,499,984**
Alternative B	-328,519,000	-335,937,565	-360,415,827	-367,775,284	-385,715,690	-396,054,072	-414,524,422	-431,572,795	-450,703,315	162,573,650	**-4,567,934,672**	**-1,928,209,351**

Table I.6-29. TVA System-Wide Estimated 20-Year Life Cycle CH4 Costs, Biden Administration, Compared to the No Action Alternative, by Life Cycle Phase (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electric Power Technology	One-Time Upstream CH4 Cost	Yearly Combined Ongoing Combustion and Non-Combustion CH4 Cost and Leakage Cost										
	2027	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Alternative A	603	0	0	0	0	15	-570	-614	-676	-696	-791	-860
Alternative B	57,331	0	0	0	161,620	-210,941	-1,854,787	-1,993,840	-2,206,469	-2,243,206	-2,551,066	-2,692,318

Electric Power Technology	Yearly Combined Ongoing Combustion and Non-Combustion CH4 Cost and Leakage Cost (cont'd)									One-Time Downstream CH_4 Cost	Total Cost (Nominal $)	NPV (2023 $)
	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057		
Alternative A	-918	-951	-1,087	-1,078	-1,148	-1,191	-1,266	-1,399	-1,351	51	-13,926	-5,767
Alternative B	-3,199,841	-3,268,363	-3,595,408	-3,651,376	-4,018,984	-4,190,638	-4,437,039	-4,802,693	-5,073,947	101,738	-49,670,227	-21,046,183

Table I.6-30. TVA System-Wide Estimated 20-Year Life Cycle N_2O Costs, Biden Administration, Compared to the No Action Alternative, by Life Cycle Phase (Biden Administration EO 13990 Interim Rates, 3% Discount Rates)

Electric Power Technology	One-Time Upstream N_2O Cost	Yearly Ongoing Combustion and Non-Combustion N_2O Cost										
	2027	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Alternative A	66	0	0	0	0	96,795	-3,933,146	-4,159,623	-4,532,541	-4,603,175	-5,157,442	-5,522,573
Alternative B	6,235	0	0	0	350,514	-426,406	-3,868,978	-4,161,276	-4,574,942	-4,651,565	-5,260,517	-5,553,566

Electric Power Technology	Yearly Ongoing Combustion and Non-Combustion N_2O Cost (cont'd)									Downstream N_2O Cost	Total Cost (Nominal $)	NPV (2023 $)
	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057		
Alternative A	-6,506,689	-6,652,948	-7,283,883	-7,398,481	-8,106,191	-8,111,651	-8,913,700	-9,277,917	-10,155,219	5	**-100,218,313**	**-42,614,234**
Alternative B	-6,568,157	-6,709,757	-7,343,813	-7,458,691	-8,171,095	-8,178,272	-8,982,560	-9,349,010	-10,231,587	2,135	**-101,131,309**	**-43,016,766**

Table I.6-31. TVA System-Wide Estimated 20-Year Life Cycle CO_2 Costs, Prior Administration, Compared to the No Action Alternative, by Life Cycle Phase (Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate))

Electric Power Technology	One-Time Upstream CO_2 Cost	Yearly Ongoing Combustion and Non-Combustion CO2 Cost										
	2027	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Alternative A	624,487	0	0	0	0	397,918	-18,461,321	-19,088,654	-19,417,190	-19,298,176	-20,263,670	-24,152,790
Alternative B	59,408,876	0	0	0	-1,645,702	-9,372,358	-27,741,224	-28,041,089	-28,541,981	-28,110,473	-27,995,236	-32,264,302

Electric Power Technology	Yearly Ongoing Combustion and Non-Combustion CO2 Cost (cont'd)									Downstream CO_2 Cost	Total Cost (Nominal $)	NPV (2023 $)
	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057		
Alternative A	-25,642,009	-25,996,515	-26,866,320	-26,645,035	-27,222,949	-26,532,350	-27,494,694	-28,118,385	-32,070,847	26,616	**-366,221,883**	**-161,166,263**
Alternative B	-33,257,204	-32,843,753	-33,544,676	-33,079,060	-33,533,389	-33,288,199	-33,689,565	-33,922,692	-38,552,258	11,231,010	**-418,783,275**	**-178,196,858**

Table I.6-32. TVA System-Wide Estimated 20-Year Life Cycle CH_4 Costs, Prior Administration, Compared to the No Action Alternative, by Life Cycle Phase (Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate))

Electric Power Technology	One-Time Upstream CH4 Cost	Yearly Combined Ongoing Combustion and Non-Combustion CH4 Cost and Leakage Cost										
	2027	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Alternative A	65	0	0	0	0	2	-59	-64	-67	-69	-75	-82
Alternative B	43,901	0	0	0	17,445	-22,914	-191,965	-207,403	-219,019	-223,531	-242,912	-257,084

Electric Power Technology	Yearly Combined Ongoing Combustion and Non-Combustion CH4 Cost and Leakage Cost (cont'd)									One-Time Downstream CH_4 Cost	Total Cost (Nominal $)	NPV (2023 $)
	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057		
Alternative A	-84	-87	-95	-95	-97	-96	-102	-109	-105	3	**-1,216**	**-514**
Alternative B	-292,332	-299,140	-315,198	-320,404	-338,141	-338,516	-358,320	-372,688	-393,338	5,732	**-4,325,827**	**-1,869,998**

Table I.6-33. TVA System-Wide Estimated 20-Year Life Cycle N_2O Costs, Prior Administration, Compared to the No Action Alternative, by Life Cycle Phase (Estimates Used in Conducting Regulatory Impact Analyses under Prior EPA Administration, 2020 (3% Discount Rate))

Electric Power Technology	One-Time Upstream N_2O Cost	Yearly Ongoing Combustion and Non-Combustion N_2O Cost										
	2027	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Alternative A	6	0	0	0	0	9,207	-354,672	-372,454	-385,406	-388,534	-414,048	-439,969
Alternative B	4,752	0	0	0	33,567	-40,561	-348,886	-372,602	-389,011	-392,618	-422,323	-442,438

Electric Power Technology	Yearly Ongoing Combustion and Non-Combustion N_2O Cost (cont'd)									Downstream N_2O Cost	Total Cost (Nominal $)	NPV (2023 $)
	2034	2035	2036	2037	2038	2039	2040	2041	2042	2057		
Alternative A	-493,757	-500,849	-523,000	-526,868	-551,250	-546,951	-574,586	-599,367	-634,500	0	**-7,296,999**	**-3,207,107**
Alternative B	-498,421	-505,126	-527,303	-531,156	-555,664	-551,443	-579,025	-603,960	-639,272	109	**-7,361,382**	**-3,235,163**

Appendix J – Kingston Natural Resources Survey

Environmental Records Processing Form

Title of File		
Kingston Fossil Plant Natural Resources Survey		
Site/Plant/Project Name	Accession Number (optional)	Work Order Number (optional)
KIF/Natural Resources Survey		
Your Name	Date Submitted (YYYYMMDD)	Document Date (YYYYMMDD)
Amy McCampbell	20200922	20200420

Show Instructions

For assistance, please contact the Facility or Site Environmental Contact for your site/project, the Environmental Media Specialists (See Contacts on Environment InsideNet Page), or your Administrative Support Person.

Document Type

COMPREHENSIVE SITE SURVEYS

Record Type

Biological Compliance

Kingston Fossil Plant
Natural Resources Survey

Biological Compliance

ENVIRONMENTAL COMPLIANCE & OPERATIONS

2020

Table of Contents

1.0 Introduction

1.1 Purpose of reviews

The Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF) is a 1.7-gigawatt coal burning power plant with nine generating units located in Roane County, Tennessee, at the confluence of the Clinch and Emory Rivers on the shore of Watts Bar Reservoir. While portions of the plant property are heavily impacted by development of the plant infrastructure, large portions of the plant remain in some form of natural or mowed/maintained vegetation.

To facilitate project planning at KIF, comprehensive environmental surveys were performed for the entire KIF plant site in the summer of 2019. Resources identified consist of surface water features including streams, ponds, and wetlands; vegetation communities; terrestrial zoology habitats; and potential habitat for federal and state threatened and endangered species.

The locations of streams, wetlands, protected species themselves or habitat for protected species were mapped in the field using a Trimble Geo 7x handheld GPS receiver and shapefiles created in ArcMap 10.5.

1.2 Limitations of Reviews/Data

This data is a snapshot in time and reflects conditions at the time of the survey. The data presented in this report is intended for use in project siting and planning. All projects will still require formal NEPA review, but field data collected during the comprehensive site survey will be used to support that process and will, in many cases, preclude the need for additional surveys.

Table 1.2.1 - Expiration Dates for Resource Data

Resource	Data Expiration Date[1]	Comments
Aquatics	2024	Data collected is good for 5 years as per USACE guidelines
Wetlands	2024	Data collected is good for 5 years as per USACE guidelines
Botany/Vegetation	2029	10 year window to account for new species listings and changes in habitat
Terrestrial Zoology	January 2021	Periodic resurveys to document changes in habitat usage & new species listings

1.3 Study Area description

TVA owns and manages approximately 2000 acres of property in the vicinity of the KIF plant site. For the purposes of this comprehensive site survey, the survey boundary included only the 1255-acre plant property directly associated with power production (TVA Tract ID XWBR-190PT, Parcel Number 190, Zone 2 Project Operations).

The survey does not include any of the land held for recreational or natural resource management.

2.0 Resource Areas

2.1 Aquatic Features

Aquatic features such as streams, wet-weather conveyances/ephemeral streams, intermittent streams, and ponds at KIF are protected under the federal Clean Water Act (CWA) and state Tennessee Department of Environment and Conservation (TDEC) regulations. Identification and mapping of these features on the KIF property was conducted using the Tennessee Division of Water Pollution Control (Version 1.4) field forms by a Tennessee qualified hydrologic professional (Craig Phillips 1036-TN11).

Results

A total of 35 aquatic features occur within the KIF plant boundary (Table 2.1.1.) Of those, two are perennial and four are intermittent streams, two are ponds, and 27 are wet-weather conveyances/ephemeral streams.

Table 2.1.1 Aquatic Features

Sequence ID	Stream Type	Latitude	Longitude
1	Intermittent	35.89446	-84.49409
2	Intermittent	35.89393	-84.49321
3	Intermittent	35.89446	-84.50005
4	Intermittent	35.89694	-84.53374
5	Perennial	35.89627	-84.53016
6	Perennial	35.89402	-84.5331
e001	WWC/Ephemeral	35.90289	-84.50306
e002	WWC/Ephemeral	35.90301	-84.50001
e003	WWC/Ephemeral	35.90113	-84.49983
e004	WWC/Ephemeral	35.90112	-84.50136
e005	WWC/Ephemeral	35.89986	-84.4977
e006	WWC/Ephemeral	35.89791	-84.49484
e007	WWC/Ephemeral	35.89696	-84.49471
e008	WWC/Ephemeral	35.8945	-84.49419
e009	WWC/Ephemeral	35.89697	-84.51158
e010	WWC/Ephemeral	35.90118	-84.5095
e011	WWC/Ephemeral	35.89494	-84.53176
e012	WWC/Ephemeral	35.89486	-84.50423
e013	WWC/Ephemeral	35.89661	-84.52771
e014	WWC/Ephemeral	35.89622	-84.5055
e015	WWC/Ephemeral	35.89752	-84.50511
e016	WWC/Ephemeral	35.89895	-84.50174
e017	WWC/Ephemeral	35.89995	-84.50038
e018	WWC/Ephemeral	35.89855	-84.50125
e019	WWC/Ephemeral	35.8952	-84.50267
e020	WWC/Ephemeral	35.89682	-84.50238
e021	WWC/Ephemeral	35.89681	-84.50258
e022	WWC/Ephemeral	35.89413	-84.50352
e023	WWC/Ephemeral	35.89566	-84.50408

Sequence ID	Stream Type	Latitude	Longitude
e024	WWC/Ephemeral	35.89771	-84.50408
e025	WWC/Ephemeral	35.9036	-84.51908
e026	WWC/Ephemeral	35.90437	-84.51872
e027	WWC/Ephemeral	35.89681	-84.53514
P01	Other	35.89624	-84.49887
P02	Other	35.89729	-84.53353

The perennial streams on site consisted of cobble/ bedrock substrate with riffle-pool habitat. Intermittent streams typically flow during late winter and early spring, but dry later in the year once trees have leafed-out and transport enough water from the water table to limit year-round flow in these drainage features.

Wet Weather Conveyances (WWCs) are man-made or natural, and flow only in direct response to precipitation runoff in their immediate locality. Ephemeral/ WWC channels documented during the comprehensive site survey represent features observed at the time of the survey. These features can disappear or new ones appear as a response to surface runoff from precipitation events. If WWCs are discovered that were not originally documented, a TDEC Hydrologic Determination should be conducted and the location of these features updated to the Comprehensive Site Survey.

Three classes were used to indicate the current condition of streamside vegetation across the length of the stream, as defined below, and listed in Table 2.1.2.

- Forested - Riparian area is fully vegetated with trees, shrubs, and herbaceous plants. Vegetative disruption from mowing or grazing is minimal or not evident. Riparian width extends more than 60 feet on either side of the stream.
- Partially forested - Although not forested, sparse trees and/or scrub-shrub vegetation is present within a wider band of riparian vegetation (20 to 60 feet). Disturbance of the riparian zone is apparent.
- Non-forested - No or few trees are present within the riparian zone. Significant clearing has occurred, usually associated with pasture or cropland.

All streams mapped on site contained forested riparian habitat. This intact forested buffer provides benefits to water quality as well as reduces stream bank erosion and maintains stable stream channels.

Table 2.1.2 - Riparian Condition of Perennial and Intermittent Streams Located Within the KIF Plant Boundary

Riparian Condition	# Perennial Streams	# Intermittent Streams	TOTAL
Forested	2	4	6
Partially forested			
Nonforested			

Limitations of Data

Aquatic features are typically fairly static on the landscape, and associated with topographic gradients and low-lying areas. The data presented is useful for project planning, infrastructure siting, and emergency response purposes. The data collected for this report will be valid for permitting purposes until 2024.

2.2 Wetlands

Wetlands are areas inundated by surface water or groundwater such that vegetation adapted to saturated soil conditions are prevalent. Wetlands generally include swamps, marshes, bogs, wet meadows, shoreline fringes, and similar areas.

As with aquatic features, wetlands present on KIF property are protected under the federal Clean Water Act (CWA), Executive Order (EO) 11990, and the Tennessee Department of Environment and Conservation (TDEC) regulations.

Wetland features were primarily identified along reservoir shorelines, riparian flats of drainage features, depressional features, and low-lying poorly drained areas. These wetlands exhibit a range of functions within the watershed, including water quality and flood abatement, fish and wildlife habitat, groundwater recharge, and shoreline stabilization.

Results

Fifteen wetland areas were mapped on the KIF site (Table 2.2.1). Wetland determinations were performed according to USACE standards, which require documentation of wetland (hydrophytic) vegetation, hydric soil, and wetland hydrology (Environmental Laboratory, 1987; Reed, 1997). Broader definitions of wetlands, such as that used by the U.S. Fish and Wildlife Service (Cowardin et al., 1979), the Tennessee definition (Tennessee Code 11-14-401), and the TVA Environmental Review Procedures definition (TVA, 1983), were also considered in this review. In addition, the TVA Rapid Assessment Method (TVARAM) was used to assess wetland condition and identify wetlands with special ecological significance (Mack, 2001).

Table 2.2.1 – Wetlands Present on KIF Site

Field ID	Cowardin Classification[1]	Field Notes	Acres
W001	PSS1A	Scrub-shrub wetland associated with drainage feature	0.01
W002	PFO1A	Forested wetland in low-lying area	0.03
W003	PEM1A	Emergent/scrub-shrub wetland along shoreline	0.09
W004	PFO1A	Forested wetland at head of wet-weather conveyance to Watts Bar Reservoir	0.1
W005	PFO1A	Forested wetland at head of wet-weather conveyance to Watts Bar Reservoir	0.1
W006	PFO1A	Forested wetland associated with low-lying forested area	0.13
W007	PSS/PEM1A	Emergent/scrub-shrub wetland associated with runoff feature	0.14
W008	PEM1A	Emergent/scrub-shrub wetland along shoreline	0.15
W009	PFO1A	Forested wetland associated with low-lying wet-weather conveyance	0.19
W010	PEM/PSS1A	Emergent/scrub-shrub wetland in roadside drainage area	0.3
W011	PFO/PSS/PEM1E/PSS1C	Emergent/scrub-shrub/forested wetland associated with low-lying wet-weather conveyance along shoreline	0.4

Field ID	Cowardin Classification[1]	Field Notes	Acres
W012	PFO/PSS/PEM1E/PSS1C	Emergent/scrub-shrub/forested wetland associated with low-lying wet-weather conveyance along shoreline	0.53
W013	PEM1E/PSS	Emergent/scrub shrub wetland associated with stream	0.67
W014	PFO1A	Forested wetland associated with embayment of Watts Bar Lake	1.1
W015	PEM1E/PSS	Emergent/scrub shrub wetland associated with stream	1.72
TOTAL			**5.66**

[1]PFO1A = palustrine forested, broad-leaved deciduous, temporarily flooded;
PSS1A = palustrine scrub-shrub,broad-leaved deciduous;
PEM1A = palustrine emergent, persistent vegetation

Limitations of Data

Wetlands are dynamic habitats, and their boundaries may shrink or expand both seasonally, and over a period of years, based on changes in hydrology. The data presented is useful for project planning, infrastructure siting, and emergency response purposes. The data as presented is not intended for use in specific NEPA reviews though it can be used to support individual NEPA reviews.

2.3 Botany/Vegetation

The vegetation found within the KIF site is largely a function of the land use history of the site; a large proportion of the KIF site has been heavily disturbed by the construction, operation, and maintenance of the generation and transmission infrastructure present there. In general, the most heavily disturbed and most degraded habitats are currently covered with herbaceous vegetation. Many areas support highly altered early successional plant habitats, with scattered areas of forest. Field surveys also took into account the habitat requirements of state and federally-listed threatened and endangered species.

Results

The vast majority of herbaceous vegetation on the KIF site is dominated by non-native plant species and possesses little conservation value. Some areas of herbaceous vegetation, principally along transmission line ROW, contain significant populations of native plants, but these areas still only constitute marginally intact habitat. Several forested tracts throughout KIF contain large overstory trees, but even these areas have a depauperate herbaceous layer. At least an equal proportion of forest on KIF is heavily fragmented, degraded by non-native species infestations, and contains small diameter trees indicative of the previous disturbance on-site.

Field surveys of the KIF site, along with interpretation of aerial photos, resulted in 73 discrete areas of vegetation (Table 2.3.1 – Appendix). The vast majority of these polygons have no potential to support state or federally listed plant species, or unique plant communities, and would not require additional field surveys if a project is proposed there. Brief summaries of the vegetation composition and structure within each polygon are listed in Table 2.3.1.

Threatened and Endangered Species

No areas were found to contain habitat that would support federally-listed plant species. Two polygons (Botany 067 & Botany 044) were found to contain patches of intact, higher quality habitat that could support specific state-listed species.

Limitations of Data

Assuming areas remain undisturbed, the various vegetation communities will remain fairly stable with little change in species composition and habitat value over a 10-20 year time period. The full site survey is good for ten years, unless new species are listed that could be found on the KIF site.

2.4 Terrestrial Zoology

The types of terrestrial wildlife that are found on a site are directly related to the habitats present on the site. Located within the Blue Ridge ecoregion, the KIF site supports a variety of common wildlife species. Field surveys also took into account the habitat requirements of state and federally-listed threatened and endangered species.

Results

Herbaceous fields and forest fragments provide habitat for a variety of wildlife species across the KIF site. In herbaceous fields dominated by Johnson grass, Eastern meadowlarks, grasshopper sparrows, and savannah sparrows are common. Red-tailed and red-shouldered hawks use the open areas for hunting. Edge habitat occurs where fields meet with forests. This edge habitat creates a diverse bird community. Birds inhabiting edges include northern bobwhite, eastern phoebe, Carolina wren, brown thrasher, white-eyed vireo, northern cardinal, indigo bunting, eastern towhee, field and song sparrows, and others. Small mammals and larger mammals such as white-tailed deer and coyotes use these edges.

Forests on the peninsula range from dry oak-hickory and dry mesic oak-hickory forests to bottomland forests. Oak-hickory forests provide habitat for wild turkey, yellow-billed cuckoos, woodpeckers, eastern wood pewees, blue jays, American crows, Carolina chickadees, eastern tufted titmice, white-breasted nuthatches, and many Neotropical migrants. Mammals occurring in oak-hickory forests include deer mice, white-tailed deer, gray fox, gray squirrel, eastern chipmunk, and others. Reptiles include rat snakes, five-lined skinks, eastern box turtles, and others.

Narrow bands of bottomland forests are found on the peninsula along the river margin and within wet sloughs. Birds observed in these areas include green and great blue herons, wood ducks, spotted sandpipers, belted kingfishers, and eastern kingbirds. Mammals specific to bottomland forests in the area include the beaver and muskrat. Because these areas typically stay wet, amphibians may be abundant. Amphibians include the American toad, eastern newt, spring peeper, and others. Water snakes are also typically abundant. Fringe wetlands along the Clinch River provide habitat for red eared sliders, painted turtles, and other turtle species.

Field surveys of the KIF site, along with interpretation of aerial photos, resulted in 57 discrete habitat areas (Table 2.4.1 – Appendix). The vast majority of these polygons have no potential to support state or federally listed animal species communities, and would not require additional field surveys if a project is proposed there. Brief summaries of these areas and their potential to suport T&E species are listed in Table 2.4.1.

Threatened & Endangered Species

Beyond the common wildlife species found on the KIF site, there are specific findings that identify potential habitat for federal and state threatened and endangered wildlife species. Field surveys of the KIF site, along with interpretation of aerial photos, resulted in 57 discrete habitat areas (habitat polygons). The majority of these polygons have no potential to support state or federally listed wildlife species.

Osprey are protected under the Migratory Bird Treaty Act and the Executive Order for Migratory Birds 13186. It is illegal to hurt, harm, or harass these birds without a federal permit. Osprey build nests on trees (live and dead), and man-made structures such as lighting towers, utility poles, buildings and channel markers near lakes and rivers. They build nests by repeatedly dropping large sticks from the air until enough sticks have accumulated and a shallow bowl-shape can be fashioned in the middle of the sticks to form a nest. Shortly after making the nest 1-4 eggs (typically 3 eggs) will be laid. At this point the nest is deemed “active” and the behavior of the adult osprey changes. The female sits on the eggs to incubate them for 5-6 weeks. She rarely leaves the nest and relies on her partner to bring her food. After the eggs hatch, both mother and father will spend most of their time foraging for food to feed the young. Adults can be observed perching on the edge of the nest peering into the center. Young learn to fly at 50-60 days old but are still dependent on their parents for several additional weeks and often stay close to the nest. Young look almost identical to their parents at this point but can be seen be seen begging for food from parents. When the young have left the nest, the nest is deemed “inactive”. These birds have very high site fidelity, meaning they will come back to the same nest or nesting location year after year.

- Five osprey nests were observed on KIF in May 2019. Two are on Transmission line structures, one is in a lighting structure near the coal pile, one is on a nesting platform in the Emory River, and one is on an island adjacent to KIF in the Emory River. At the time of survey, all nests were active. 660 foot buffers were placed around each of these nests on the attached map.
- While the osprey nest is active (typically between March 1st and July 31), activities within 660ft of the nest are limited to vegetation maintenance (bushhogs, mowers, and selective herbicide application only). Proposed reconductoring, slides, structure installations, earth moving machinery, and other loud disturbances are not allowed. Removal or disturbance of an active nest would require use of a permit held by the US Department of Agriculture. A field survey by Terrestrial Zoology or Natural Resources staff can be requested at any time to determine if the nest is active.
- Inactive nests can be removed but this removal must be documented. Please note, if nests are removed the same birds will likely try to renest in the same location or location that is even more inconvenient for projects. It is recommended that nests built in a tolerable location be left in place. Inactive nests that must be removed should be removed in winter (October – February) and nesting deterrents installed on the structure promptly thereafter.

- If potentially disturbing work must occur within 660 feet of an osprey nest when it is active, if activity of a nest is uncertain, or if you would like to remove an inactive nest, contact Liz Hamrick (865-632-4011) or RJ Moore (865-632-3440-office; 423-661-6336-mobile) for guidance to ensure compliance with federal law and to ensure proper documentation.
    - If disturbance cannot be avoided, Moore or Hamrick will contact USDA for guidance/ to request permit use. Please do not contact USDA directly.

At least three species of state and/or federally protected bats may occur on KIF property (**Indiana bat, northern long-eared bat (NLEB), and gray bat**).

- Federally listed Indiana bats and northern long-eared bats roost in trees in spring, fall, and summer. Females of these species roost in groups and have their live young underneath the bark of dead, dying, or damaged trees in summer. They can use trees as small as 3 inches in diameter. These bats roost in any species of trees as long as it has the right physical characteristics. Larger white oaks, shag bark hickories, and dead trees with sloughing bark or hollow trunks are thought to be the most ideal. Forested habitat for bats is ephemeral and roosts selection changes as trees mature, die, and decay. As a result, habitat for this species changes and forested areas that were previously not suitable for bats may become suitable as forests mature. Similarly, forested areas with suitable roosts may become unsuitable if all potential roosting trees die/fall. Therefore habitat surveys for these species are only good for a few years (expiration date given below). Removal of suitable roosting trees (occupied or not) can be considered a violation of the Endangered Species Act. TVA has consulted with the US Fish and Wildlife Service to allow for removal of suitable bat roosting habitat under TVA's Bat Strategy, but only with proper documentation, notification, and minimization of impacts.
- Gray bats roost in caves year-round. They will travel up to 50 miles per night to forage. No caves are known on KIF property but there is a known maternity cave for gray bats in Roane County approximately 9 miles away. Gray bats have also been documented on the Oak Ridge Reservation approximately 5.8 miles away from KIF. Gray bats have been documented foraging over the Clinch River.
- All three bat species forage for insects either over open fields, forested areas, and/or bodies of water such as wetlands, streams, and the Clinch and Emory Rivers.
- All three species have been documented roosting in buildings. All buildings must be surveyed by Terrestrial Zoology before demolition to ensure no bats would be impacted.
- All projects must comply with TVA's Bat Strategy. For most that means filling out a Bat Strategy Form, sending it to an email address, and attaching it to your NEPA document. Many routine actions (as detailed on the form) do not require the form to be filled out at all. Other actions, such as tree removal, require review by Terrestrial Zoology in the Biological Compliance group. Contact Liz Hamrick (ecburton@tva.gov or 865-632-4011) for assistance.

Limitations of Data

By their nature, terrestrial animals move across the landscape and may or may not use the same habitat features year after year. In addition, habitat for some species such as Indiana bat and northern long-eared bat is ephemeral. For these reasons mapped Terrestrial Zoology resources are not permanent and will need to be revisited periodically. New Terrestrial Zoology resources may also appear on site as birds shift nesting locations and vegetation grows/dies. In addition, new species may be listed that could be found on the KIF site.

3.0 Literature Cited

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Appendix

Table 2.3.1 – Botany Table

Botany Polygon	Descriptor	Field Notes
Botany 001	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 002	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 003	Deciduous Forest	The deciduous forest in this area occupies areas that have been heavily disturbed by operations at KIF. The forest strip is comprised of small diameter trees and weedy herbaceous species. The area has no potential to support state or federally listed plants.
Botany 004	Sparsely Vegetated	This sparsely vegetated waste area has been, and continues to be, heavily disturbed by plant operations at KIF. Herbaceous vegetation occurs sporadically throughout this area and is weedy and dominated by non-native plants. This area has no potential to support state or federally listed plants.
Botany 005	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 006	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 007	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 008	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 009	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 010	Herbaceous Vegetation	Vegetation in the ash disposal area is comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 011	Herbaceous Vegetation	Vegetation in this area comprised of weedy species indicative of disturbed habitats. The area has no potential to support state or federally listed plants.
Botany 012	Mixed Evergreen Deciduous Forest	This small patch of mixed forest contains trees indicative of upland habitats. The area has no potential to support state or federally listed plants.

Botany Polygon	Descriptor	Field Notes
Botany 013	Open Water	This area is not vegetated.
Botany 014	Deciduous Forest	This small patch of early successional deciduous forest is dominated by small diameter trees and other weedy vegetation. The forest strip is comprised of small diameter trees and weedy herbaceous species. The area has no potential to support state or federally listed plants.
Botany 015	Herbaceous Vegetation	Mowed grass. This area has no potential to support state or federally listed plants.
Botany 016	Sparsely Vegetated	This sparsely vegetated waste area has been, and continues to be, heavily disturbed by plant operations at KIF. Herbaceous vegetation occurs sporadically throughout this area and is weedy and dominated by non-native plants. This area has no potential to support state or federally listed plants
Botany 017	Sparsely Vegetated	This sparsely vegetated waster area has been, and continues to be, heavily disturbed by plant operations at KIF. Herbaceous vegetation occurs sporadically throughout this area and is weedy and dominated by non-native plants. This area has no potential to support state or federally listed plants.
Botany 018	Deciduous Forest	Common overstory species include sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), black cherry (*Prunus serotina*) red maple (*Acer rubrum*), and American beech (*Fagus grandifolia*). This area has no potential to support state or federally listed plants.
Botany 019	Mixed Evergreen Deciduous Forest	This small patch of mixed forest contains trees indicative of upland habitats. The area has no potential to support state or federally listed plants.
Botany 020	Herbaceous Vegetation	This transmission line ROW is populated with a large proportion of non-native vegetation that is indicative of weedy, early-successional habitats. This area has no potential to support state or federally listed plants
Botany 021	Herbaceous Vegetation	This area along the edge of the KIF property is mostly comprised of regularly mowed areas that have no potential to support state or federally listed plants
Botany 022	Herbaceous Vegetation	This area along the edge of the KIF property is mostly comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 023	Herbaceous Vegetation	This area along the edge of the KIF property supports a few clumps of trees, but is mostly comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 024	Deciduous Forest	This small patch of mixed forest contains trees indicative of upland habitats. The area has no potential to support state or federally listed plants.

Botany Polygon	Descriptor	Field Notes
Botany 025	Deciduous Forest	This small patch of early successional deciduous forest is dominated by small diameter trees and other weedy vegetation. The forest strip is comprised of small diameter trees and weedy herbaceous species and has no potential to support state or federally listed plants.
Botany 026	Deciduous Forest	The riparian forest in this area supports trees that are approximately 12" in diameter. The narrow strip of habitat is weedy in the understory and is not indicative of high quality plant habitat. The area has no potential to support state or federally listed plants.
Botany 027	Herbaceous Vegetation	This area along the edge of the KIF property supports a few clumps of trees, but is mostly comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 028	Deciduous Forest	This narrow strip of forest is dominated by early successional tree species and non-native plants in the understory. This area has no potential to support state or federally listed plants.
Botany 029	Deciduous Forest	This narrow strip of forest is dominated by early successional tree species and non-native plants in the understory. This area has no potential to support state or federally listed plants.
Botany 030	Sparsely Vegetated	This area comprises the core of the KIF generating infrastructure. The area is mostly devoid of vegetation. The area does contain some small areas that are landscaped and regularly mowed. This area has no potential to support state or federally listed plants.
Botany 031	Mixed Evergreen Deciduous Forest	This area is comprised of a mosaic of habitat types that are determined by the ongoing disturbance resulting from operations at KIF. Some of the area is comprised of disturbed open areas dominated by non-native herbaceous vegetation. The majority of the area is covered with small diameter, mixed evergreen deciduous forest. This area has no potential to support state or federally listed plants.
Botany 032	Herbaceous Vegetation	This area is comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 033	Herbaceous Vegetation	This area is comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 034	Herbaceous Vegetation	This area is comprised of regularly mowed areas that have potential to support state or federally listed plants.
Botany 035	Herbaceous Vegetation	This area is comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 036	Deciduous Forest	This small patch of forest contains trees indicative of upland habitats. The area has no potential to support state or federally listed plants.
Botany 037	Herbaceous Vegetation	This area is comprised of regularly mowed areas that have no potential to support state or federally listed plants.

Botany Polygon	Descriptor	Field Notes
Botany 038	Deciduous Forest	This small patch of mixed forest contains trees indicative of upland habitats. The area has no potential to support state or federally listed plants.
Botany 039	Herbaceous Vegetation	This area is comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 040	Sparsely Vegetated	The deciduous forest strip situated between the entrance road and the railroad yard is dominated by early successional trees in the overstory and is dominated by non-native species like Chinese privet (*Ligusticum sinense*) in the understory. This area has no potential to support state or federally listed plants.
Botany 041	Deciduous Forest	The deciduous forest strip situated between the entrance road and the railroad yard is dominated by early successional trees in the overstory and is dominated by non-native species like Chinese privet (*Ligusticum sinense*) in the understory. This area has no potential to support state or federally listed plants.
Botany 042	Sparsely Vegetated	This sparsely vegetated waste area has been, and continues to be, heavily disturbed by plant operations at KIF. Herbaceous vegetation occurs sporadically throughout this area and is weedy and dominated by non-native plants. This area has no potential to support state or federally listed plants.
Botany 043	Deciduous Forest	This tiny patch of deciduous forest has a broken canopy and does not support intact native plant habitat. This area has no potential to support state or federally listed plants.
Botany 044	Deciduous Forest	This strip of forest along Watts Bar Reservoir ranges from more disturbed, early successional habitats to mature hardwood forest with trees from 12-24"dbh. The state-listed plant fetter-bush (*Leucothoe racemosa*) was documented from this area in 1984, but has not been seen since then. The area still contains some patches of intact, higher quality deciduous forest.
Botany 045	Herbaceous Vegetation	This area is comprised of regularly mowed areas that have no potential to support state or federally listed plants.
Botany 046	Open Water	This area is not vegetated.
Botany 047	Herbaceous Vegetation	This area is mostly open and comprised of areas that are regularly mowed. In addition, there are small areas with deciduous trees. The plant habitats are very disturbed and do not support intact native plant communities. This area has no potential to support state or federally listed plants.

Botany Polygon	Descriptor	Field Notes
Botany 048	Mixed Evergreen Deciduous Forest	Much of this unit, particularly in the western portions, is heavily disturbed and comprised of overstory trees from 4-8" dbh. Common trees include sweetgum (*Liquidambar styraciflua*), loblolly pine (*Pinus taeda*), yellow-poplar (*Liriodendron tulipifera*), tree-of-heaven (*Ailanthus altissima*), and sugarberry (*Celtis laevigata*). The invasive plants multiflora rose (Rosa multiflora) and Japanese stiltgrass (*Microstegium vimineum*) are common in the understory. This area has no potential to support state or federally listed plants.
Botany 049	Herbaceous Vegetation	This small area of herbaceous vegetation is populated almost entirely with invasive species including tall fescue (*Schedonorus arundinaceus*) and sericea lespedeza (*Lespedeza cuneata*). White wingstem (*Verbesina virginica*) is also common. This area has no potential to support state or federally listed plants.
Botany 050	Deciduous Forest	This sparsely vegetated waste area has been, and continues to be, heavily disturbed by plant operations at KIF. Herbaceous vegetation occurs sporadically throughout this area and is weedy and dominated by non-native plants. This area and has no potential to support state or federally listed plants.
Botany 051	Herbaceous Vegetation	This small ROW corridor is similar to other larger ROW in the area in that it is dominated by non-native plants including *Bromus* spp., autumn olive (Elaeagnus umbellata), and Johnson grass (*Sorghum halepense*). This area has no potential to support state or federally listed plants.
Botany 052	Deciduous Forest	Average diameter of overstory trees in this area ranged from 18-24" dbh and the stands appeared relatively undisturbed, particularly in the interior. Sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), and white ash (*Fraxinus americana*) are the most prevalent trees on lower slopes, along with redbud (*Cercis canadensis*), dogwood (*Cornus florida*), pawpaw (*Asimina triloba*), and buckeye (*Aesculus pavia*) in the shrub layer. The species composition shifts moving upslope and includes white oak (*Quercus alba*), hickories (*Carya tomentosa, C. glabra, C. cordiformis*), American beech (*Fagus grandifolia*), and basswood (*Tilia americana*). Scattered pine occurs in the uplands. The herbaceous layer was not rich. No plants of conservation concern occur on site.
Botany 053	Herbaceous Vegetation	This area is mostly open and comprised of areas that are regularly mowed. In addition, there are small area with deciduous trees. The plant habitats are very disturbed and do not support intact native plant communities. This area has no potential to support state or federally listed plants.
Botany 054	Deciduous Forest	This narrow block of forest is dominated by early successional tree species and non-native plants in the understory. This area has no potential to support state or federally listed plants.

Botany Polygon	Descriptor	Field Notes
Botany 055	Herbaceous Vegetation	These ROW are dominated by non-native species throughout. Prominent plants include *Bromus* spp., autumn olive (Elaeagnus umbellata), Johnson grass (*Sorghum halepense*), tall fescue (*Schedonorus arundinaceus*), and sericea lespedeza (*Lespedeza cuneata*). This area has no potential to support state or federally listed plants.
Botany 056	Herbaceous Vegetation	This ROW is dominated by non-native species throughout. Prominent plants include *Bromus* spp., autumn olive (Elaeagnus umbellata), Johnson grass (*Sorghum halepense*), tall fescue (*Schedonorus arundinaceus*), and sericea lespedeza (*Lespedeza cuneata*). Some native plants observed include dogbane (*Apocynum cannabinum*), common milkweed (*Asclepias syriaca*), blackberry (*Rubus argutus*), yellow wingstem (*Verbesina alternifolia*), white wingstem (*Verbesina virginica),* and poverty oatgrass (*Danthonia spicata*). This area has no potential to support state or federally listed plants.
Botany 057	Herbaceous Vegetation	This area has sporadic clusters of trees, but is mostly herbaceous vegetation. All parts of this area have been heavily disturbed and contain few native species. This area has no potential to support state or federally listed plants.
Botany 058	Herbaceous Vegetation	This area has been previously disturbed by the construction and operation of the existing transmission line. This site is currently dominated by species indicative of early successional, weedy habitats. This area has no potential to support state or federally listed plants.
Botany 059	Herbaceous Vegetation	This are is comprised of regularly mowed herbaceous vegetation that closely resembles similar habitats found in pastures and old agricultural fields across east Tennessee. Some species include *Bromus* spp., clovers (*Trifolium campestre, T. pretense, T. repens*), ryegrass (*Lolium perenne*), Johnson grass (*Sorghum halepense*) and tall fescue (*Schedonorus arundinaceus*). This area has no potential to support state or federally listed plants.
Botany 060	Deciduous Forest	The deciduous forest ranged from more disturbed to relatively intact, mature stands. Diameter of overstory trees ranged from less than 10" to 24"+. Common tree species include yellow-poplar (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), hickory (*Carya tomentosa, C. glabra, C. cordiformis*), oak (*Quercus falcata, Q. alba, Q. rubra*) in the overstory, winged elm (*Ulmus alata*), sugar maple (*Acer saccharum*), ironwood (*Carpinus caroliniana*) in the midstory. Pawpaw (*Asimina triloba*) is a common understory shrub. No plants of conservation concern were observed.
Botany 061	Deciduous Forest	This patch of wet forest has not been recently disturbed, but is small and fragmented. This area does not support state or federally listed plants.

Botany Polygon	Descriptor	Field Notes
Botany 062	Mixed Evergreen Deciduous Forest	Smaller diameter trees (6-10" dbh) occur here compared to forested areas directly to the north. This even age stand is dominated sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), and Virginia pine (*Pinus virginiana*) in the overstory and Japanese stiltgrass (*Microstegium vimineum*) in the herb layer. The site is heavily disturbed by previous landuse. This area has no potential to support state or federally listed plants.
Botany 063	Deciduous Forest	Average diameter of overstory trees in this area ranged from 18-24" dbh and the stands appeared relatively undisturbed. Sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), and white ash (*Fraxinus americana*) are the most prevalent trees on lower slopes, along with redbud (*Cercis canadensis*), dogwood (*Cornus florida*), pawpaw (*Asimina triloba*), and buckeye (*Aesculus pavia*) in the shrub layer. The species composition shifts moving upslope and includes white oak (*Quercus alba*), hickories (*Carya tomentosa, C. glabra, C. cordiformis*), American beech (*Fagus grandifolia*), and basswood (*Tilia americana*). Scattered hemlock (*Tsuga canadensis*) and white pine (*Pinus strobus*) occur sporadically in the eastern portion of this polygon. The herbaceous layer was not rich. No plants of conservation concern were observed.
Botany 064	Deciduous Forest	This stand is even aged, highly disturbed, and generally contains few trees over 12-16" dbh. This site apparently supported Virginia pine in the past, but now the overstory is comprised mainly of small sweetgum (*Liquidambar styraciflua*) and yellow-poplar (Liriodendron tulipifera) in the overstory and Japanese stiltgrass (*Microstegium vimineum*) in the herb layer. A few larger trees do occur closer to the open ROW to the east. This area has no potential to support state or federally listed plants.
Botany 065	Deciduous Forest	Common overstory trees in this stand include Sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), and black cherry (*Prunus serotina*), sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*) in the midstory, and Chinese privet (*Ligusticum sinense*) in the shrub layer. Common herbs include Japanese stiltgrass (*Microstegium vimineum*), wild comfrey (*Cynoglossum virginianum*), Virginia creeper (*Parthenocissus quiquefolia*), and Christmas fern (*Polystichum acrostichoides*). This area has no potential to support state or federally listed plants.
Botany 066	Deciduous Forest	This stand is similar to 065, but more disturbed. Kudzu (*Pueraria lobata*) covers several acres in the middle of this stand. This area has no potential to support state or federally listed plants.
Botany 067	Deciduous Forest	Comparable to Botany 063 in uplands. Small wetlands in drainages; possible state-listed plant southern rein orchid (*Platanthera flava* var. *herbiola*) present in eastern wetland. Seasonal survey needed to confirm.

Botany Polygon	Descriptor	Field Notes
Botany 068	Deciduous Forest	Sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), white ash (*Fraxinus americana*), black cherry (*Prunus serotina*), sugar maple (*Acer saccharum*), and sycamore (*Platanus occidentalis*) common in overstory. Some trees up to 24" dbh. Pawpaw (*Asimina triloba*) prevalent in shrub layer. Herb layer with *Carex* sp., IThe interior of the forest is characterized by large canopy trees that often reach 24-30" dbh. Common overstory species include blackgum (Nyssa sylvatica), red oak (Quercus rubra), southern red (Quercus falcata), sweetgum (Liquidambar styraciflua), and white oak (Quercus alba) with the occasional white pine (Pinus strobus). Midstory trees include dogwood (Cornus florida), red maple (Acer rubrum), and sourwood (Oxydendrum arboreum) with pawpaw (Asimina triloba) and muscadine (Vitis rotundifolia), often thick, in the shrub layer. The herbaceous layer is depauperate and contains few species, including licorice bedstraw (*Galium circaezans*), and false nettle (*Boehmeria cylindrica*). This area has no potential to support state or federally listed plants.
Botany 069	Deciduous Forest	The interior of the forest is characterized by large canopy trees that often reach 24-30" dbh. Common overstory species include blackgum (*Nyssa sylvatica*), red oak (*Quercus rubra*), southern red (*Quercus falcata*), sweetgum (*Liquidambar styraciflua*), and white oak (*Quercus alba*) with the occasional white pine (*Pinus strobus*). Midstory trees include dogwood (*Cornus florida*), red maple (*Acer rubrum*), and sourwood (*Oxydendrum arboreum*) with pawpaw (*Asimina triloba*) and muscadine (*Vitis rotundifolia*), often thick, in the shrub layer. The herbaceous layer is depauperate and contains few species. This area has no potential to support state or federally listed plants.
Botany 070	Deciduous Forest	This area is relatively disturbed, most trees are <12" dbh. Common overstory species include sweetgum (*Liquidambar styraciflua*), yellow-poplar (*Liriodendron tulipifera*), black cherry (*Prunus serotina*) red maple (*Acer rubrum*), and American beech (*Fagus grandifolia*). The non-native shrubs bush honeysuckle (*Lonicera maackii*) and Chinese privet (*Ligusticum sinense*) are prevalent throughout.This area has no potential to support state or federally listed plants.
Botany 071	Deciduous Forest	Very large trees in this forest to 30" dbh. Common trees include southern red (*Quercus falcata*), red oak (*Quercus rubra*), and American beech (*Fagus grandifolia*). The herbaceous layer is depauperate and contains few species. This area has no potential to support state or federally listed plants.

Botany Polygon	Descriptor	Field Notes
Botany 072	Deciduous Forest	Some large shortleaf pine (*Pinus echinata*) to 28" dbh in this stand. Otherwise similar to other mature oak-hickory stands elsewhere on the property; 24-30" trees common. Small draw is more mesic than the rest of the stand. Southern red oak (*Quercus falcata*) white oak (*Q. alba*) and northern red oak (*Q. rubra*) common in overstory along with sugar maple (*Acer saccharum*) and mockernut hickory (*Carya tomentosa*) in slightly more mesic areas. Few species in herb layer. This area has no potential to support state or federally listed plants.
Botany 073	Herbaceous Vegetation	Emergent wetland with Carex spp., spotted ladysthumb (*Polygonum persicaria*), brookweed (*Samolus parviflorus*), *Scirpus* sp. and *Rumex* sp. This area has no potential to support state or federally listed plants.

Table 2.4.1 – KIF Habitat Types & Potential Threatened and Endangered (T&E) Species

Habitat ID	Habitat	T & E Species with potential to use habitat[1]		
		Indiana bat/ NLEB roosting[2]	Bat Foraging	Osprey
1	Scattered Trees with Wetlands		X	
2	Deciduous Forest	X	X	
3	Herbaceous Vegetation with water		X	
4	Deciduous Forest	X	X	
5	Open Water		X	
6	Herbaceous habitat			
7	Sparsley vegetated	X	X	
8	Deciduous Forest with osprey nest in tree	X	X	X
9	Wooden Nesting Platform in Reservoir			X
10	Deciduous Forest	X	X	
11	Herbaceous Vegetation	X	X	
12	Deciduous Forest	X	X	
13	Mixed Evergreen and Deciduous Forest		X	
14	Lighting Tower			X
15	Deciduous Forest	X	X	
16	Deciduous Forest		X	
17	Deciduous Forest	X	X	
18	Deciduous Forest		X	
19	Deciduous Forest		X	
20	Deciduous Forest	X	X	
21	Deciduous Forest	X	X	

Habitat ID	Habitat	T & E Species with potential to use habitat[1]		
22	Herbaceous vegetation with scattered trees	X	X	
23	Deciduous Forest		X	
24	Deciduous Forest	X	X	
25	Deciduous Forest	X	X	
26	Deciduous Forest	X	X	
27	Wetland surrounded by forest		X	
28	Herbaceous wetland		X	
29	Scattered Trees along grassy/riprap shoreline		X	
30	Deciduous Forest	X	X	
31	Deciduous Forest	X	X	
32	Deciduous Forest		X	
33	Transmission tower			X
34	Herbaceous vegetation			
35	Deciduous Forest	X	X	
36	Herbaceous vegetation			X
37	Herbaceous vegetation			X
38	Transmission tower			X
39	Herbaceous vegetation			
40	Herbaceous vegetation with wetland		X	
41	Herbaceous vegetation			
42	Deciduous Forest	X	X	
43	Deciduous Forest with wetlands	X	X	
44	Mixed Evergreen and Deciduous Forest	X	X	
45	Deciduous Forest	X	X	
46	Deciduous Forest	X	X	
47	Deciduous Forest	X	X	
48	Deciduous Forest	X	X	
49	Deciduous Forest	X	X	
50	Deciduous Forest	X	X	
51	Deciduous Forest	X	X	
52	Deciduous Forest	X	X	
53	Deciduous Forest	X	X	
54	Deciduous Forest	X	X	
55	Deciduous Forest	X	X	
56	Large Red Oak	X	X	
57	Mixed Evergreen and Deciduous Forest	X	X	

[1] T&E = Threatened and Endangered
[2] Surveys expire in January 2021

Appendix K – Evaluating the Presence and Maintenance of a Balanced Indigenous Population of Fish and Wildlife in the Tennessee River Downstream of TVA's Kingston Fossil Plant

Evaluating the Presence and Maintenance of a Balanced Indigenous Population of Fish and Wildlife in the Tennessee River Downstream of TVA's Kingston Fossil Plant

Harriman, Roane County, Tennessee

Tennessee Valley Authority

September 2021

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EXECUTIVE SUMMARY

This document presents results of biological monitoring conducted during summer and autumn 2020 to evaluate the status of the aquatic community in the Tennessee River (Watts Bar Reservoir) downstream of TVA's Kingston Fossil Plant thermal discharge. This report is intended to support continuance of the 316(a) alternate thermal limit (ATL) for the plant discharge based on successful demonstration, in accordance with Section 316(a) of the Clean Water Act, that a balanced indigenous population (BIP) of fish and wildlife was present and being maintained in the river downstream of the plant.

In evaluating the selected fish community metrics relevant to determination of the maintenance of a BIP of fish and wildlife, it is apparent that the fish community structure in the thermally affected reach downstream was similar to that in the unaffected reach upstream during summer and autumn 2020. Reaches have not differed significantly for most (11 of 12) metrics and RFAI scores since sampling began, and observed values for all metrics in 2020 were within historical ranges observed.

In the context of EPA's interpretation of the regulatory definition of a BIP, TVA maintains that a BIP is currently being demonstrated in Watts Bar Reservoir, based on evaluation of the most recent biological data collected during summer and autumn 2020 (see Section 3.0 of this report). This interpretation requires demonstration that the following attributes are present and being maintained in the waterbody:

1. The population is typically characterized by diversity at all trophic levels,
2. The population has the capacity to sustain itself through cyclic seasonal changes,
3. The necessary food chain species are present,
4. Pollution-tolerant species are not dominant, and
5. Indigenous species are appropriately represented.

Based on the findings reported here, TVA believes that continuation of the current ATL [daily maximum temperature of 97.0 °F (36.1 °C)] for the Kingston Fossil Plant discharge (Outfall 002) will reasonably assure the protection and propagation of a BIP.

1.0 INTRODUCTION

This document presents results of biological monitoring conducted during summer and autumn 2020 as a means to evaluate the status of the aquatic community in the Clinch and Emory rivers (Watts Bar Reservoir) downstream of the Tennessee Valley Authority's (TVA) Kingston Fossil Plant (KIF) thermal discharge. This report is intended to support continuance of the alternate thermal limit (ATL) for the plant discharge (Outfall 002) in a renewed National Pollutant Discharge Elimination System (NPDES) permit for the facility (NPDES Permit No.: TN0005452) based on successful demonstration, in accordance with Section 316(a) of the Clean Water Act, that a balanced indigenous population (BIP) of fish and wildlife was present and being maintained in the river downstream of the plant.

This report is constructed to target § 316(a) regulatory requirements and the characteristic elements of a BIP. In the context of § 125, Subpart H, this report constitutes the § 316(a) "demonstration" the Director requires in considering whether to grant an ATL in the NPDES permit for a facility. The readers of this report are directed to Appendix A for the details of field study design, biological community sampling methods, and Reservoir Fish Assemblage Index (RFAI) methodology.

1.1 Facility Information

Construction of the KIF plant began on April 30, 1951, and the last of nine fossil-powered steam generating units began commercial operation on December 2, 1955. Total nameplate-rated capacity is 1,700 megawatts (MW), and the plant can generate approximately 10-billion kilowatt-hours of electricity per year, enough to power 700,000 homes.

The KIF facility is located in Roane County, Tennessee on the right descending bank of a peninsula at the confluence of the Emory and Clinch Rivers on Watts Bar Reservoir (Figure 1). Cooling water for the once-through (open-cycle) condenser cooling system is withdrawn from Watts Bar Reservoir via an intake channel and skimmer wall at Emory River Mile (ERM) 1.9. Heated effluent is discharged to Watts Bar Reservoir via Outfall 002 at Clinch River mile (CRM) 2.6 as authorized by the NPDES permit (Figure 2).

When operating at design (nameplate) capacity, the KIF units require approximately 1,394 million gallons per day [2,157 cubic feet per second (cfs)] of condenser cooling water and reject 6.97 x 10^9 BTU per hour of waste heat. This waste heat increases the temperature of the cooling water by approximately 7.8 °C (14.4 °F) before it is discharged into the river. The actual condenser flow, and hence the change in temperature from ambient (ΔT), may vary somewhat with the circulating water pump head and the condenser efficiency.

Relevant plant operational data—mean daily temperatures at the CCW intake and discharge, mean daily flow through the CCW system, and mean daily power generation by the nine fossil units at KIF—were compiled from 2014 through 2020 and are included in Appendix B. Biological monitoring was conducted upstream and downstream of KIF on October 6 and 13, 2020.

1.2 Description of the Receiving Waterbody

The KIF facility is located on Watts Bar Reservoir at a peninsula formed where the Emory River embayment joins the Clinch River embayment at CRM 4.4, about four miles southeast of Harriman, Tennessee and two miles northeast of Kingston, Tennessee (Figure 1). Watts Bar Reservoir was impounded in 1942 and at full pool covers approximately 38,600 acres.

The topography of Watts Bar Reservoir in the vicinity of the discharge outlet consists of a small embayment and main river channel on the plant side (right descending bank) which is about 600 feet (ft) wide and approximately 40 ft deep, bordered on the left descending bank by a shallow overbank area that varies in depth from 2 to 15 ft and is approximately 700 ft in width. Downstream of KIF, the embayment empties into the main impoundment of Watts Bar Reservoir on the Tennessee River.

KIF is located approximately 20.4 river miles downstream of Melton Hill Dam on the Clinch River and 65.3 river miles upstream from Watts Bar Dam on the Tennessee River. Due to the disproportionate volume of water downstream from this location, river flow in the vicinity of the plant is primarily dependent upon releases from Melton Hill Dam, and to a lesser extent by unregulated flows from the Emory River (Figure 1). Annual daily average flows (1977-2019) have ranged from approximately 3,000 to 15,000 cfs. Daily mean flows during 2020 were generally higher than historical means from January through May, and similar during the remaining months (Figure 3).

1.3 Regulatory Basis

Kingston Fossil Plant's NPDES permit (effective date of March 1, 2018), inclusive of the ATL, will expire on February 28, 2023. The current status of a BIP in Watts Bar Reservoir is relevant to the re-verification of the alternate thermal limit in the next permit.

1.3.1 Applicable Thermal Criteria

TDEC has specified "use classifications" for the state's surface waters and developed temperature criteria intended to support those uses (TDEC Rule 0400-40-04 and 0400-40-03.03, respectively). The Clinch River at the location of KIF has been classified for the following uses: Municipal, Industrial, and Domestic Water Supply, Industrial Water Supply, Fish and Aquatic Life, Recreation, Irrigation, Livestock Watering and Wildlife, and Navigation. Except for Irrigation and Livestock Watering and Wildlife (qualitative criteria), temperature criteria relevant to warm-water conditions of the Clinch River at KIF specify that:

"The maximum water temperature change shall not exceed 3°C [5.4°F] *relative to an upstream control point. The temperature of the water shall not exceed 30.5°C* [86.9°F] *and the maximum rate of change shall not exceed 2°C* [3.6°F] *per hour. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or middepth whichever is less, and the temperature in flowing streams shall be measured at mid-depth."* [Rule 0400-40-03-.03]

The KIF plant's "once-through" cooling water system design provides for the most thermodynamically efficient method of generating electricity and as a result produces a heated discharge. As such, the thermal discharge typically exceeds TDEC's established temperature criteria. In such cases, the TDEC rules specific to the Fish and Aquatic Life use classification provide that:

"*A successful demonstration as determined by the state conducted for thermal discharge limitations under Section 316(a) of the Clean Water Act, (33 U.S.C. §1326), shall constitute compliance*… [with the temperature criteria]."

TVA has previously made a successful demonstration for the KIF thermal discharge in support of an ATL as further discussed below.

1.3.2 Currently Permitted Conditions

Currently permitted thermal discharge limitations for KIF specify that the daily maximum temperature is not to exceed 36.1°C (97.0°F) (Page 3 of 27, NPDES permit TN0005452). This ATL is based on a previous demonstration by TVA, in accordance with CWA §316(a) and TDEC Rule 0400-40-03-.03 noted above, that a balanced indigenous population (BIP) of fish, shellfish, and wildlife is supported in Watts Bar Reservoir potentially affected by the thermal discharge. The ATL, as supported by the biological studies, also encompasses the other components of the TDEC temperature criteria, specifically the change in temperature from ambient/upstream conditions and rate of change in temperature. KIF has maintained a good compliance record with its ATL throughout each NPDES permit term since first authorized in the mid-1970s; ongoing biological monitoring has consistently demonstrated the ATL is protective of aquatic communities in the river near the facility.

1.3.3 Criteria for Thermal Variances under § 316(a)

The regulatory provisions that implement CWA §316(a) provide limited guidance on precisely what the demonstration study must contain to be considered adequate and do not identify precise criteria against which to measure whether a "*balanced and indigenou*s" aquatic community is protected and maintained. Instead, the regulations provide broad guidelines.

Under the broad regulatory guidelines, the discharger must show that the thermal variance desired, "*considering the cumulative impact of its thermal discharge together with all other significant impacts on the species affected*," will "*assure the protection and propagation of a balanced, indigenous community of shellfish, fish and wildlife in and on the body of water into which the discharge is to be mad*e (40 CFR §125.73). Critical to the demonstration is the meaning of the term "balanced indigenous community". The rules provide the following definition:

> "The term "*balanced indigenous community*" is synonymous with the term balanced, indigenous population (i.e., BIP) in the Act and means a biotic community typically characterized by diversity, the capacity to sustain itself

> through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications" (40 CFR §125.73).

Pursuant to this regulatory definition, a successful demonstration must show that under the desired ATL, and in light of the cumulative impact of the thermal discharge together with all other significant impacts on the species affected, the following characteristics, which are indicative of a BIP, will continue to exist: (1) diversity, (2) the capacity of the community to sustain itself through cyclic seasonal changes, (3) the presence of necessary food chain species, and (4) a lack of domination by pollution tolerant species.

There are several methodologies a discharger may pursue in making a §316(a) demonstration. Under the regulations, new dischargers must use predictive methods (e.g., laboratory studies, literature surveys, or modeling) to estimate an appropriate thermal variance that will assure the protection and propagation of a balanced, indigenous community prior to commencing the thermal discharge. However, existing dischargers, such as KIF, need not use predictive methods. For such dischargers, §316(a) demonstrations may be based upon the "*absence of prior appreciable harm*" to a balanced, indigenous community (see 40 CFR §125.73(c)(1)(i) and (ii)). Such demonstrations must show either that:

i) No appreciable harm has resulted from the thermal component of the discharge taking into account the interaction of such thermal component with other pollutants and the additive effect of other thermal sources to a balanced, indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge has been made; or

ii) Despite the occurrence of such previous harm, the desired alternative effluent limitations (or appropriate modifications thereof) will nevertheless assure the protection and propagation of a balanced, indigenous community of shellfish, fish, and wildlife in and on the body of water into which the discharge is made.

Furthermore, in determining whether or not prior appreciable harm has occurred, the regulations provide that the permitting agency consider the length of time during which the applicant has been discharging and the nature of the discharge. The regulations do not define "*prior appreciable harm*." However, using the definition of "balanced, indigenous community," mixing zone criteria are generally granted under either of the following circumstances:

1. When a discharger shows that the characteristics of a BIP (i.e., diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species, and a lack of domination by pollution tolerant species) exist. Stated another way, the existence of such characteristics essentially prove that the aquatic community has not been appreciably harmed; or

2. Despite any evidence of previous harm, the characteristics of a BIP, as stated above, will nevertheless be protected and assured under the alternate limit.

The standard to "assure" a BIP does not require a "no effects" determination, but rather "reasonable assurance" of the protection and propagation of a BIP[1].

1.3.4 Mixing Zone Requirements in Tennessee Rule 0400-40-03-.05

As noted above, § 316(a) pertains to the Fish and Aquatic Life use classification and provides NPDES-permitted facilities a regulatory compliant means of demonstrating that promulgated temperature criteria may be more stringent than necessary to support a BIP. In such cases, less stringent thermal criteria (i.e., ATLs) are justified. However, other use classifications such as Domestic Water Supply and Recreation must be protected as well. Compliance with TDEC temperature criteria for these uses is typically determined after the discharge has had the opportunity to mix with the receiving water; that is, an allowable mixing zone is determined.

TDEC rules define the mixing zone as:

"*That section of a flowing stream or impounded waters in the immediate vicinity of an outfall where an effluent becomes dispersed and mixed*." [0400-40-03-.04(12)]

The rules [0400-40-03-.05(2)] further provide that mixing zones are to be restricted in area and length and not:

1. prevent the free passage of fish or cause aquatic life mortality in the receiving waters;
2. contain materials in concentrations that exceed acute criteria beyond the zone immediately surrounding the outfall;
3. result in offensive conditions;
4. produce undesirable aquatic life or result in dominance of a nuisance species;
5. endanger the public health or welfare; or
6. adversely affect the reasonable and necessary uses of the area;
7. create a condition of chronic toxicity beyond the edge of the mixing zone;
8. adversely affect nursery and spawning areas; or
9. adversely affect species with special state or federal status.

While TVA's §316(a) demonstration study plan fully examines the effects of the thermal discharge on the aquatic life components of the mixing zone requirements, the potential effects to other non-aquatic life use classifications are generally not evaluated. Therefore, this plan has been revised

[1] *See In re Dominion Energy Brayton Point, LLC*, 13 E.A.D. 407, 2007 WL 3324213, at *16 (EAB Sept. 27, 2007); *see also In re Public Service Company of New Hampshire et al. (Seabrook Station, Units 1 and 2)*, 1 E.A.D. 332, 1977 WL 22370, at *11-14 (EAB June 10, 1977).

herein to incorporate or collect additional information needed to address the reasonable potential for impairment of other non-aquatic life uses in Watts Bar Reservoir near the facility.

2.0 BIOLOGICAL STUDIES AND ASSESSMENTS

2.1 Previous § 316(a) Demonstration Study

TVA conducted comprehensive §316(a) demonstration-related studies of the KIF thermal effluent in the mid-1970s to support establishment of the initial and current ATL for the plant discharge (TVA, 1974; TVA 1975; TVA 1978a; TVA 1978b; TVA 1983).

The mid-1970s studies included extensive sampling of the aquatic community including:

- Phytoplankton,
- Periphyton,
- Zooplankton,
- Benthic macroinvertebrates,
- Aquatic macrophytes; and
- Fish populations.

Hydrothermal, water quality and other parameters also were evaluated.

Major findings of these studies included:

- Analysis of the data indicates that the assemblages of phytoplankton, zooplankton, and benthic macroinvertebrates were diverse and, in general, relatively abundant.
- Phytoplankton communities were dominated by diatoms and green algae; blue green algae were never present in nuisance levels.
- The zooplankton communities were found to be similar at all stations during 15 of 16 survey months.
- The benthic communities were similar regardless of their location.
- Fish species occurrence, distribution, and abundance were similar pre- and post-operation indicating no impacts.
- Other fisheries studies indicated that the thermal discharge resulted in no discernible increase in parasitism, no detrimental changes in length-weight relationships, adequate reproduction, and minimal impacts on growth characteristics.
- No avoidance of thermal discharge was apparent; rather there appeared to be an attraction to the warmer water compared to the cooler control station.
- Thermal blockage to fish movement is not expected since the cross-sectional area of the main river channel below 10 feet is unaffected by the thermal plume.

2.2 Contemporary Studies

In 2001, TVA and TDEC reached an agreement whereby results of TVA's River and Reservoir Monitoring program (f.k.a., "Vital Signs" program), designed to measure ecological and water quality health on a reservoir-wide basis, would be the accepted study design for measuring the presence and maintenance of a BIP to support § 316(a)-based ATLs (Appendix C). Study design at the time (starting in 2001) was based on measuring biotic integrity using multi-metric community structure assessment techniques and focused on fish community sampling in three zonal areas of the reservoir during autumn: the inflow, transitional and forebay zones. Seasonal assessments (summer & autumn) were conducted twice—2012 and 2020—at the request of TDEC. Macroinvertebrate community sampling began in 2009. Biological sampling zones and collection methods are illustrated in Figures 4 and 5.

In 2009-2010, there was increasing regulatory interest at the federal level in having NPDES permit applicants update studies supporting ATLs and to better focus study design on the regulatory definition of a BIP as provided in 40 CFR §125.73. Accordingly, TVA developed Study Plans incorporating sampling locations closer to its power plants to supplement data collected in the three reservoir zonal areas, and included more traditional comparative analysis techniques in addition to the long-used multi-metric assessment techniques. New assessments of wildlife communities that could potentially be impacted by thermal discharges were also conducted.

The TVA's biological assessment data has consistently indicated that fish assemblages of Watts Bar Reservoir downstream of the KIF thermal discharge were similar to those of upstream reference locations. The findings have demonstrated, with acceptance by TDEC and EPA Region 4, the presence, protection and maintenance of a BIP in Watts Bar Reservoir in support of continuing the ATL in the KIF NPDES permit.

2.3 Previously Accepted BIP Assessment Practice

As previously indicated, beginning in 2001 and up until about 2010, TVA's use of multi-metric assessment techniques was for the most part the accepted primary method of demonstrating a BIP for supporting the continuance of the existing ATL at KIF, and the status of the fish community was the primary community of interest (Appendix C).

TVA's multi-metric Reservoir Fish Assemblage Index (RFAI) attempts to address characteristics of a BIP in a holistic manner by measuring 12 population "metrics", scoring the metrics based on expectations of healthy populations in the region, and summing the scores to arrive at an overall RFAI score and subsequent rating. The maximum RFAI score attainable is 60. Ecological health ratings are then applied to the scoring ranges: 12-21 "Very Poor", 22-31 "Poor", 32-40 "Fair", 41-50 "Good", or 51-60 "Excellent". It has generally been accepted that an RFAI rating of "Fair" or better in the thermally affected area can be considered demonstration of a BIP, particularly where RFAI scores for unaffected upstream areas are similar. A difference of six points or less between the thermally affected area and unaffected upstream area indicates statistical similarity of the fish communities between the two sites.

Beginning in 2009, TVA has conducted autumn (and summer 2012) monitoring of the benthic macroinvertebrate community in Watts Bar Reservoir, developing its Reservoir Benthic Index (RBI) of biotic integrity for Tennessee River reservoirs. Multi-metric assessment methods for evaluating ecological health of benthic communities in large river systems and/or artificial reservoir settings are not as well established as they are for wadeable streams, but nonetheless, provide valuable supplemental information in support of the fish community assessment. TVA's RBI is calculated similarly to the RFAI except that it uses seven metrics specific to the macroinvertebrate assemblage. Each metric is assigned a score based on reference conditions; the metric scores are then summed to produce an overall RBI score for each sample site. The maximum RBI score is 35. Ecological health ratings are then applied to scoring ranges: 7-12 "Very Poor", 13-18 "Poor", 19-23 "Fair", 24-29 "Good", or 30-35 "Excellent." A difference of four points or less between the thermally affected area and unaffected upstream area indicates statistical similarity of the benthic macroinvertebrate community between the two sites.

As stated by EPA Region 1 in the supporting documents for the draft Merrimack Station NPDES permit[2]: "Assessing changes in the resident fish community of a water body often provides the most conspicuous evidence of impacts to the overall aquatic community . . . ." The BIP determination in that proceeding (in 2011) relied largely on fish community data for the Hooksett Pool portion of the Merrimack River, the receiving water for the Merrimack Station thermal discharge. However, EPA Region 1 also noted that a comprehensive § 316(a) demonstration is not just limited to fish; planktonic organisms, macroinvertebrates, "habitat formers" (e.g., aquatic vegetation), and wildlife are all important communities to be assessed, but importantly "at the level of detail appropriate to the facility's potential to impact these communities." Explaining further, EPA indicated "no hard and fast rule can be made as to the amount of data that must be furnished [for a successful § 316(a) demonstration] . . . and much depends on the circumstances of the particular discharge and receiving waters." [3]

2.3.1 Results of BIP Studies, 2000 – 2019

2.3.1.1 Reservoir Fish Assemblage Index (RFAI)

Baseline RFAI scores for autumn 2001 were "42-Good" for the reach downstream of KIF and "45-Good" for the thermally unaffected reach upstream. In 2019, RFAI scores for autumn were rated "46-Good" for both downstream and upstream reaches. With the exception of an 8-point difference in 2011, scores for the two reaches differed by four points or less (statistically similar; Appendix A) during each sample year (Figure 6; Table 1). Over the period from 2000-2019, the average RFAI score for the downstream reach is "41-Good" and for the upstream reach is "43-Good". The average difference in scores for the two reaches over this period is 3 points (Table 1).

Summer samples in the same reaches during 2012 and 2020 produced RFAI scores improved over,

[2] EPA Region 1. 2011. Draft NPDES Permit for the PSNH Merrimack Station; Appendix D, page 36.
[3] *Seabrook*, 1977 EPA App. LEXIS 16, at *31; as cited in EPA Region 1. 2011. Draft NPDES Permit for the PSNH Merrimack Station; Appendix D, page 25.

equal to, or similar (difference of 4 points or less) to those for autumn samples during 2012 and 2020. At the thermally affected downstream reach in 2020, summer RFAI scores were 4 points higher than autumn (Table 1).

Values for the RFAI metrics and averages for the period from 2001 through 2019 (Table 2) were highly similar between reaches and compare as follows:

Upstream vs. Downstream

- Average numbers of species
- One more indigenous species downstream than upstream
- Three more centrarchid species downstream
- Same number of benthic invertivore species between reaches
- Same number of intolerant species between reaches
- One more top carnivore species downstream
- Average proportions
- Downstream reach, as compared to upstream reach:
- Slightly higher percentage of tolerant individuals (by ~2%)
- Slightly higher percentage of sample dominated by one species (by ~5%)
- Slightly lower percentage of non-native individuals (by ~0.5%)
- Slightly lower percentage of top carnivore individuals (by ~3%)
- Slightly higher percentage of omnivore individuals (by ~2%)
- Slightly lower percentage of individuals with anomalies (by ~0.3%)
- Catch rate
- Downstream reach averaged ~12 more fish per effort than upstream

Average metric values between seasons at the thermally affected reach downstream compare as follows:

Summer vs. Autumn

- Average numbers of species
- Two more indigenous species during autumn
- One more centrarchid species during autumn
- One less benthic invertivore species during autumn
- Same number of intolerant species

- Two more top carnivore species during autumn
- Average proportions
- Summer season, as compared to autumn:
- Lower percentage tolerant individuals (by ~11%)
- Lower percentage of sample dominated by one species (by ~15%)
- Slightly lower percentage of non-native individuals (by ~3%)
- Slightly lower percentage of top carnivore individuals during (by ~4%)
- Slightly higher percentage of omnivore individuals (by ~4%)
- Slightly lower percentage of individuals with anomalies (by ~1%)
- Catch rate
- Summer averaged ~18 more fish per effort than upstream

2.4 Metric-by-Metric Comparison of 2020 Data between Sites and Comparison to 2000–2019 Data

To determine if there are any differences in the ecological health of the fish communities at the thermally affected downstream reach and upstream reach in 2020, this section presents results of 2020 monitoring from summer and autumn, focusing on the twelve metrics of the RFAI methodology. This section also includes a comparison of 2020 data with that of 2000–2019 to determine if there are any differences between current fish communities and historical.

2.4.1 Results of 2020 BIP Study

Table 2 presents RFAI scores and observed data values for the individual metrics of the RFAI during summer and autumn 2020. More detailed 2020 results including metric scores of the RFAI, and lists and abundances of fish species collected during 2020 can be found in Appendix E. Based on review of Table 2, the following observations can be made regarding the overall RFAI scores and fish community metrics for the downstream reach.

- <u>Total RFAI scores</u> – RFAI scores at the downstream reach were either higher than or similar to (6 points different or less) upstream scores during both summer and autumn. Additionally, the summer 2020 score ("43-Good") was higher than that of autumn 2020 ("39-Fair"; Table 1). The downstream reach in autumn 2020 scored 7 points lower than that of the previous autumn sample in 2019; the upstream reach in 2020 also scored lower (4 points) than autumn 2019. With the exception of one sample in 2011, RFAI scores during every sample year have been not been statistically different between reaches (i.e. "similar"; Appendix A). As expected, when compared between reaches, scores since 2001 have not been significantly different ($P=0.26$; Table 3).
- <u>Number of species (indigenous)</u> – There were no differences between reaches in numbers of indigenous species collected per effort during either summer or autumn 2020, or between seasons at the downstream reach ($P>0.05$; Appendix E). Numbers of indigenous

species have trended similarly at both reaches over the years (Figure 7), and as a result, have not been significantly different between reaches (P=0.57; Table 3). Numbers of indigenous species at both reaches were 4 species less in autumn 2020 than in 2019.

- Number of centrarchid species (excluding black bass) – Numbers of centrarchid species collected have been significantly higher at the downstream reach than upstream (P<0.0001) among the years, differing by about 3 species per sample (Table 3). This continued in summer and autumn 2020, with more centrarchid species collected downstream during both seasons. The same five centrarchid species were observed in both reaches, with the exception of green sunfish, which was only collected upstream (Appendix E).

- Number of benthic invertivore species – Average numbers of benthic invertivore species collected since 2001 were four at both reaches and, along with average numbers collected, have not been significantly different between reaches (P=0.89, P=0.69; Table 3). The similarity continued during both seasons in 2020, as numbers of benthic invertivore species at the downstream reach were equal (both 5), and numbers of species only differed between reaches by one species (Table 3). As a result, numbers of benthic invertivores did not differ significantly between reaches or seasons at either reach (P>0.05; Appendix E).

- Number of intolerant species – Numbers of intolerant species have varied little among samples, ranging from collections of three to eight species at both reaches, and have averaged equal numbers of species between reaches during both seasons. One more intolerant species was collected upstream (7) than downstream (6) during both summer and autumn 2020 (Table 2). Numbers of intolerant species collected since 2001 have not been significantly different (P=0.76; Table 3).

- Percent individuals as tolerant –This percentage exhibited more variation after 2010 than before, but trends have generally been similar between reaches (Figure 8). As a result, percentages of tolerant individuals have not been significantly different between reaches since 2001 (P=0.94). In 2020, percentages were lower at the downstream reach during summer and similar between reaches during autumn. However, when compared by effort, a higher number of tolerant species were collected per effort at the downstream reach than upstream during both seasons (P=0.02, P=0.01), albeit, only by about 1 species; catch rates of tolerant individuals were not different between reaches. Eight species considered pollution tolerant contributed to these proportions during 2020, with four collected during all four samples (Appendix E).

- Percent of sample dominated by one species – Bluegill was the most prevalent species collected at both reaches during both summer and autumn 2020. This percentage has varied widely at both reaches since 2001 but trended similarly, and as a result, no significant difference in this metric between reaches was observed (P=0.51; Table 3).

- Percent individuals as non-indigenous – Percentages have varied widely at both reaches since 2001, but have trended similarly (Figure 9). When compared among the sample years, the percentages of non-indigenous fishes have not been significantly different between reaches (P=0.98). The values for both reaches in 2020 were highly similar to respective historical averages. Five non-indigenous species contributed to percentages in 2020 (Appendix E).

- Number of top carnivore species – Numbers of top carnivore species collected since 2001 have not varied much ranging from 7 to 12 species at the downstream reach and 8 to 13 species upstream. Historically, there has been no difference in numbers of top carnivore species between reaches (P=0.59). Additionally, numbers of top carnivore species were not significantly different between reaches or seasons in 2020 (P>0.05; Appendix E).

- Percent individuals as top carnivores – Percentages of top carnivores at both reaches in autumn 2020 were at the highest or near highest observed since sampling began, and within historical ranges during summer 2020. This percentage has been consistently higher at the upstream reach for all sample years (P=0.01; Table 3), but percentages have trended similarly at both reaches (Figure 10). Even with these trends, differences in percentages between reaches have been less than 4% during most sample years.

- Percent individuals as omnivores – Percentages of omnivores have generally followed the same patterns at both reaches among samples, and as a result, reaches have not differed (P=0.56) with respect to percentages of omnivores (Table 3). Differences between reaches have been minimal, rising above 8% during only three of 15 sample years (Figure 11). Nine omnivorous species contributed to the proportions observed in 2020, with six being collected during all four samples (Appendix E).

- Average number per effort – Catch rates at both reaches have been highly variable over the sample years, ranging from approximately 17 to 92 fish per effort at both reaches, but have trended similarly (Figure 12). Even though average catch rates were approximately 8 fish per effort higher at the downstream reach, catch rates have not been significantly different over the sample years (P=0.24).

- Percent of individuals with anomalies – The percentage of individuals exhibiting anomalies has remained consistently low at both reaches, rarely rising above 2%. No difference in percent anomalies has existed between reaches (P=0.66).

In evaluating these metrics, it is apparent from the RFAI scores and observed values for each of the twelve metrics that there has been no significant shift in fish community structure at the downstream reach in either summer or autumn 2020 when compared to previous years and between seasons. Reasons for this conclusion include:

- RFAI scores downstream of KIF not statistically different (i.e., difference less than six points; see Appendix A) from those upstream during either season.

- Observed values for all metrics in 2020 were within historical ranges observed since sampling began in 2001 (Table 2).

- Differences in observed values between 2020 and 2019 at the affected reach were mirrored in the unaffected reach (i.e., lower scores at both, less indigenous species at both, higher percent tolerant individuals at both, etc), indicating environmental effects.

- No significant differences between reaches historically for most (11 of 12) metrics and RFAI scores. The one metric showing a difference—percent as top carnivores—differed by an average of 4% (Table 3).

- With exception of numbers of intolerant species collected per effort, no significant differences between reaches in 2020 for all parameters tested (Appendix E).

3.0 EPA-DEFINED Elements of a Balanced Indigenous Population

Specific definitional elements of a BIP have been provided in the public record by EPA Region 4 regarding the thermal discharge from another TVA power plant (Gallatin). Below, each element is described focusing, as has historically been done, on how fish populations in the Clinch River downstream of KIF either achieve or do not achieve the expectations for the BIP element.

3.1 Focusing on the EPA Region 4 BIP Descriptions

EPA Region 4 has identified in past communications with TVA (and other electric utilities) the five essential elements that it has determined constitute a BIP based on interpretation of the regulations. In a letter from EPA to Tennessee Department of Environment and Conservation (TDEC) dated August 11, 2011 regarding its review of the Gallatin Fossil Plant NPDES permit renewal,[4] EPA included guidance on demonstrating a BIP. In the letter EPA states:

> The definition of "balanced, indigenous community" at 40 CFR § 125.71(c) contains several key elements. To be consistent with the regulations, each of these key elements should be specifically addressed in the demonstration, and the Study Plan should be designed to generate information relevant to these elements. Those elements include: (1) "a population typically characterized by diversity at all trophic levels;" (2) "the capacity to sustain itself through cyclic seasonal changes;" (3) "presence of necessary food chain species;" (4) "lack of domination by pollution-tolerant species;" and (5) "indigenous".

Further, EPA Region 4 provided helpful insight on each of the BIP elements identified in its letter to TDEC. Below, each element is presented along with TVA's interpretation of the most current KIF biological data for 2020.

<u>With regard to BIP element 1, EPA indicates</u>:

> "<u>A population typically characterized by diversity at all trophic levels</u>" means that all of the major trophic levels present in the unaffected portion of the water body should be present in the heat-affected portions. The EPA recognizes that community structure differences will occur, however, the number of species represented in each trophic level in the unaffected portions should be reasonably similar in the heat-affected portions of the water body.

Trophic levels are usually interpreted as the typical ecological levels of producers (algae, macrophytes), herbivores (zooplankton, invertebrate grazers, and algae-eating fish), and predators (predatory invertebrates and fish). The presence of these trophic levels can be deduced from the

[4] Letter dated August 11, 2011 from Christopher B. Thomas, Chief, Pollution Control & Implementation Branch, Water Protection Branch, EPA Region 4 to Paul E. Davis, Director, Division of Water Pollution Control, TDEC, regarding EPA review and comments on the draft NPDES permit for TVA's Gallatin Fossil Plant (NPDES TN0005428). Provided in Appendix F.

feeding habits (guilds) of the fish sampled. The RFAI multi-metric analysis was designed to evaluate appropriate densities and diversity of these trophic states present in the fish community.

A list of benthic macroinvertebrates and corresponding densities from summer and autumn samples upstream and downstream of KIF presented in Table 5 with functional feeding group designations. More detailed 2020 results, including results of statistical tests, metric scores of the RBI and lists and abundances of benthic macroinvertebrate species collected during summer and autumn 2020 can be found in Appendix E.

From review of Tables 4 and 5, TVA concludes:

Fish Community (Table 4)

- All expected major trophic levels present in the unaffected portion of the waterbody are present in the affected portion during both summer and autumn 2020.
- The number of species representing each trophic guild in the affected reach was "reasonably similar" to that for the unaffected portions of the waterbody during autumn 2020. During each season, seven of eight trophic guilds were either represented equally between reaches or differed by only one species. Top carnivores species were collected in higher numbers (5 and 3 more, resp.) at the upstream reach during both summer and autumn, but those additional species were represented by few individuals. This was supported by statistical tests performed on numbers of species and catch rates for each trophic guild which showed no differences between reaches, with the exception of numbers of omnivores per effort (Appendix E).
- The most prevalent guilds in both seasons (by number of species) have been top carnivores (e.g., largemouth bass), insectivores (e.g., bluegill), and omnivores (e.g., gizzard shad). No guilds have shown consistent dominance between the reaches (Tables 3 and 4).
- By numbers of individuals, omnivores and insectivores have almost always (13 of 17 samples) been more abundant in the upstream sampling reach than in the downstream reach, but the differences have not been significant ($P>0.05$). All other trophic guilds have shown no consistent dominance in abundance between reaches (Table 4).
- Trophic guild representation (number of species) since 2001 has remained steady in both reaches (Figure 7).

Macroinvertebrate Community (Table 5)

- All expected functional feeding groups were present upstream and downstream of KIF during both summer and autumn 2020.
- The number of macroinvertebrate taxa represented in each functional feeding group in the affected reach is "reasonably similar" to, if not more favorable than, that for the unaffected portions of the waterbody with downstream reach during most years sampled including 2020.

- The most prevalent species groups included “collector/gatherer” (CG) and “collector/filterer” (CF). For each of these two groups, dominance between upstream and downstream sites varied annually, but long-term averages were similar in both thermally affected and unaffected areas. Averages for other well-represented groups such as “predators” (PR) and “scrapers” (SC) were similar as well.

- Average densities of all functional feeding groups were similar between sampling area.

- Overall, increasing trends in number of species and mean densities were noted at both sampling areas and seasons, driven mostly by the CF, PR and CG functional feeding groups.

With regard to BIP element 2, EPA indicates:

> “The capacity to sustain itself through cyclic seasonal changes" means that any additional thermal stress will not cause significant community instability during times of natural extremes in environmental conditions. Community data should be collected during normal seasonal extremes as well as during optimal seasonal conditions. Data should be compared between heat affected and unaffected portions of the receiving water body to account for normal community changes corresponding with a change in season.

To provide a detailed analysis of the seasonal maintenance of BIP in areas affected by the KIF thermal discharge, data from the summer 2020 sample was compared in Table 6 to autumn 2020. To maximize number of data points, values of metrics in Table 6 were computed for each electrofishing effort and compared using ANOVA and Tukey’s Studentized Range Test.

Total scores of the multi-metric assessment only differed by four points or less between seasons at each reach. At the downstream reach, six of eight metrics showed no difference between summer and autumn samples:

- Number of indigenous species
- Number of non-indigenous species
- Number of benthic invertivore species
- Number of intolerant species
- Proportion of sample as tolerant inviduals
- Proportion of sample with anomalies

Those indicating statistical differences between summer and autumn samples at the downstream reach were overall abundance of fish and percent of sample as omnivores. The significant differences of both metrics were due (directly and indirectly) to higher collections of primarily three insectivore species at the downstream reach during autumn (a combined ~300 more bluegill, Mississippi silverside, and spotfin shiner individuals; Appendix E). Omnivore individuals were actually similar (Appendix E) between seasons, but the increased insectivores lowered the proportion per effort, resulting in the significant difference.

To assess maintenance of BIP of the benthic macroinvertebrate community through seasons, data were compared during summer and autumn 2020 in Table 7. The RBI scores for both transects downstream of the plant were equal between seasons, rated "Excellent" or "Good", and scored equally or higher than the upstream sampling area during both seasons. These indicate an ability to sustain through seasonal changes.

With regard to BIP element 3, EPA indicates:

> "Presence of necessary food chain species" means that the necessary food webs remain intact so that communities will be sustaining. We believe that exhaustive food web studies are not necessary provided that invertebrate, fish and wildlife communities are otherwise healthy, i.e., represented by sufficiently high species diversity and abundance (appropriate for that portion of the receiving water body) for the identified trophic levels and sustaining through normal seasonal changes.

As noted previously, all major functional feeding groups present in the unaffected portion of the waterbody are present in the affected portion. The number of species representing each functional feeding group in the affected reach was "reasonably similar," or more favorable to, those in the unaffected reach, and prevalence (abundance) of the major functional feeding groups varied between the reaches over the sampling history (Table 5). In addition, the downstream reaches have scored or averaged in the upper "Good" rating or higher during the last eight samples.

For the fish community (Table 4), all major trophic levels present in the upstream reach were observed in the downstream reach, and collections were not significantly different between reaches. When compared among all samples, none of the trophic levels showed differences between reaches in numbers of species or abundance between reaches (Table 3). These results indicate that the long-term presence of necessary food chain items at the downstream reach has not been different from upstream.

With regard to BIP element 4, EPA indicates:

> "Non-domination of pollution-tolerant species" means that in the case of thermal effluent community assemblages in heat affected portions of the water body dominated by heat tolerant species do not constitute a BIP. The EPA recognizes that because all species have varying levels of thermal tolerance, communities in the heat affected portions of the receiving water body may possess altered assemblages in terms of species present and abundance. All community data should be collected, analyzed and presented to clearly demonstrate that affected communities have not shifted to primarily heat tolerant assemblages.

Table 8 presents the numbers of indigenous fish species and individuals with upper incipient lethal limits (UILT) of 95 °F to 102 °F (considered "heat tolerant" for analysis purposes) collected upstream and downstream of KIF during summer 2012 and 2020 and autumn 2001 through 2020. Differences between reaches have mostly been small, differing by more than two species only twice. As expected, a Wilcoxon Rank Sum statistical test performed on the datasets indicates that average numbers of species have not been statistically different between reaches (P=0.73). Additionally, average abundance of heat tolerant individuals has not been different (P=0.38) between reaches. These data indicate no expressed dominance of heat tolerant species in either reach and no historical shift in abundance between reaches.

Table 9 presents the relative abundance of heat tolerant and heat sensitive (UILT <91 °F) indigenous fish species collected upstream and downstream of KIF during summer 2012 and 2020 and autumn 2001 through 2020. In direct comparison, heat tolerant species make up a much greater proportion than heat sensitive species in both upstream and downstream sample reaches and during both seasons. There were no differences in relative abundances of heat tolerant (P=0.26) or heat sensitive (P=0.25) fish between reaches.

<u>With regard to BIP element 5, EPA indicates:</u>

> “<u>Indigenous</u>" has been further clarified in the regulations: "Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the Act and may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)." The EPA recognizes that non-indigenous species are present in most aquatic systems in the United States. All community data should be analyzed and presented to demonstrate that community assemblages in the heat-affected portions of the receiving water body are not significantly different from non-affected communities with regard to the number of non-indigenous species in the assemblages.

Table 11 presents the number of non-indigenous fish species and the number of individuals representing these species collected upstream and downstream of KIF during summer 2012 and 2020 and autumn 2001 through 2020. Though Watts Bar Reservoir represents an artificial, man-made feature, available data indicate there are very few non-indigenous fish species present in the reservoir around KIF, and similar numbers of species were collected in both reaches during summer and autumn samples. A Wilcoxon Rank Sum statistical test performed on the autumn 2020 dataset indicates that numbers of non-indigenous species and abundances were not different between reaches or between seasons in 2020 (P>0.05; Appendix E) or long-term (P=0.66; P=0.79). Recent increases have been observed at the downstream reach in 2010, 2015, and to a lesser extent, 2020 (Figure 9). These increases can be attributed primarily to one species, Mississippi silverside, which are known to school in large numbers. When encountered, these large numbers often result in “oversampling” by electrofishing efforts, causing misrepresentation of the species in relative proportions of the community. Thermal tolerance data for the non-indigenous species are presented in Table 12. Of the six non-indigenous species identified, UILT data designate striped bass, muskellunge and yellow perch as heat sensitive and common carp as heat tolerant; data are not available for the remaining two species.

Further, there are no known species in the study area whose presence is attributable to the KIF thermal discharge or to any known pollutant.

3.2 Other Considerations for a Balanced Indigenous Population

As noted earlier from the EPA Region 1 Merrimack Station permitting, assessing changes and important trends in the resident fish community of a water body often provides the most conspicuous evidence of impacts to the overall aquatic community,[5] but information on other communities such as planktonic organisms, macroinvertebrates, "habitat formers" (e.g., aquatic vegetation), and wildlife also inform decision making with regard to the presence/absence of a BIP.

3.2.1 Macroinvertebrate Community

Because benthic macroinvertebrates are relatively immobile, negative impacts to aquatic ecosystems can be detected earlier in benthic macroinvertebrate communities than in fish communities. These data have been used historically to supplement multi-metric RFAI results to provide a more thorough examination of differences in aquatic communities upstream and downstream of thermal discharges.

However, as noted earlier, the downstream reaches have scored or averaged in the high "Good" range or higher during the most recent eight samples (Figure 13). In addition, the status of the macroinvertebrate community structure based on specific metrics, as presented in Table 7 and summarized in previous Section 3.1 regarding BIP Elements 1 (diversity at all trophic levels), 2 (sustain through seasonal changes), and 3 (food chain species), demonstrate a seasonally abundant and diverse macroinvertebrate community present at both downstream and upstream reaches.

In October 2005, TVA conducted a survey that utilized a combination of quantitative and qualitative sampling methods to document the existing mollusk (unionid mussels) community and habitat conditions along the shoreline at and upstream of the plant discharge (Yokely 2005). The survey produced a total of 81 live specimens representing four species which were collected from 31 transects. No federally threatened or endangered, or State-protected mussels were found during the survey. River substrates were noted as degraded ("sub-optimal") in the study area with hard clay being the dominant substrate overlain by varying thickness of soft mud.

In summary, ecological conditions of benthic macroinvertebrate communities, when compared between the downstream and upstream reaches, have been consistently "similar" since initiation of sampling and lab-processing of data in 2001. Results support the general conclusion that the

[5] EPA Region 1. 2011. Draft NPDES Permit for the PSNH Merrimack Station; Appendix D, page 36.

KIF thermal effluent has had no adverse environmental impact on the benthic macroinvertebrate community downstream of the plant.

3.2.2 Threatened and Endangered Species

Table 13 provides a list of federal and/or State-protected aquatic species with potential to occur in the Watts Bar Reservoir within a 10-mile radius of KIF. One species of fish, spotfin chub, is listed as federally threatened and threatened within Tennessee; six other species are listed with State-protective status: ashy darter, blue sucker, flame chub, tangerine darter, Tennessee dace, and lake sturgeon. The lake sturgeon is the only of these species that has been collected during TVA's biological monitoring from 2001 to 2020 in Watts Bar Reservoir near KIF. This is a target species in a State-sponsored reintroduction program and has been aggressively stocked in many Tennessee reservoirs over the last several years. It is highly unlikely ashy darter, flame chub, tangerine darter, and Tennessee dace would be collected in Watts Bar Reservoir near the KIF discharge given their preference for smaller stream habitats.

Nine mussels with both federal and state protected status are known or believed to exist within a 10-mile radius of KIF: Alabama lampmussel, fine-rayed pigtoe, orange-foot pimpleback, oyster mussel, pink mucket, purple bean, shiny pigtoe pearlymussel, spectaclecase, and turgid blossom pearlymussel. Two other mussels are listed with state protective status: Cumberland moccasinshell and pyramid pigtoe (Table 13). However, as mentioned previously, no federally threatened or endangered, or state protected mussels were found during the 2005 survey of the Clinch River/Watts Bar Reservoir adjacent to KIF conducted by Yokely (2005). River substrates were noted as degraded ("sub-optimal") in the study area with clay being the dominant substrate overlain by varying thickness of soft mud.

Additionally, TVA queried the TDEC "Rare Species by County" database, U.S. Fish and Wildlife Service (USFWS) Environmental Conservation Online System (ECOS) and the USFWS Information for Planning and Consultation (IPAC) (queried 24 August 2021) to supplement information on rare aquatic species and designated potentially occurring near KIF. These systems utilize known federally (ECOS and IPAC) and State-listed (TDEC) species by county. These data inherently search broader areas than the TVA Database queries and, consequently, listed additional federally and State-listed species as potentially occurring near the KIF project. While TVA recognizes these additional species may occur or have occurred in Roane County, Tennessee, we have determined that they would not be affected by KIF since they are either no longer occurring in the Clinch River near KIF or occur in habitats outside of the affected KIF project area within Roane County.

3.2.3 Wildlife Community

Beginning in 2011, visual wildlife surveys have been conducted to assess bird, reptile, and mammal populations around KIF. Numbers and categories of wildlife observed during 2011, 2012, 2013, 2015, and 2020 are presented in Table 14. Observations recorded during each year were primarily of birds, with similar species observed along each transect. Similar species and numbers of mammals and reptiles were observed upstream and downstream along each bank during each year.

These observations suggest that a relatively healthy ecological community exists both upstream and downstream of KIF. However, because the typical behavior of reptiles, amphibians, and mammals limits visibility of these groups by visual survey methods, estimation of the presence and diversity of these taxa was also limited. It is important to note that the visual encounter survey provides a preliminary near shore wildlife assessment to determine if the thermally affected area downstream of a power plant has adversely affected the bird, reptile, amphibian or mammal communities. If such adverse environmental impact is suspected, more sampling strategies that could provide more quantitative data will be proposed to more accurately estimate the presence and diversity of these groups.

3.2.4 Aquatic Habitat

The type, quality, and abundance of aquatic habitats dictate the diversity and abundance of organisms present in aquatic systems. To minimize bias in biological assessments, it is important to adequately describe/characterize shoreline and pelagic habitats in reference and "affected" reaches when attempting to discern potential impacts to biological systems from pollutant sources.

3.2.4.1 Habitat Formers

Habitat formers are mentioned in EPA's § 316(a) guidance document (EPA 1977) as an element of investigation in § 316(a) demonstrations. In freshwater systems, aquatic macrophytes, submerged and emergent, are the most obvious habitat formers and can be critical to the structure and function of ecological systems.

In the case of the anthropogenically modified Watts Bar Reservoir, important habitat formers such as aquatic macrophytes are not present in abundance in the system. Habitat surveys conducted by TVA in 2020 found no aquatic macrophytes at any of the 32 sites within either the downstream or upstream biological monitoring reach (Table 15 and 16).

3.2.4.2 Physical Habitat

TVA collects shoreline and river bottom habitat data upstream and downstream of KIF (Figure 14) every five years to characterize habitats important to fish. The objective is to find comparable habitats at the upstream and downstream sampling reaches to, as much as possible, minimize any habitat differences that might bias interpretation of the results of the thermal study.

Within the sample area upstream of KIF, the average Shoreline Aquatic Health Index (SAHI) score for the left descending bank was 23 and right descending bank was 21. The shoreline sections at the downstream reach scored similarly between shorelines: 18 on the left descending bank and 16 on the right descending bank. Scores at both downstream and upstream reaches rated in the "Fair" range. No aquatic macrophytes were observed at either reach (Tables 15 and 16).

Figures 15 through 22 depict proportions of substrate types observed along each transect sampled for river bottom substrate. Six substrate types were identified at both reaches; wood was only observed at the reach upstream of KIF and cobble only downstream. Silt and detritus were the most prevalent substrates in both reaches making up a combined 68% at the upstream reach and 78% downstream (Table 17).

3.2.5 Representative Important Species

In its processing of the Merrimack Station NPDES permit and associated review of § 316(a) studies, EPA Region 1 states: "*[W]hile it is appropriate to identify and focus on representative important species for 'predictive' § 316(a) demonstrations, non-predictive (i.e., retrospective, or 'Type I') demonstrations, which are designed to assess prior appreciable harm, should not be restricted to assessing the status of representative important species. In fact, EPA's Draft 1977 316(a) Technical Guidance recommends that references to Representative Important Species be eliminated from Type I demonstrations* [emphasis added] *(EPA 1977a)…[W]hen assessing community-wide impacts, there is no reason to exclude any resident species that was present prior to the increase in discharges of heated effluent to Hooksett Pool*."[6]

Representative Important Species (RIS) are defined in EPA guidance as those species which are representative in terms of their biological requirements of a balanced, indigenous community of fish, shellfish, and wildlife in the body of water into which the discharge is made (EPA 1977). In agreement with EPA Region 1's interpretation of the § 316(a) guidance with regard to Type I (non-predictive) demonstrations, all species collected by TVA in RFAI sampling around KIF, including non-indigenous species, were considered to be RIS and were included in the data analyses.

3.2.6 Zone of Passage

TVA collected depth profiles of temperature from the river surface to the bottom at points along transects to characterize and map the KIF thermal plume. Transects were located upstream of the discharge in an area not affected by the thermal plume (ambient), proximate to the thermal discharge point, and at various locations downstream of the discharge concentrated in the near field area of the plume where the change in plume temperature was expected to be most rapid. The total number of transects needed to fully characterize and delineate the plume was determined in the field.

As part of its § 316(a) demonstration studies conducted for KIF during summer and autumn 2020, TVA collected temperature data profiles in the thermally influenced portion of the Clinch River and compared these to profiles collected upstream of the KIF plant in the unaffected portion of the river. Measurements were collected in the summer and autumn of 2020.

[6] See EPA Region 1. 2011. Draft NPDES Permit for the PSNH Merrimack Station; Appendix D, page 36. https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/MerrimackStationAttachD.pdf

Although water temperatures at the discharge were elevated above ambient, temperatures classified as thermal plume (greater than 2°C or 3.6°F above ambient) were not detected during summer or autumn 2020 (Table 18). This would be due to recent reductions in numbers of units operational at KIF, which translates into less thermal loading to the Clinch River.

The most recent study in which KIF operated at near full capacity on the day the survey was taken was autumn 2012 survey. Profile data from the 2012 survey were sufficient to produce graphic representation of the thermal plume footprint (Figure 23). It is clear from the profile data (Appendix E) that the plume is confined to the upper layers of the Clinch River and there is an adequate zone of passage for fish traversing the area (Table 18). Further, the graphic confirms that the § 316(a) demonstration study biological sampling stations located downstream of KIF have been firmly established within the thermal plume.

3.2.6.1 Field Measurements Relative to Zone of Passage

Water temperature, conductivity, dissolved oxygen, and pH were measured along vertical depth profiles at nine locations within each RFAI sample reach (Table 19).

During summer 2020, water temperatures at the upstream reach ranged from 71.5 to 82.8 °F, and compared similarly to those in the reach downstream of KIF with a range of 72.5 to 82.7 °F. Average temperatures across all depths differed by 2.2 °F, and those in the upper water column (0.3 and 1.5 m) by 1.2 °F.

During autumn 2020, water temperatures observed within the upstream reach varied little with a range from 64.7 to 68.7 °F, compared to a slightly wider range of 65.1 to 72.9 °F in the downstream reach. Temperatures were lower at the upstream reach by an average of about 4.0 °F at upper depths (0.3 and 1.5 m) and about 2.4 °F across all depths.

These results indicate that a sufficient zone of passage past KIF existed for fish and other aquatic life during both summer and autumn 2020.

3.2.7 Water Supply and Recreational Use Support Evaluation

TVA is not aware of any domestic water supply intakes located within approximately 10 river miles downstream of the KIF thermal discharge.

4.0 DISCUSSION and CONCLUSIONS

A number of factors drive variability in these data creating a challenge for interpretation with regard to the thermal effects of the KIF discharge on the aquatic community downstream of the plant. Inter-annual variations occur naturally in biological systems in response to food availability, predation, and ambient environmental conditions including river flow meteorological conditions; these factors may or may not be equally expressed upstream and downstream of the plant. As described in Section 3.2.4, the artificial nature of reservoirs in general, along with differences in river bottom habitat between the downstream and upstream reaches, also contribute to the challenge. Contributions of these individual factors to variation observed in the data are difficult to tease apart from plant-related thermal impacts, except during extremes of drought and during low flows.

Nonetheless, it seems apparent from the period of record data that the biological community downstream has overall been similar to the biological community upstream based on RFAI scores. Importantly, the RFAI index incorporates § 316(a) definitional elements such as diversity (number of species), trophic levels (categorization by feeding guild), presence of necessary food chain species, non-domination of pollution-tolerant species, and representation of indigenous species. Further, the repetitive sampling and scoring across many years provide a measure of sustainability (and trends).

In evaluating the selected fish community metrics of the RFAI, it is apparent that the fish community structure in the thermally affected downstream reach was similar to that of the thermally unaffected upstream reach during both summer and autumn 2020. When compared to the 2001–2019 averages, the 2020 data indicate improvement in some metrics (Percent Dominated by One Species) with room for improvement in others (Number of Top Carnivores, Percent Omnivore Individuals, and Average Number per Effort).

In evaluating the data in the context of EPA's interpretation of the regulatory definition of a BIP, TVA believes that a BIP is currently being demonstrated in Watts Bar Reservoir, based on the most recent biological data collected in summer and autumn 2020. As such, TVA believes that continuation of the current ATL [daily maximum temperature of 97.0 °F (36.1 °C)] for the KIF plant discharge (Outfall 002) will reasonably assure the protection and propagation of a BIP.

Should TDEC determine that a BIP does not currently exist, TDEC has the authority under the § 316(a) regulations to approve TVA's requested ATL on the basis that: 1) a BIP was maintained for decades up and until 2017 and 2) there is reasonable assurance that a BIP will be supported going forward. Such assurance can be confirmed via additional biological monitoring with supporting thermal modeling as a continued condition of the renewed permit. Again, absolute certainty[7] is not required in approving an ATL.

4.1 Relationship to Clean Water Act Section 316(b)

When TDEC issues the renewed NPDES permit for KIF, it will include requirements that TVA conduct a number of studies [see § 122.21(r)], the results of which are to inform the Commissioner's decisions with regard to the Best Technology Available (BTA) for reducing entrainment of fish eggs and larvae through the KIF cooling water system. Of specific relevance to the current issue, TVA will have to evaluate, among other technologies, the technical feasibility and cost of retrofitting the plant to closed-cycle cooling. While the focus of interest is entrainment reduction via the reduction in flow that accompanies closed-cycle cooling, the Commissioner can

[7] See EPA Region 1. 2011. Draft NPDES Permit for the PSNH Merrimack Station; Appendix D, page 25. https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/MerrimackStationAttachD.pdf

factor into the decision-making process any benefits that might be accrued to the receiving water due to the related reduction in thermal loading.

As such, additional § 316(a) related study of the KIF thermal discharge effects conducted in parallel with the study requirements of § 316(b) over the next permit cycle will allow for the Commissioner's holistic assessment of the impact of KIF operations on the aquatic community from thermal discharge and cooling water intake perspectives, and inform decision making for regulatory compliance with both regulations in the subsequent NPDES permit.

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FIGURES

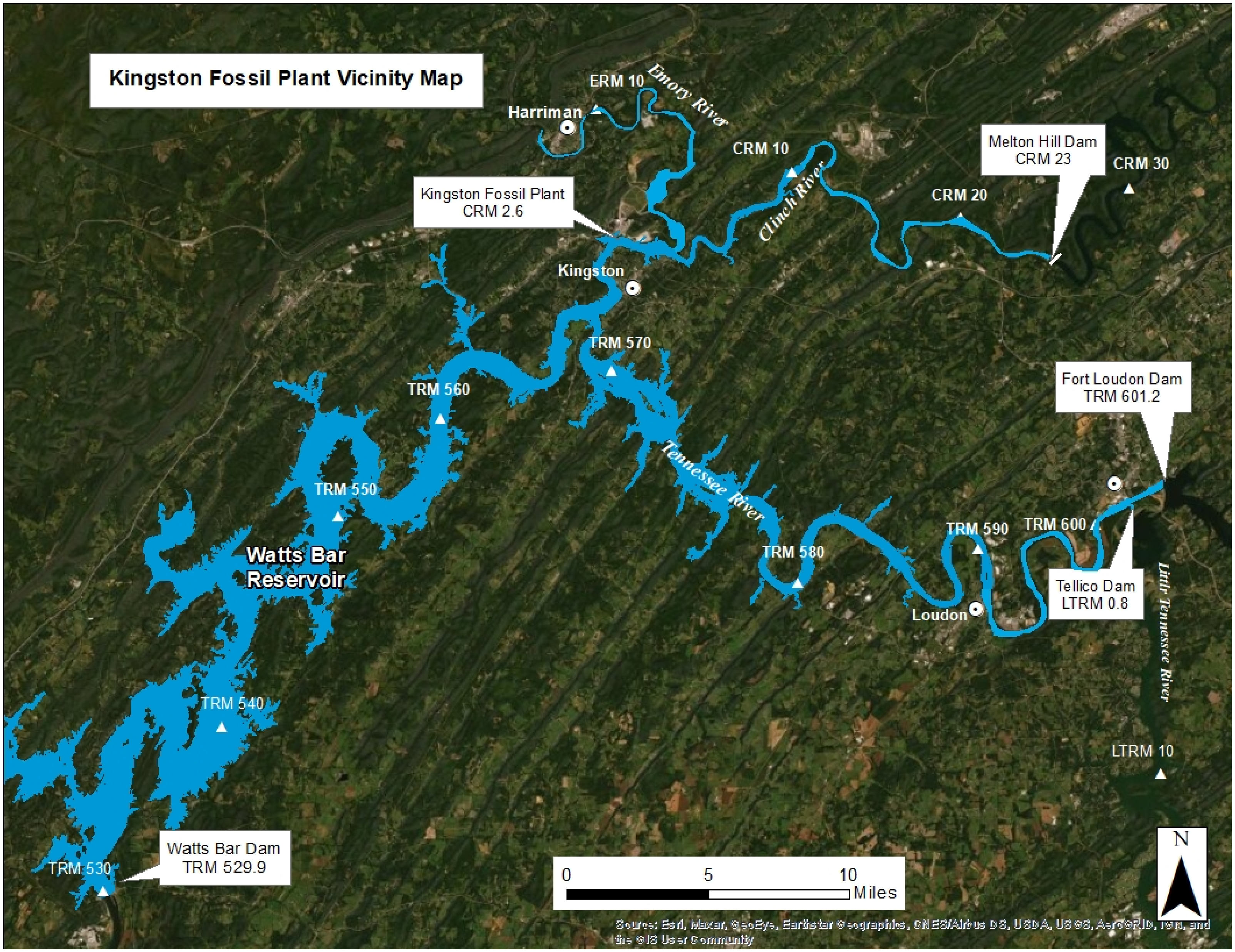


Figure 1. Vicinity map for Kingston Fossil Plant on Watts Bar Reservoir at the confluence of the Emory and Clinch rivers, showing locations of dams upstream (Melton Hill, Fort Loudon) and downstream (Watts Bar) of the plant

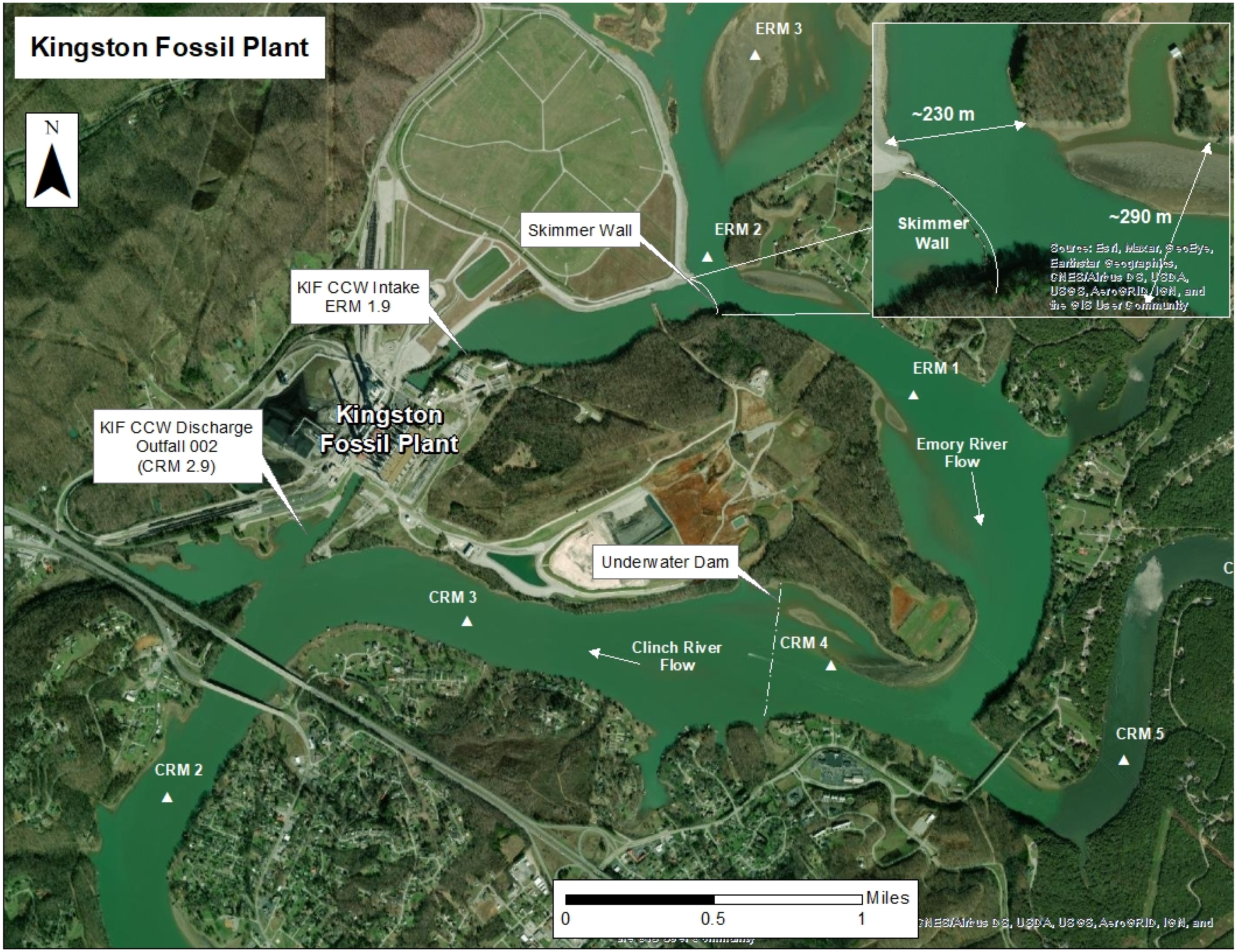


Figure 2. Site map for Kingston Fossil Plant, showing skimmer wall and condenser cooling water (CCW) intake and discharge (Outfall 002)

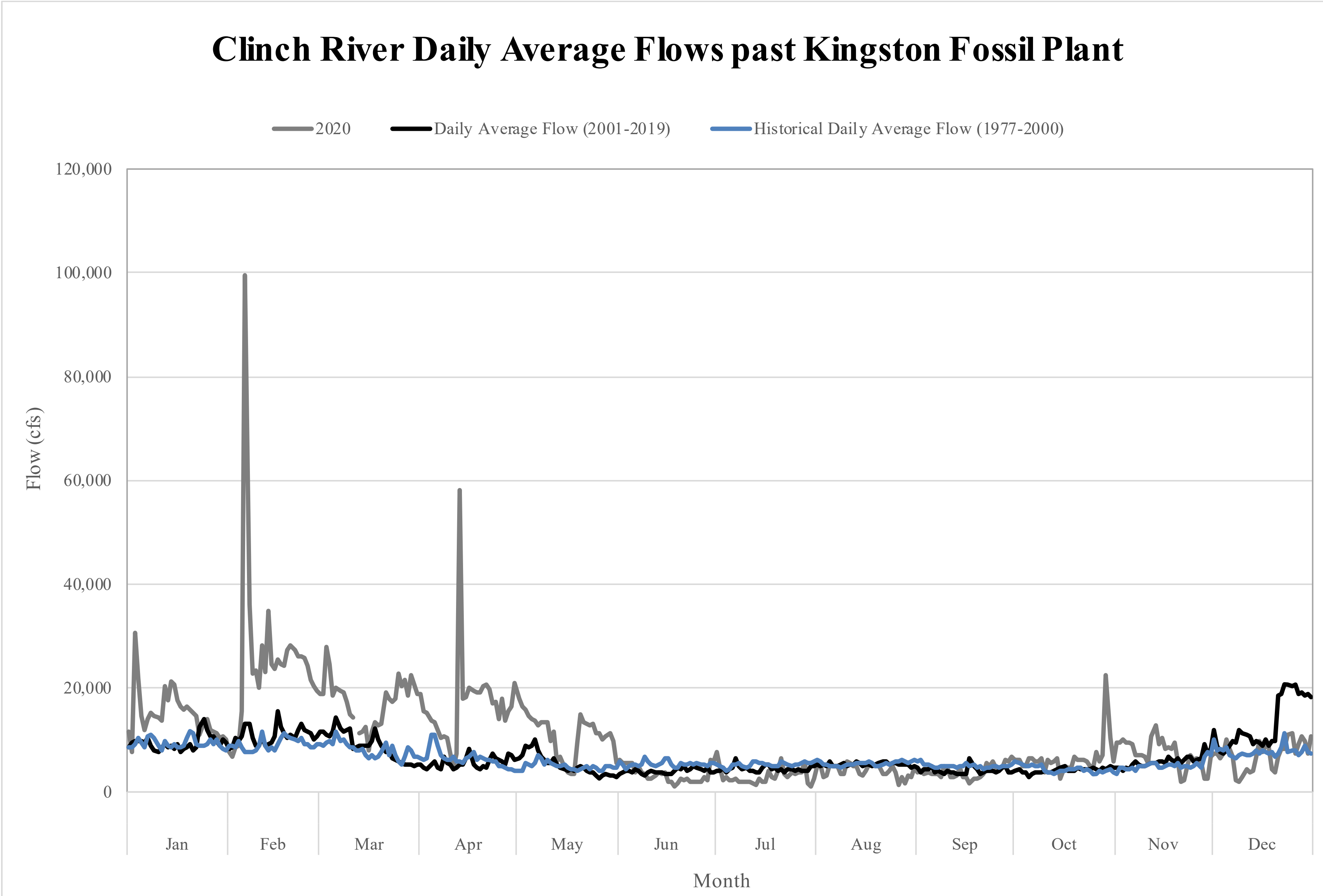


Figure 3. Average daily Clinch River flows past Kingston Fossil Plant during 1976-2000 (historical flows), 2001-2019 (previous monitoring) and 2020 (current monitoring)

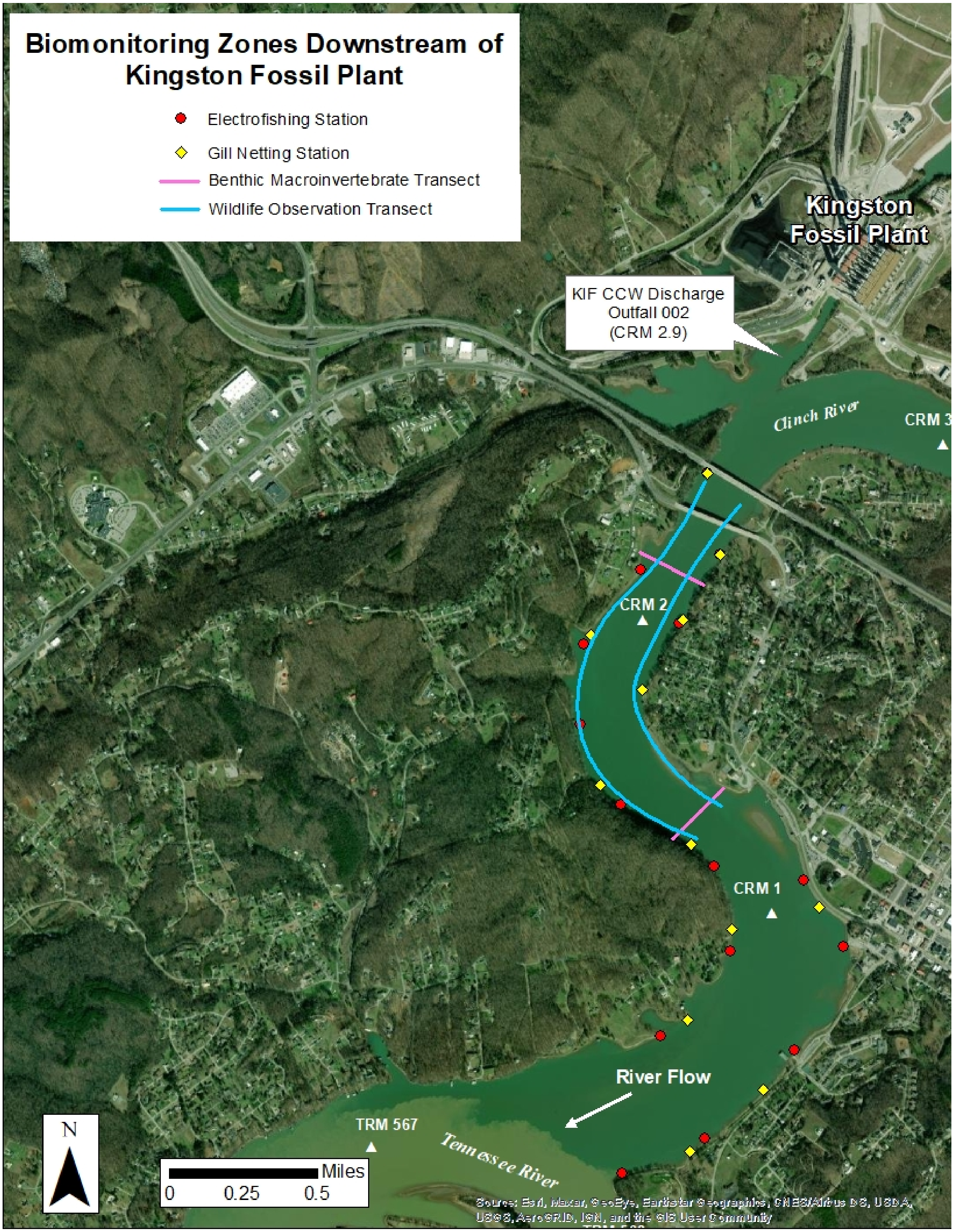


Figure 4. Biological monitoring zones downstream of Kingston Fossil Plant

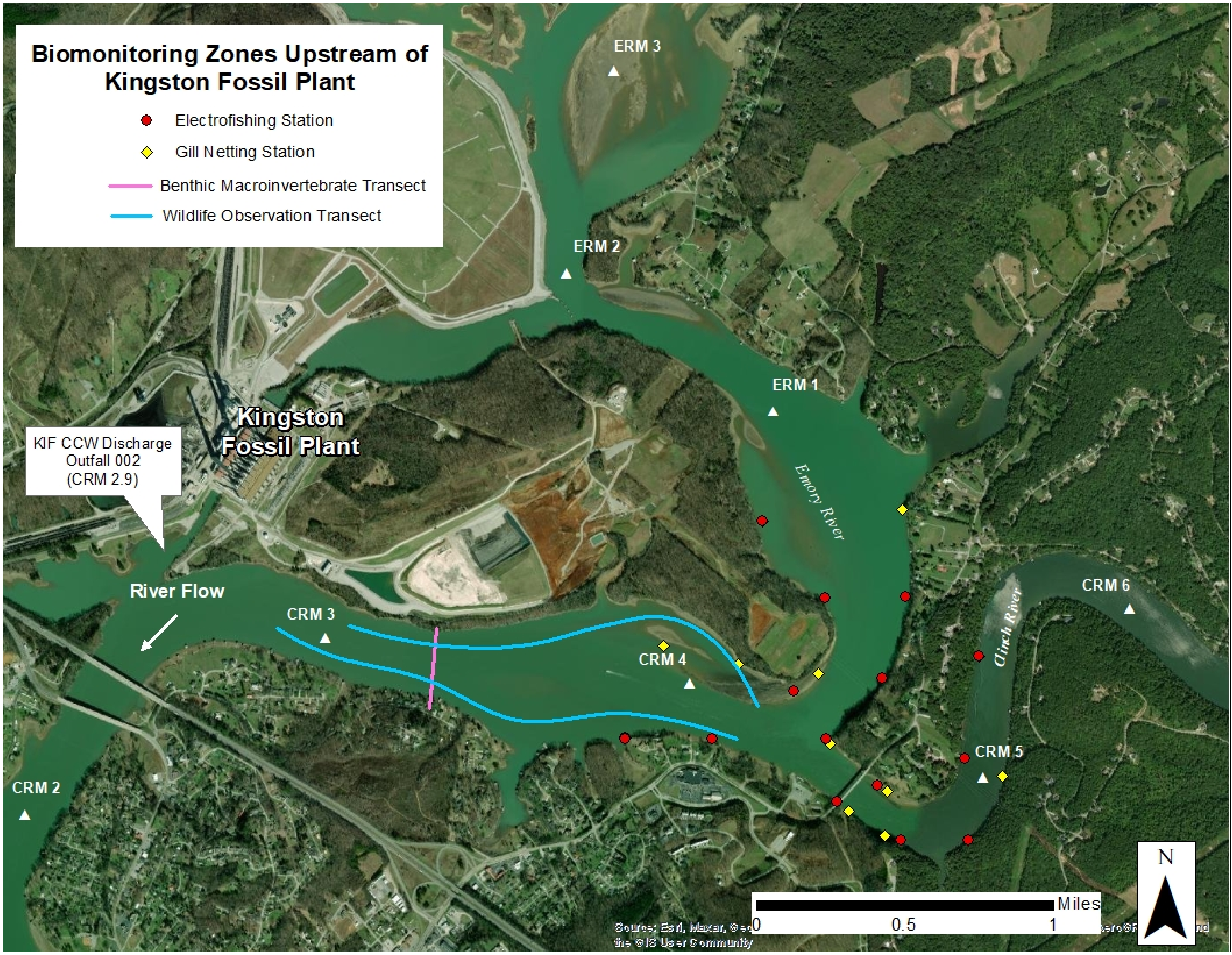


Figure 5. Biological monitoring zones upstream of Kingston Fossil Plant

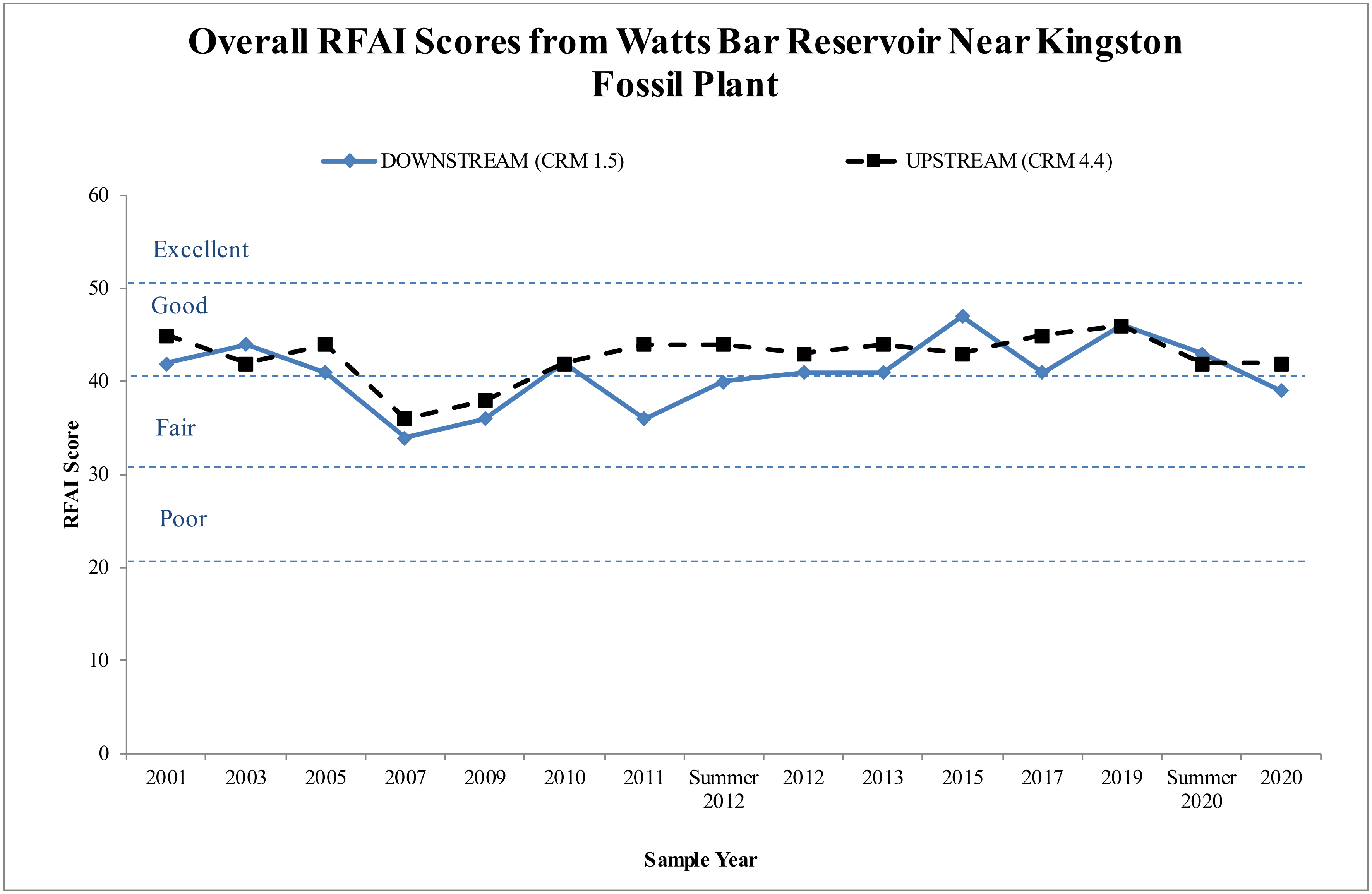


Figure 6. Reservoir Fish Assemblage Index (RFAI) scores and ratings for samples collected during summer 2012 and 2020 and autumn 2001 through 2020 in reaches upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant, as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir

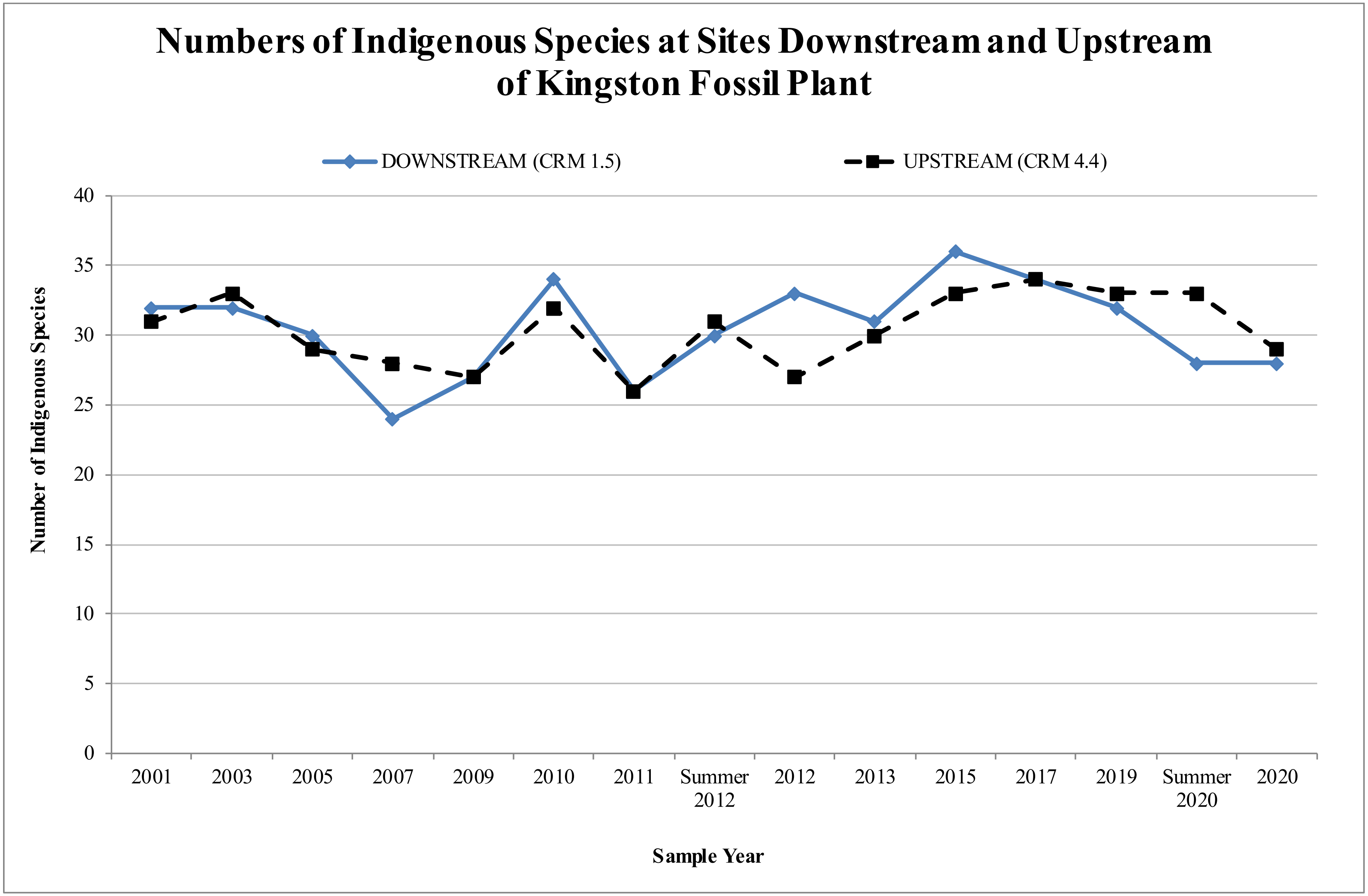


Figure 7. Numbers of indigenous species collected during summer 2012 and 2020 and autumn 2001 through 2020 from upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant, as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir

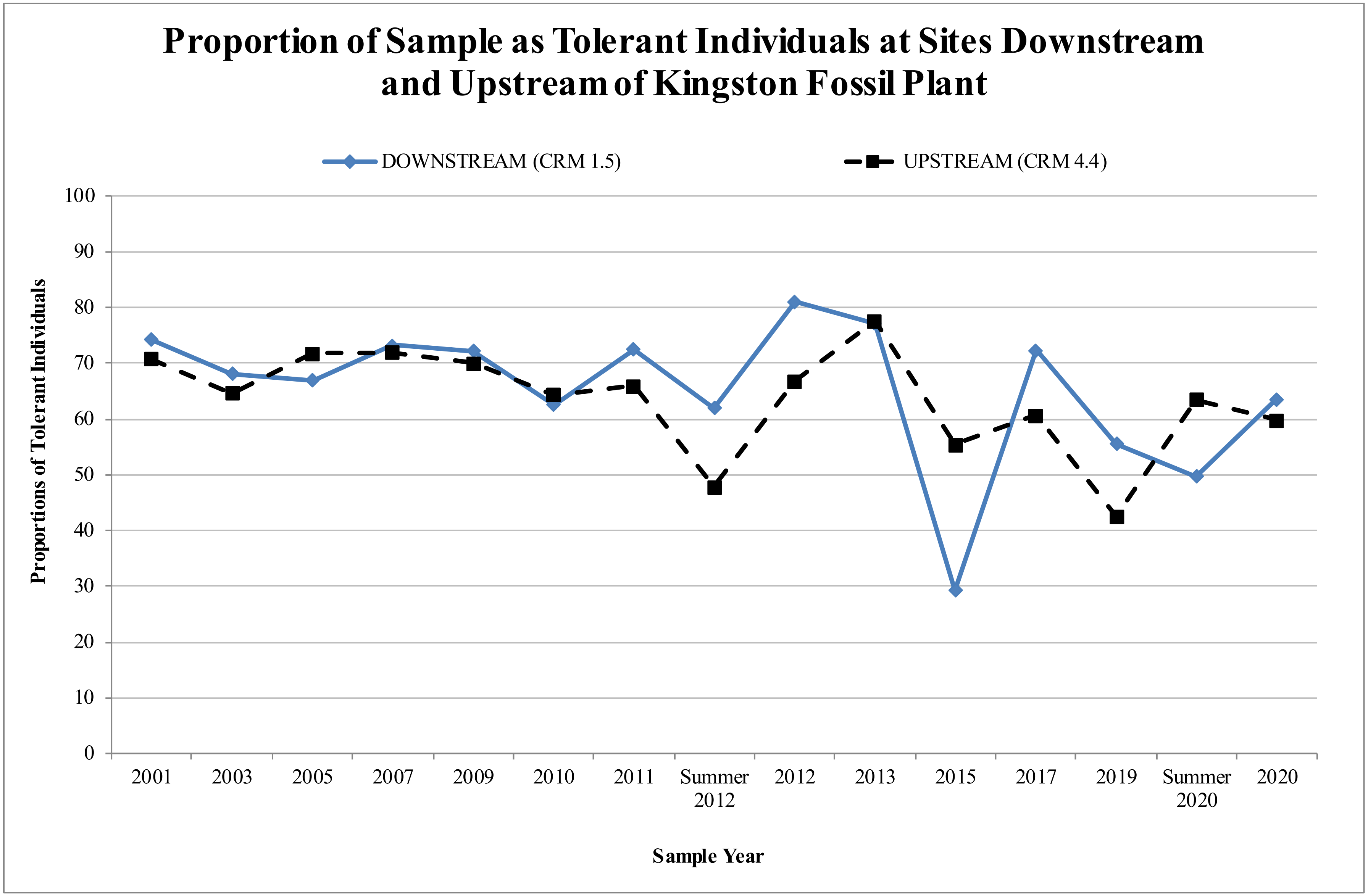


Figure 8. Proportions of tolerant individuals in samples collected during summer 2012 and 2020 and autumn 2001 through 2020 from upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant, as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir

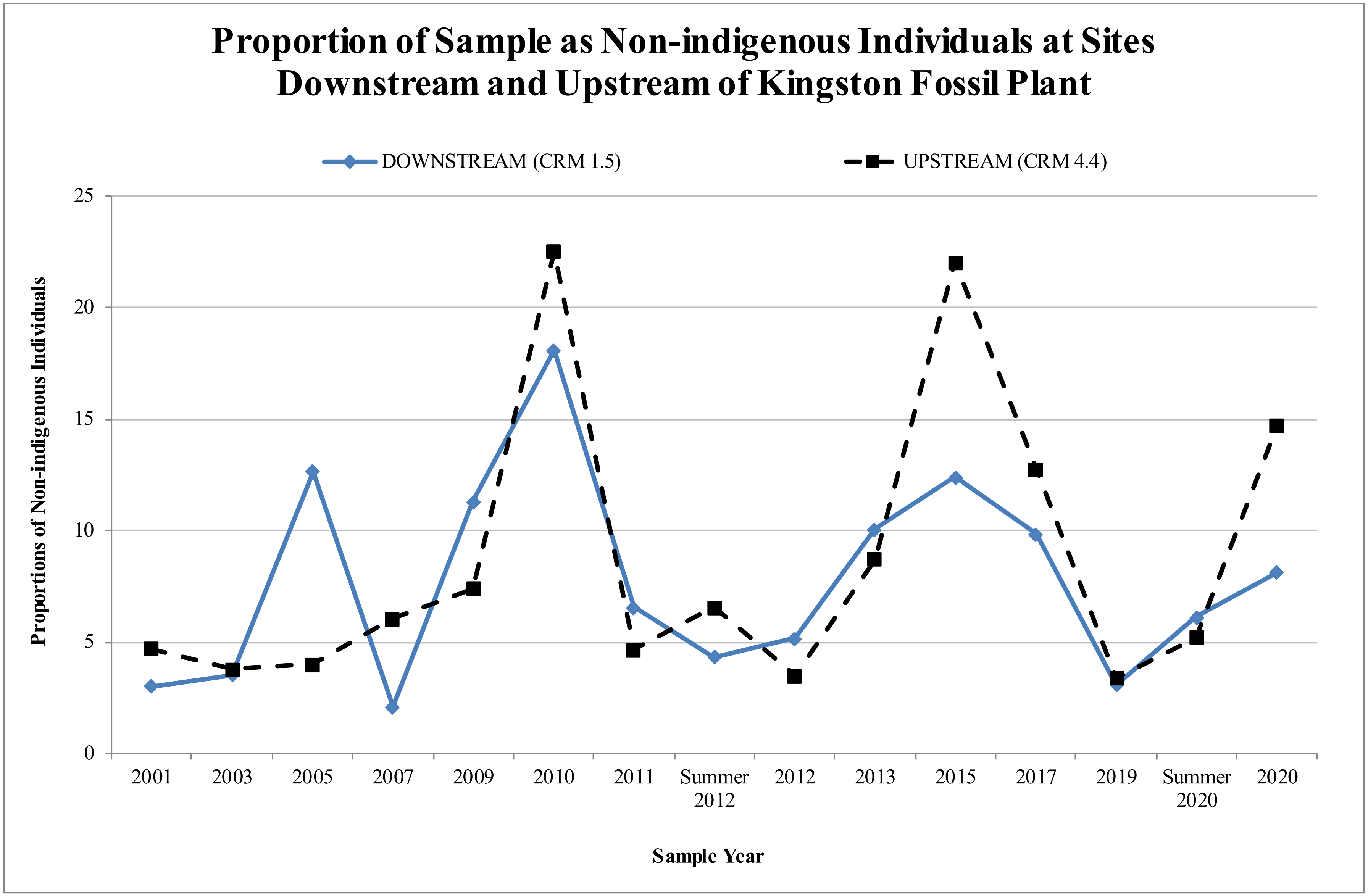


Figure 9. Proportions of non-indigenous individuals in samples collected during summer 2012 and 2020 and autumn 2001 through 2020 from upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant, as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir

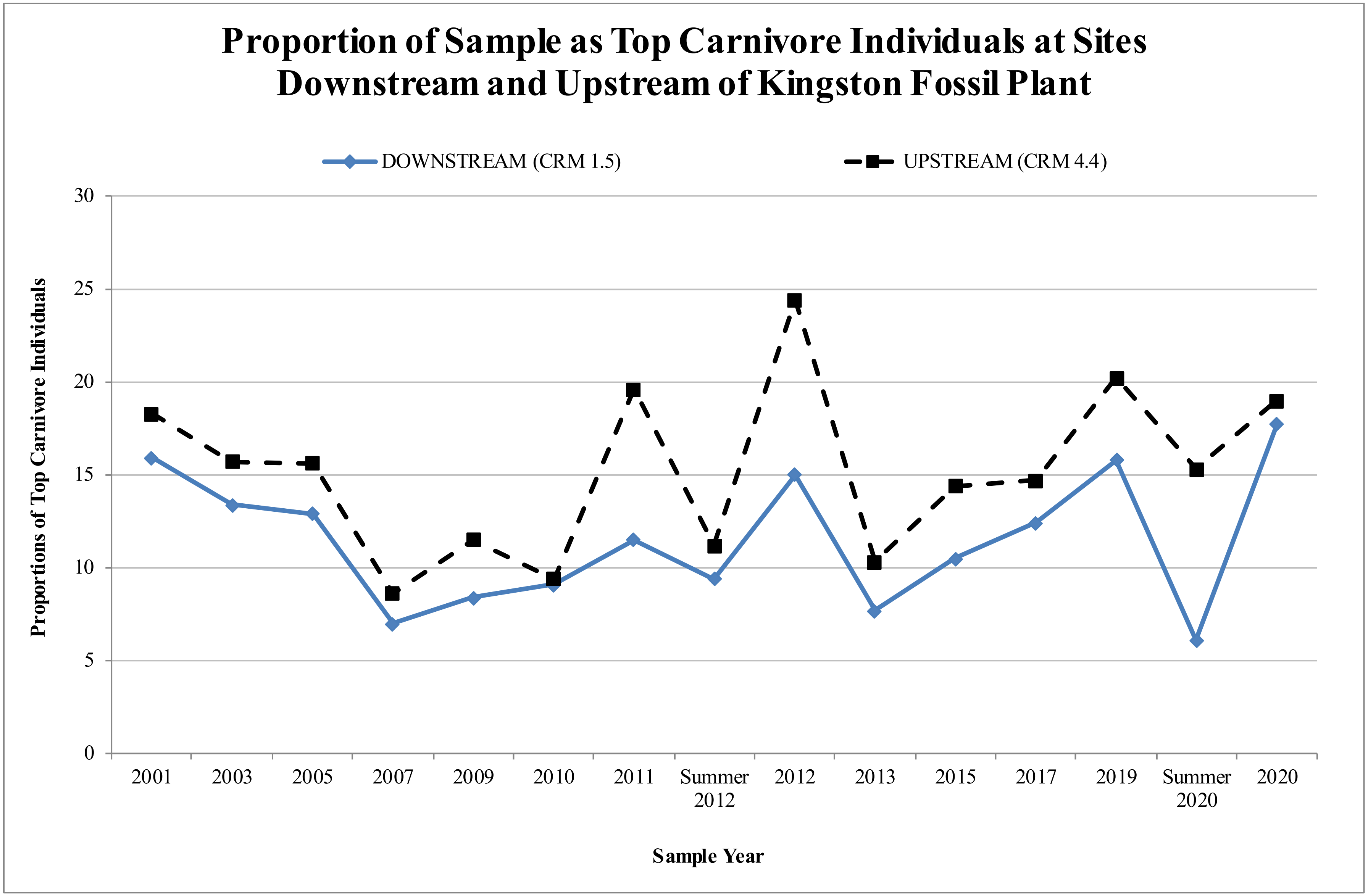


Figure 10. Proportions of top carnivore individuals in samples collected during summer 2012 and 2020 and autumn 2001 through 2020 from upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant, as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir

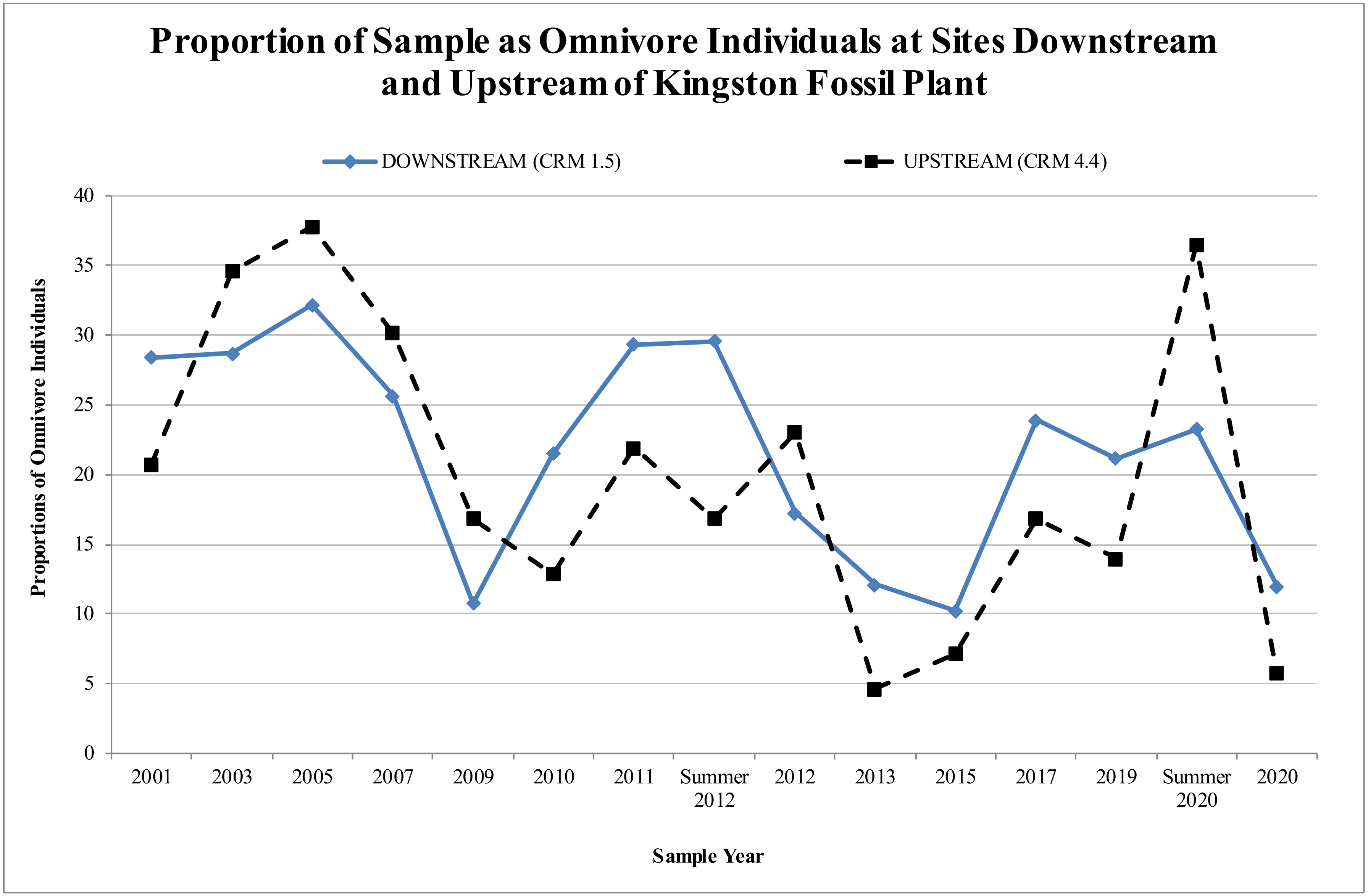


Figure 11. Proportions of omnivore individuals in samples collected during summer 2012 and 2020 and autumn 2001 through 2020 from upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant, as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir

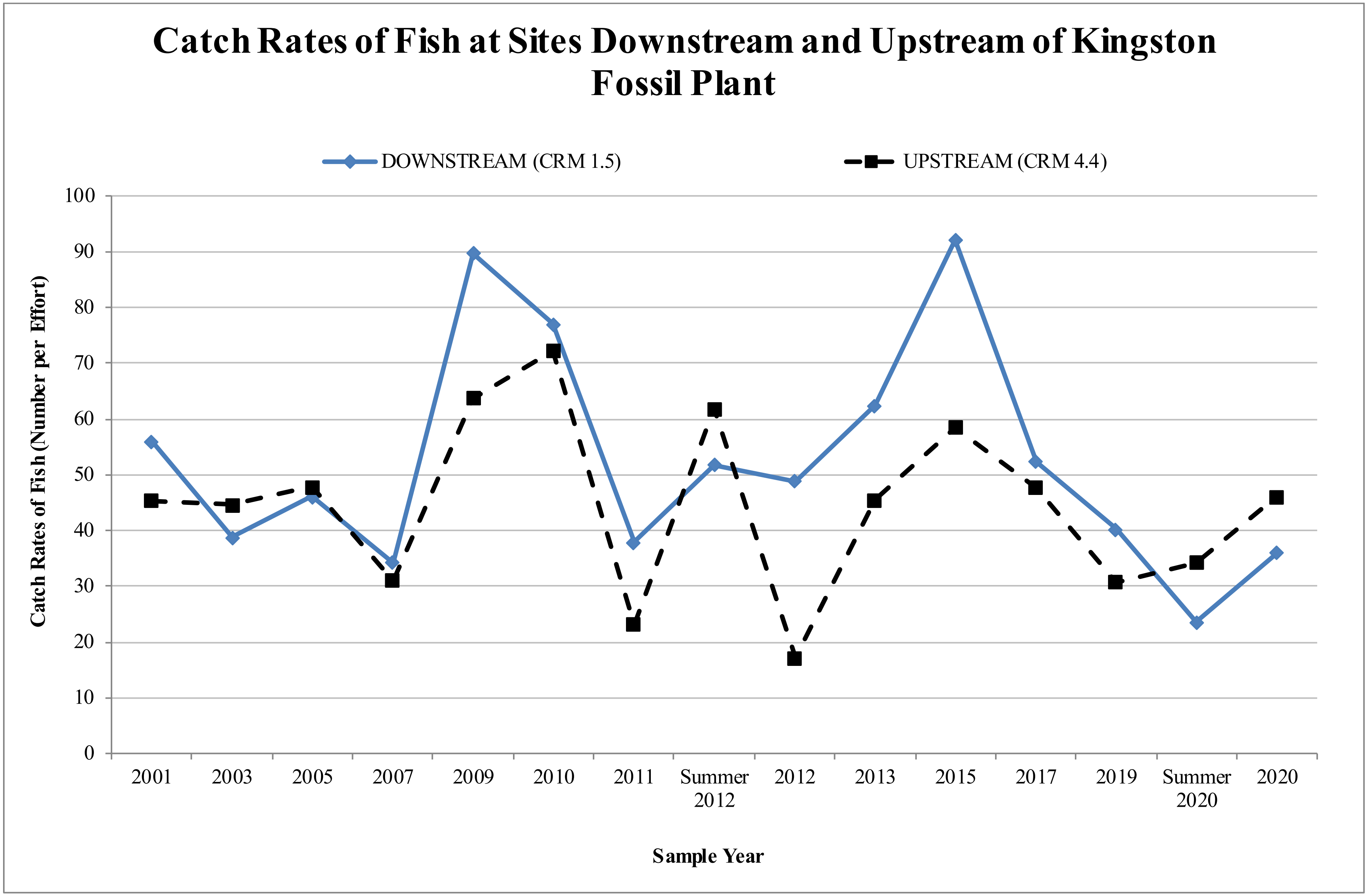
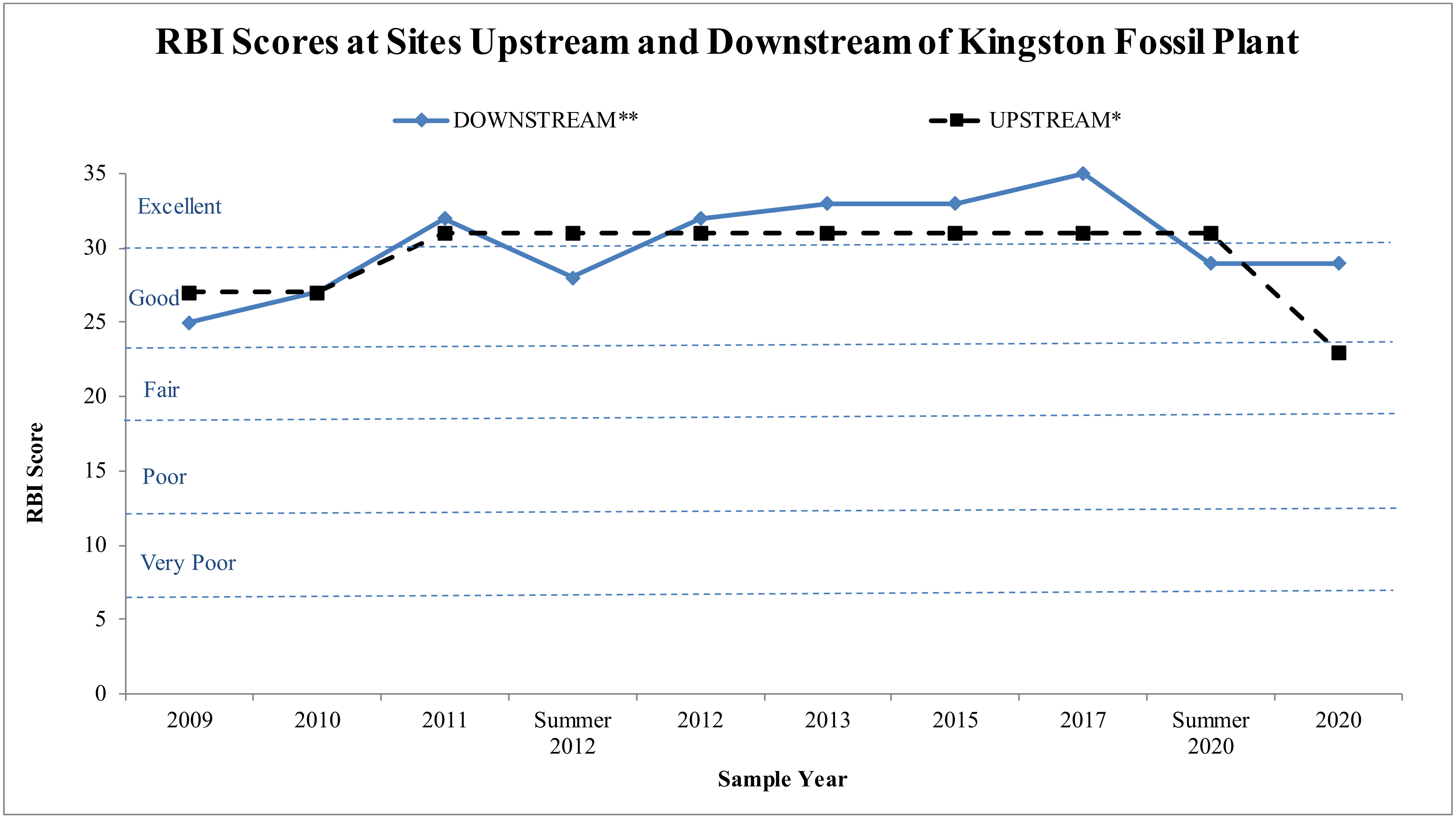


Figure 12. Catch rates of fish (number per effort) in samples collected during summer 2012 and 2020 and autumn 2001 through 2020 from upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant, as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir



*Upstream transect located at CRM 3.0 in 2009 and 2011, at CRM 3.5 in 2010, and at CRM 3.75 in 2012, 2013, 2015, 2017, and summer and autumn 2020. **Downstream is average of two transects–one located within thermal plume at CRM 2.2 and one at CRM 1.5

Figure 13. Reservoir Benthic Index (RBI) scores and ratings from sites located directly upstream* and downstream of Kingston Fossil plant (KIF; CRM 2.9) conducted during autumn samples from 2009 through 2020 and during summer 2012 and 2020 (lab-processed data) as part of the Reservoir Ecological Health Monitoring Program in Watts Bar Reservoir

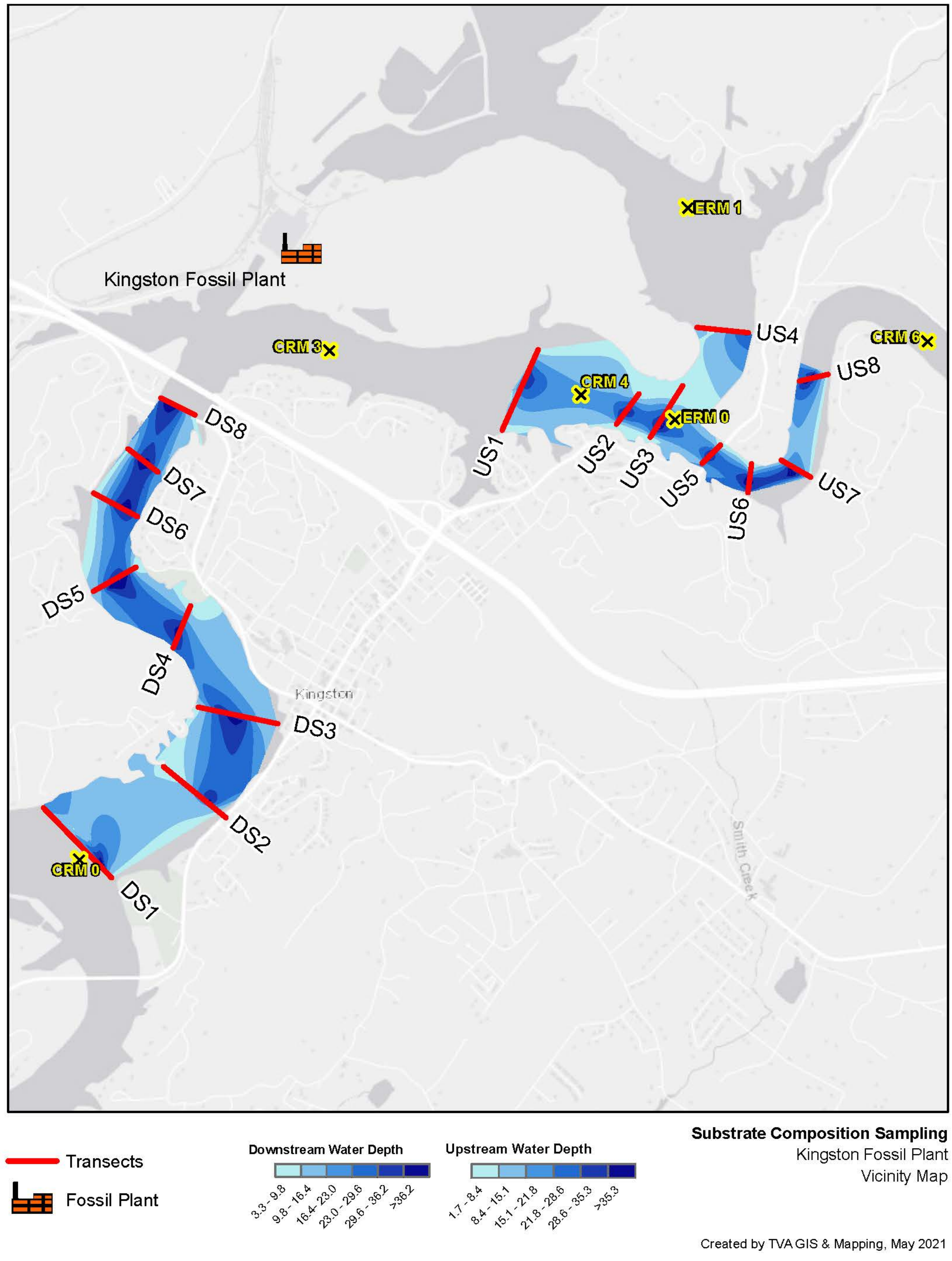


Figure 14. Transects established upstream and downstream of Kingston Fossil plant for the integrative multi-metric aquatic shoreline and river bottom habitat assessment

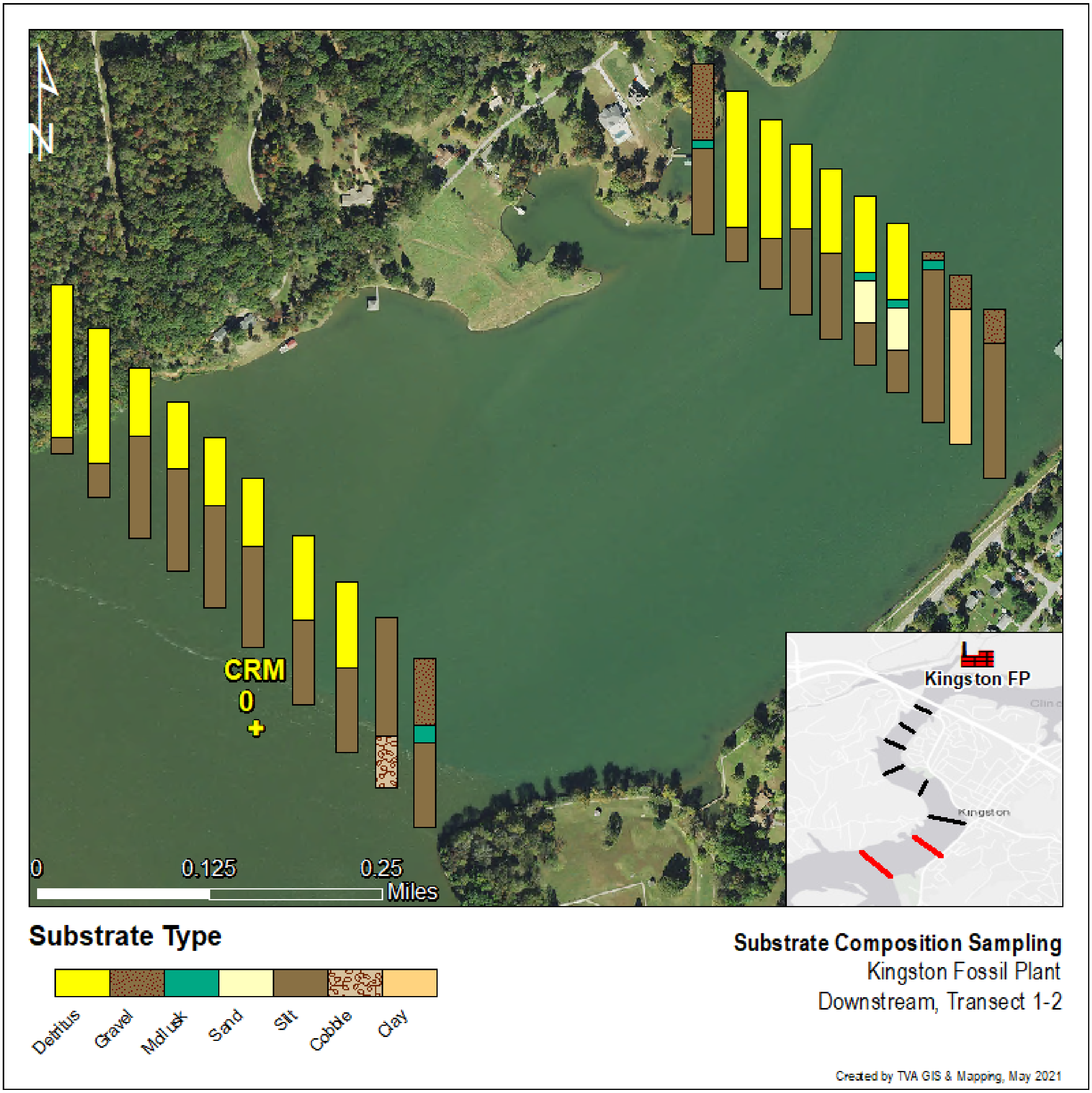


Figure 15. Substrate composition at ten equally spaced points per transect (Transects 1 and 2 shown) across the Clinch River (Watts Bar Reservoir) downstream of KIF, autumn 2020

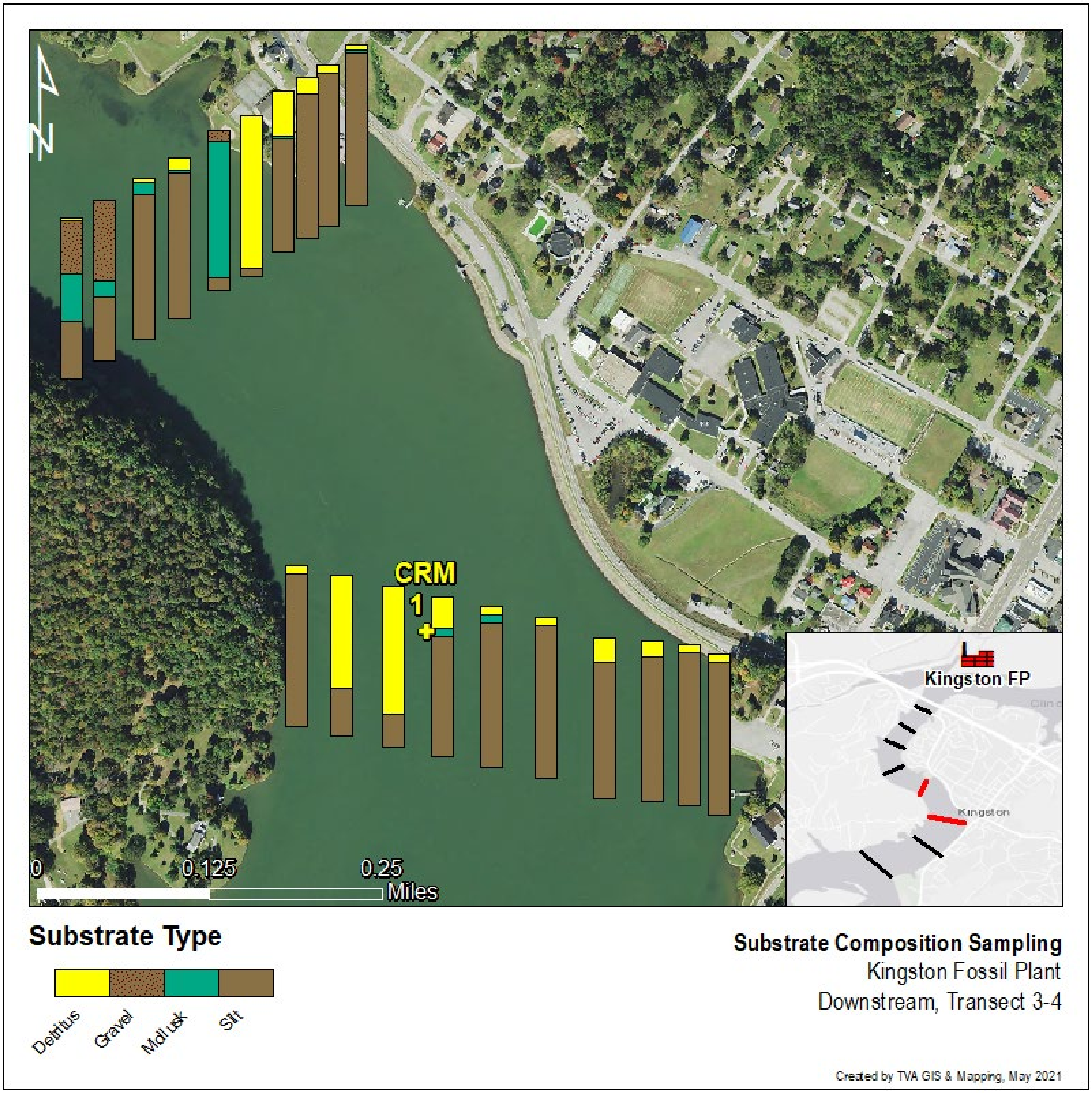


Figure 16. Substrate composition at ten equally spaced points per transect (Transects 3 and 4 shown) across the Clinch River (Watts Bar Reservoir) downstream of KIF, autumn 2020

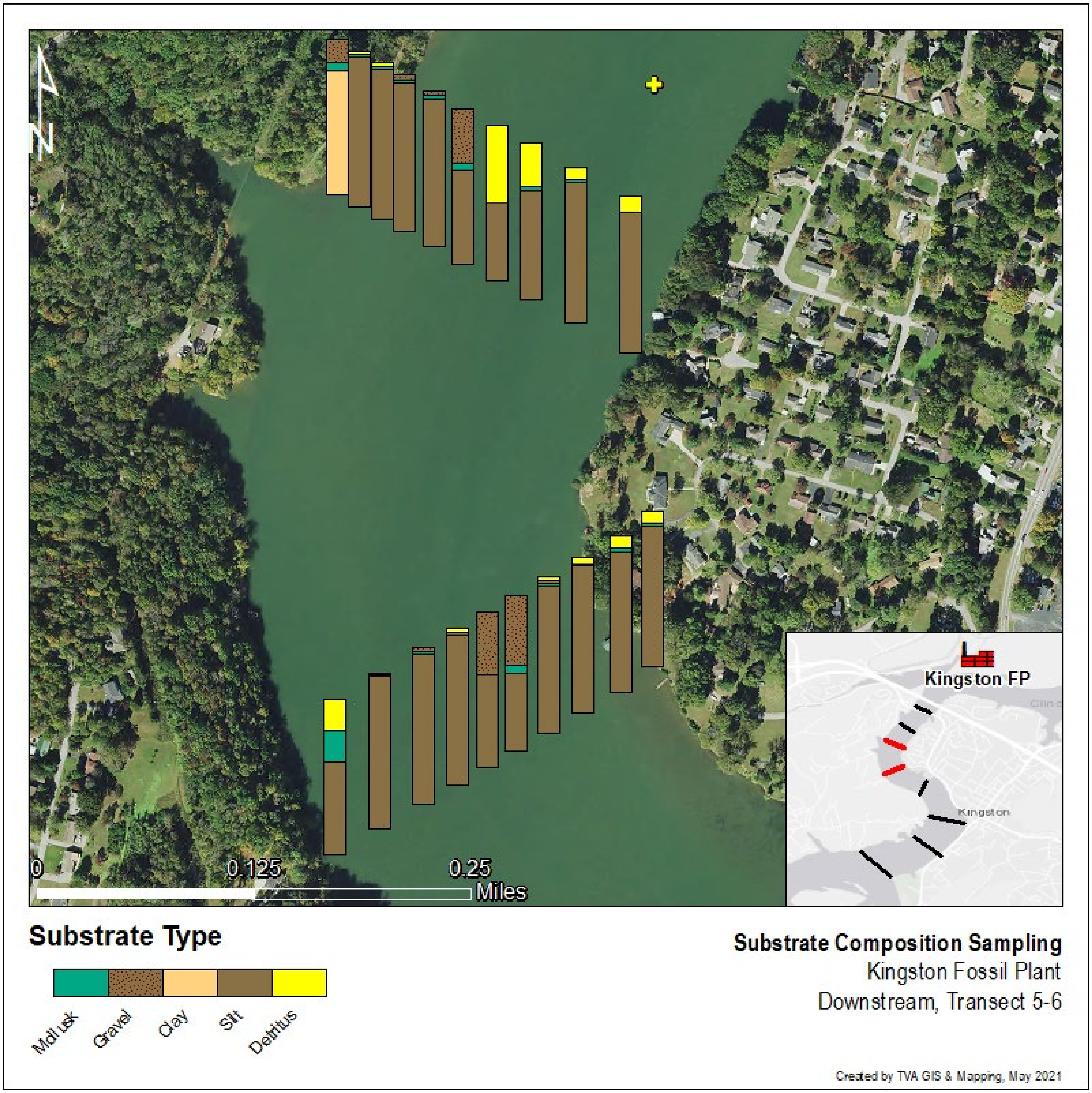


Figure 17. Substrate composition at ten equally spaced points per transect (Transects 5 and 6 shown) across the Clinch River (Watts Bar Reservoir) downstream of KIF, autumn 2020

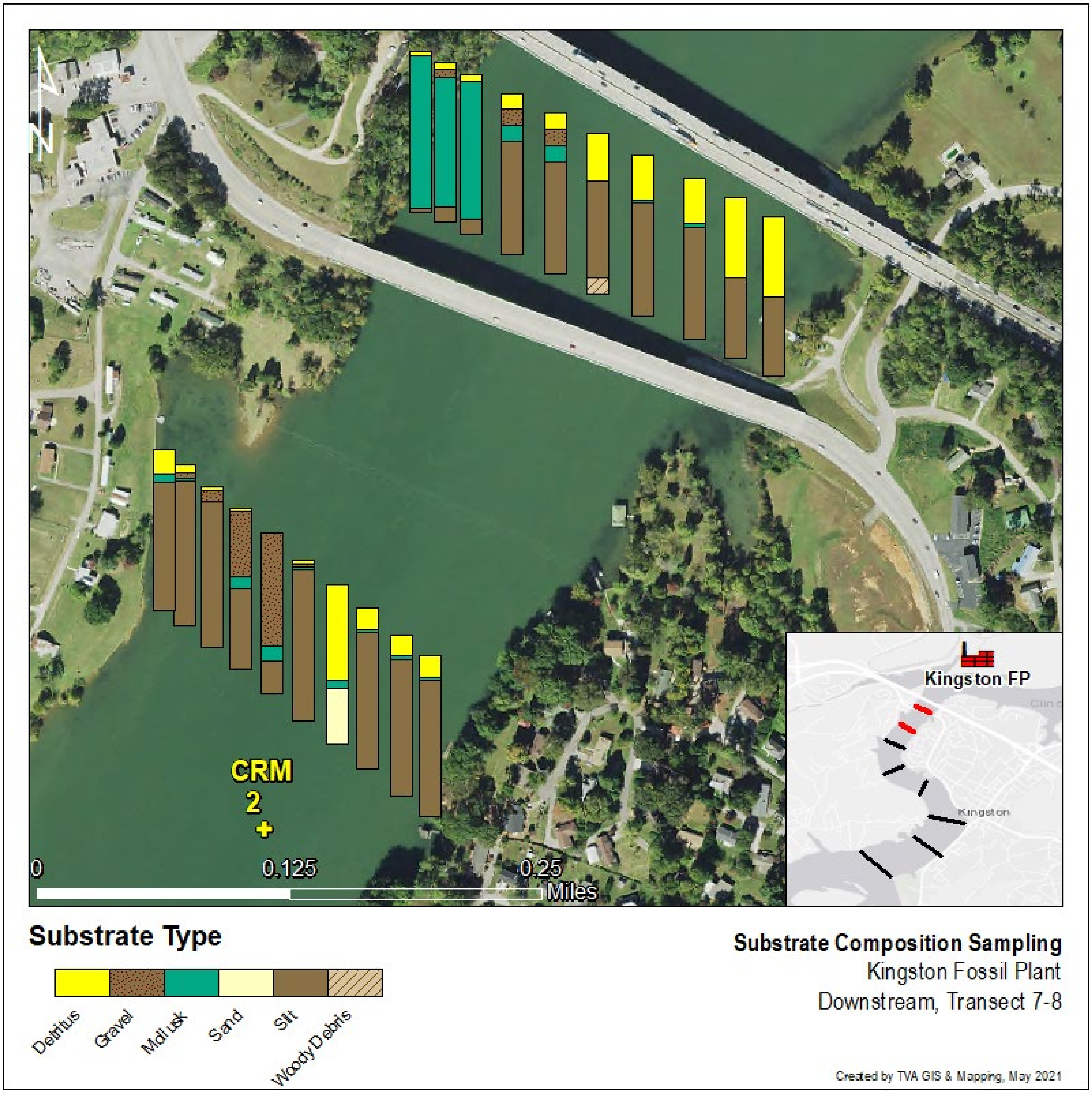


Figure 18. Substrate composition at ten equally spaced points per transect (Transects 7 and 8 shown) across the Clinch River (Watts Bar Reservoir) downstream of KIF, autumn 2020

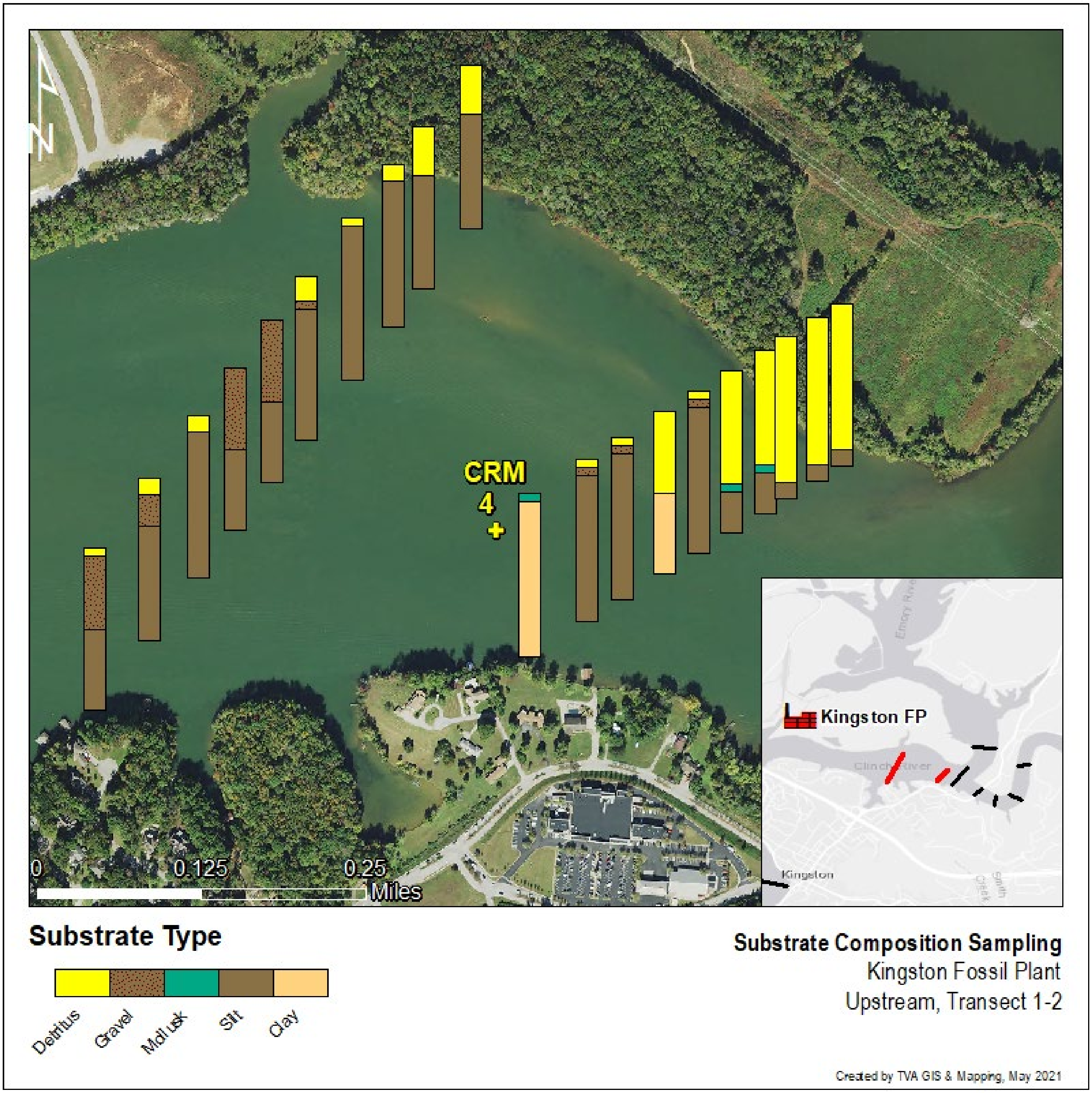


Figure 19. Substrate composition at ten equally spaced points per transect (Transects 1 and 2 shown) across the Clinch River (Watts Bar Reservoir) upstream of KIF, autumn 2020

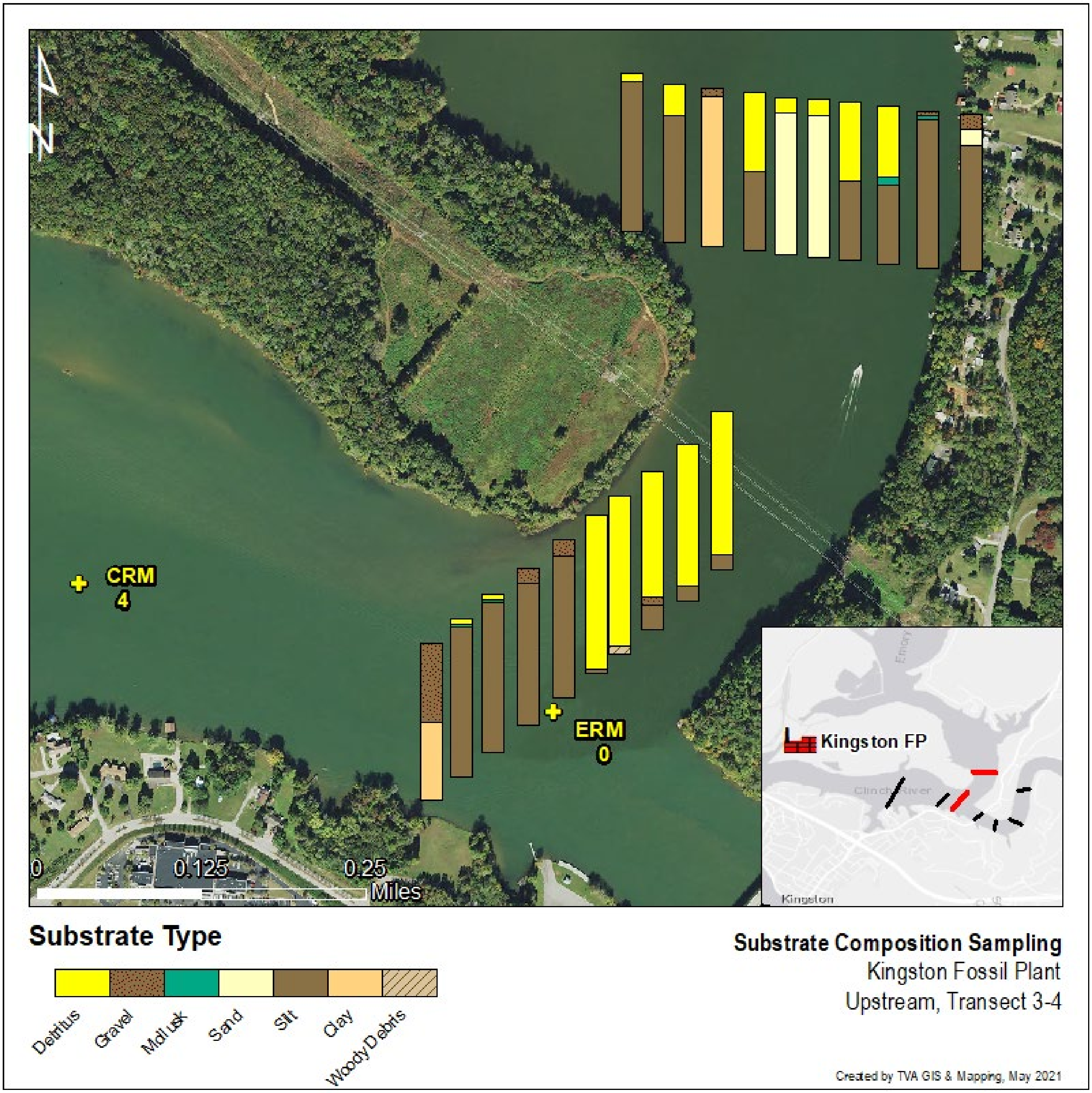


Figure 20. Substrate composition at ten equally spaced points per transect (Transects 3 and 4 shown) across the Clinch River (Watts Bar Reservoir) upstream of KIF, autumn 2020

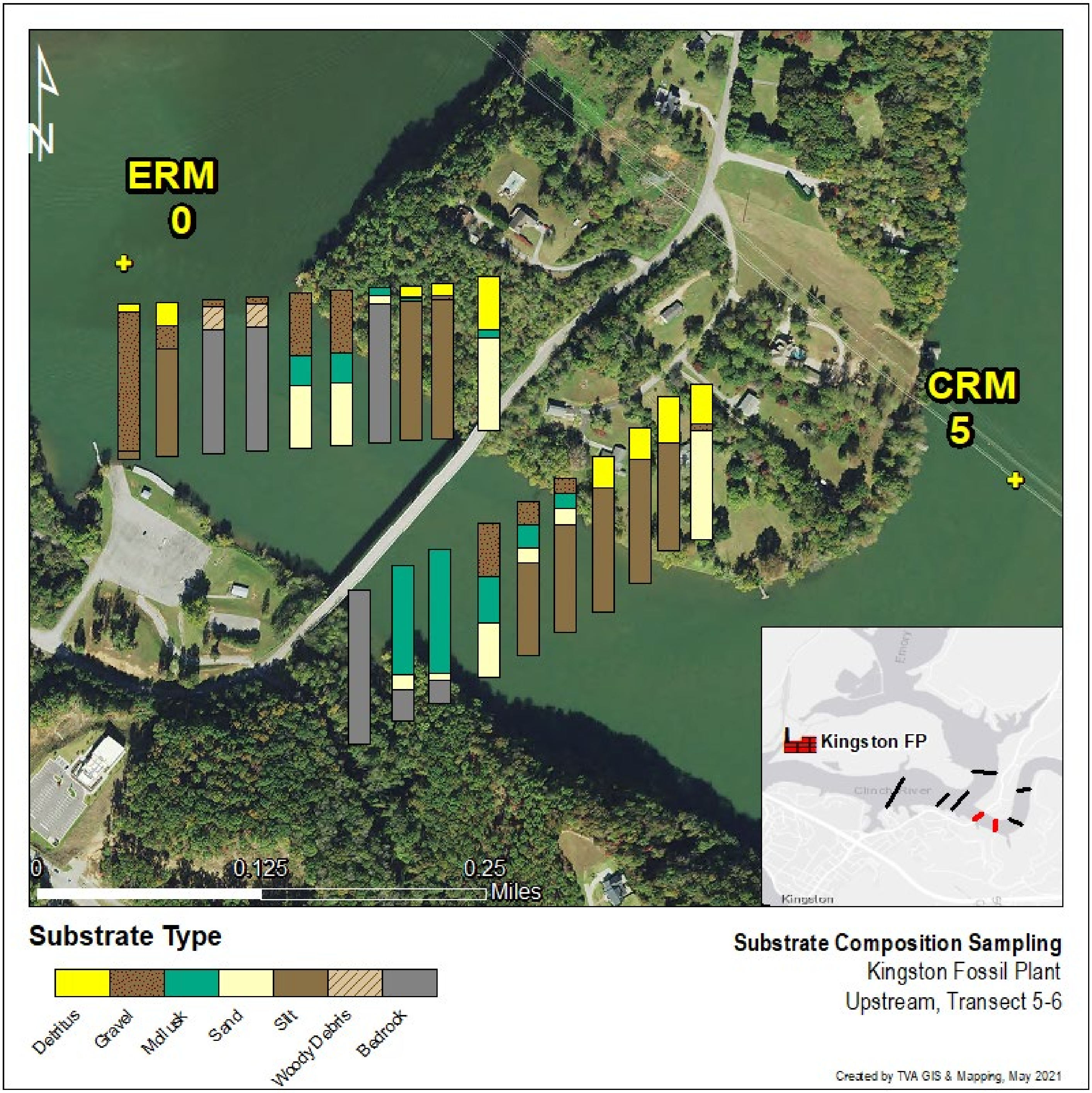


Figure 21. Substrate composition at ten equally spaced points per transect (Transects 5 and 6 shown) across the Clinch River (Watts Bar Reservoir) upstream of KIF, autumn 2020

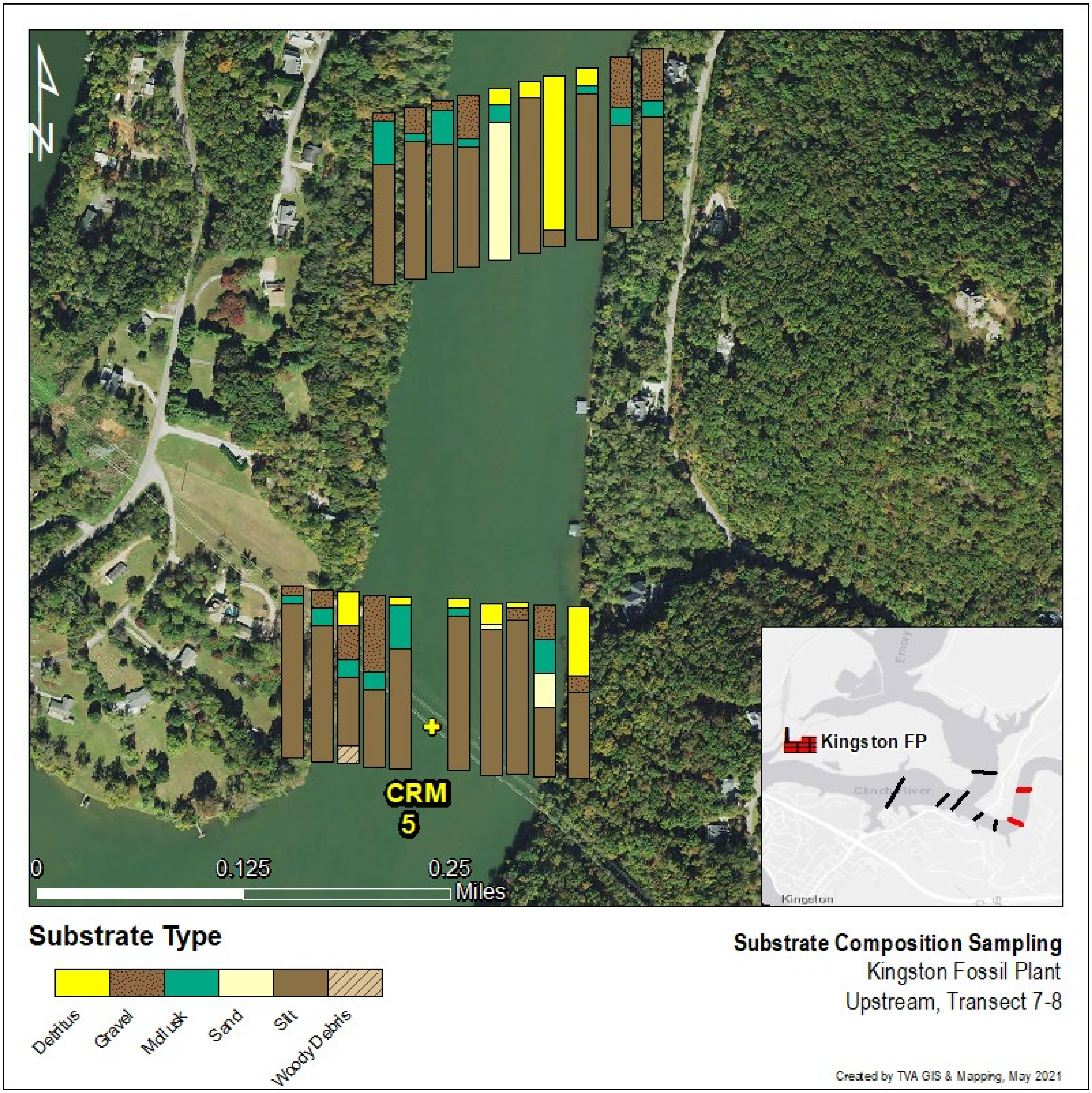


Figure 22. Substrate composition at ten equally spaced points per transect (Transects 7 and 8 shown) across the Clinch River (Watts Bar Reservoir) upstream of KIF, autumn 2020

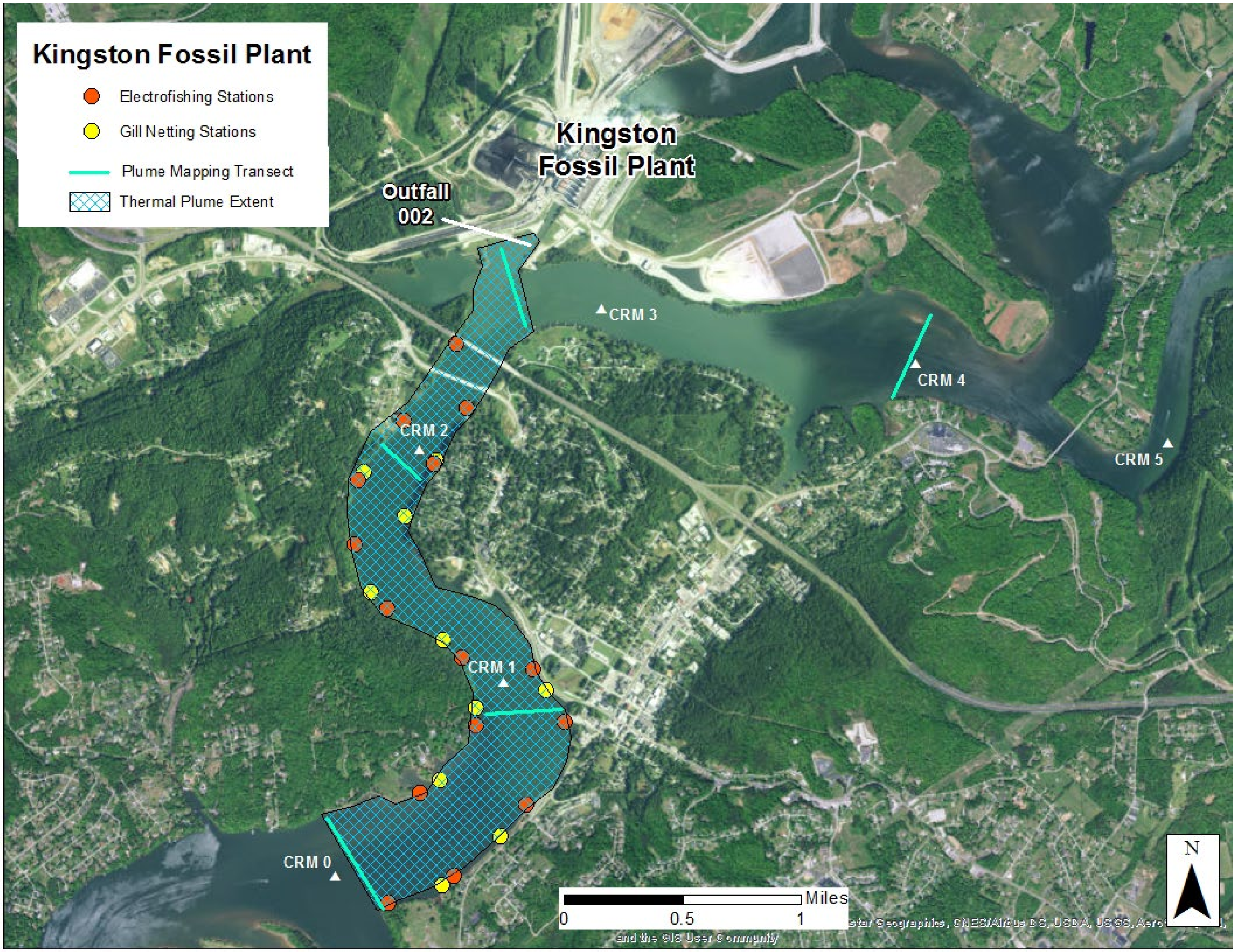


Figure 23. Extent of the KIF thermal plume and placement of § 316(a) biological sampling stations in the Clinch River arm of Watts Bar Reservoir {Source data collected during autumn 2012 when KIF was operating at near full plant capacity}

TABLES

Table 1. Seasonal Reservoir Fish Assemblage Index (RFAI) scores from fish community monitoring (including one noted summer sample) from autumn 2001 through 2020 and summer 2012 and 2020 in sample reaches directly upstream and downstream of Kingston Fossil Plant (CRM 3.4) on Watts Bar Reservoir

	RFAI Scores		
Year	**Downstream (CRM 1.5)**	**Upstream (CRM 4.4)**	**Difference**
2001	42	45	3
2003	44	42	2
2005	41	44	3
2007	34	36	2
2009	36	38	2
2010	42	42	0
2011	36	44	8
Summer 2012	40	44	4
2012	41	43	2
2013	41	44	3
2015	47	43	4
2017	41	45	4
2019	46	46	0
Summer 2020	43	42	1
2020	39	42	3
Summer AVG	42	43	3
Autumn AVG	41	43	3

***12-21 "Very Poor"; 22-31 "Poor"; 32-40 "Fair"; 41-50 "Good"; 51-60 "Excellent"**

Table 2. Comparison of RFAI scores and select metrics (gear types combined) for fish collected upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during autumn from 2001 through 2020 and during summer 2012 and 2020

Metrics	2001	2003	2005	2007	2009	2010	2011	Summer 2012	2012	2013	2015	2017	2019	Summer 2020	2020	Summer Average	Autumn Average
DOWNSTREAM (CRM 1.5)																	
RFAI Score	42	44	41	34	36	42	36	40	41	41	47	41	46	43	39	42	41
1. Number of species	32	32	30	24	27	34	26	31	33	31	36	34	32	28	28	29	31
2. Number of centrarchid species (excluding *Micropterus* spp.)	8	7	7	6	8	7	8	7	8	8	8	7	8	6	6	7	8
3. Number of benthic invertivores	3	4	4	2	3	4	3	5	5	5	5	5	5	5	5	5	4
4. Number of intolerant species	5	6	7	3	5	6	5	6	8	7	7	7	6	6	6	6	6
5. Percent tolerant individuals	74.3	68.2	67.0	73.2	72.2	62.6	72.5	61.9	81.0	77.2	29.2	72.3	55.6	49.7	63.5	55.8	67.1
6. Percent dominance by 1 species	38.6	37.7	28.6	42.4	43.3	36.6	33.6	30.0	44.6	49.5	45.7	28.1	26.4	16.0	28.5	23.0	37.9
7. Percent non-native species	3.0	3.5	12.7	2.1	11.3	18.1	6.5	4.3	5.2	10.1	12.4	9.8	3.1	6.1	8.1	5.2	8.1
8. Number of top carnivore species	11	12	11	10	10	12	10	10	11	9	12	12	11	8	7	9	11
9. Percent top carnivores	15.9	13.4	12.9	7.0	8.4	9.1	11.5	9.4	15.0	7.7	10.5	12.4	15.8	6.1	17.7	7.7	11.6
10. Percent omnivores	28.4	28.7	32.2	25.6	10.8	21.5	29.3	29.6	17.3	12.1	10.2	23.9	21.2	23.3	12.0	26.4	21.8
11. Average number per run	56.0	38.7	46.1	34.3	89.7	77.0	37.9	51.7	48.9	62.4	92.1	52.4	40.2	23.6	36.0	37.6	56.3
12. Percent anomalies	0.9	0.1	0.5	0.1	4.0	1.1	3.0	0.3	0.9	0.8	0.3	0.8	5.4	0.8	4.0	0.6	1.5
UPSTREAM (CRM 4.4)																	
RFAI Score	45	42	44	36	38	42	44	44	43	44	43	45	46	42	42	43	43
1. Number of species	31	33	29	28	27	32	26	31	27	30	33	34	33	33	29	32	30
2. Number of centrarchid species (excluding *Micropterus* spp.)	5	5	4	4	4	5	4	6	4	4	6	4	5	4	4	5	5
3. Number of benthic invertivores	4	4	6	4	2	4	3	4	3	6	5	5	7	6	4	5	4
4. Number of intolerant species	6	7	7	5	6	6	5	5	5	7	8	7	8	7	7	6	6
5. Percent tolerant individuals	70.7	64.6	71.8	71.9	70.1	64.2	65.9	47.8	66.7	77.6	55.4	60.6	42.5	63.4	59.7	55.6	65.2
6. Percent dominance by 1 species	42.7	26.7	33.1	39.3	33.8	42.4	28.2	28.7	24.7	42.9	36.9	20.8	24.1	23.2	34.6	25.9	33.0
7. Percent non-native species	4.7	3.8	4.0	6.1	7.4	22.5	4.7	6.5	3.5	8.7	22.0	12.8	3.4	5.2	14.7	5.9	8.6
8. Number of top carnivore species	10	12	10	9	10	12	9	13	10	8	11	12	10	13	10	13	10
9. Percent top carnivores	18.3	15.7	15.6	8.6	11.5	9.4	19.6	11.2	24.4	10.3	14.4	14.7	20.2	15.3	19.0	13.2	15.2
10. Percent omnivores	20.8	34.6	37.8	30.2	16.9	12.9	21.9	16.8	23.0	4.7	7.2	16.9	14.0	36.5	5.7	26.7	20.1
11. Average number per run	45.3	44.6	47.8	31.0	63.8	72.2	23.2	61.8	17.2	45.5	58.5	47.6	30.8	34.3	46.0	48.1	44.0
12. Percent anomalies	1.4	0.2	1.3	0.4	2.9	0.9	7.9	0.2	2.8	0.5	0.1	0.9	1.7	1.0	1.8	0.6	1.8

Table 3. Statistical analyses of RFAI scores, observed values for each RFAI metric, and species and abundances of trophic guilds and tolerant fish collected upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during summer 2012 and 2020 and autumn 2001 through 2020

	Mean		Standard Deviation			
	Upstream (CRM 4.4)	Downstream (CRM 1.5)	Upstream (CRM 4.4)	Downstream (CRM 1.5)	P-value	Significant Difference?
RFAI Score	42.7	40.9	2.6	3.6	0.26	No
1. Number of species	28.8	30.5	6.0	3.3	0.57	No
2. Number of centrarchid species (excluding *Micropterus* spp.)	4.3	7.3	1.2	0.8	<0.0001	Yes
3. Number of benthic invertivores	4.1	4.2	1.6	1.0	0.89	No
4. Number of intolerant species	6.0	6.0	1.7	1.2	0.76	No
5. Percent tolerant individuals	65.7	65.4	12.6	13.0	0.94	No
6. Percent dominance by one species	33.3	35.3	7.4	9.1	0.51	No
7. Percent non-indigenous species	8.4	7.8	6.7	4.6	0.98	No
8. Number of top carnivore species	9.9	10.4	2.6	1.5	0.59	No
9. Percent top carnivores	15.8	11.5	5.0	3.6	0.01	Yes
10. Percent omnivores	21.1	21.7	13.1	7.6	0.56	No
11. Average number per run	44.6	52.5	15.5	20.2	0.24	No
12. Percent anomalies	1.6	1.5	1.9	1.7	0.66	No
Number of insectivore species	10.6	10.7	1.3	1.6	0.98	No
Number of omnivore species	6.9	7.3	0.9	0.9	0.20	No
Number of planktivore species	0.9	1.0	0.5	0.5	0.74	No
Number of benthic invertivore individuals	61.5	52.8	36.9	31.3	0.69	No
Number of insectivore individuals	651.9	742.5	329.7	401.3	0.53	No
Number of omnivore individuals	209.0	266.0	117.9	93.8	0.15	No
Number of planktivore individuals	132.5	94.9	496.7	271.1	0.88	No
Number of top carnivore individuals	158.8	154.5	43.9	45.3	0.80	No
Total number of individuals	981.6	1195.5	337.2	418.5	0.14	No
Number of tolerant species	8.5	9.3	0.8	1.1	0.05	Yes
Number of tolerant individuals	705.4	843.2	258.0	330.7	0.21	No

β - Comparing two population means from normally distributed independent samples. n1=n2=15, degree of freedom=n1+n2-2=28, α=0.05, tα/2=2.048. H_o: $\mu1=\mu2$; H_o rejected if t>tα/2.

γ - Non-parametric Wilcoxon Rank Sum test on large independent samples. α=0.05, zα/2=1.96. H_o: two sampled populations have identical probability distributions. H_o rejected if P<α or |z|>zα/2

Table 4. Numbers of indigenous species and numbers of individuals representing each trophic guild in fish samples collected downstream (CRM 1.5) and upstream (CRM 4.4) of Kingston Fossil Plant during summer 2012 and 2020 and autumn 2001 through 2020

	2001		2003		2005		2007		2009		2010		2011		Sum. 2012		2012		2013		2015		2017		2019		Sum. 2020		2020		Sum. Avg.		Aut. Avg.	
# Species	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U	D	U
BI	3	5	4	5	4	7	2	5	3	3	4	5	3	4	5	4	5	4	5	7	5	6	5	6	5	7	5	6	5	5	5	5	4	5
HB	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
IN	8	9	8	8	8	7	6	7	7	8	7	8	7	8	9	7	9	7	10	9	11	9	10	10	7	9	8	6	9	8	9	7	8	8
OM	8	7	6	8	6	6	5	6	6	5	7	6	5	5	6	6	7	5	5	6	7	5	6	6	7	5	7	7	6	5	7	7	6	6
PK	2	1	2	1	1	0	1	1	1	1	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1
PS	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
TC	11	10	12	12	11	10	10	9	10	10	12	12	10	9	10	13	11	10	9	8	12	11	12	12	11	10	8	13	7	10	9	13	11	10
Total	32	32	32	34	30	30	24	28	27	27	34	33	26	27	31	31	33	27	31	31	36	33	34	35	32	33	28	33	28	29	30	32	31	31
# Indiv.																																		
BI	29	26	48	86	33	105	9	29	27	25	29	45	66	33	32	58	48	24	38	44	73	156	55	63	74	60	117	75	114	93	75	67	49	61
HB	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0
IN	739	653	506	465	491	442	565	416	1549	1018	959	990	450	266	548	541	727	195	1079	849	437	695	676	618	380	415	172	290	452	611	360	416	693	587
OM	378	192	257	364	349	425	213	221	227	250	400	213	259	113	368	239	198	87	164	26	225	85	299	195	211	106	126	309	101	80	247	274	252	181
PK	4	2	2	2	3	0	1	5	1	4	17	1	4	11	179	438	7	5	2	7	1053	8	4	1	150	7	0	8	1	1	90	223	96	4
PS	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
TC	206	205	121	157	131	175	52	58	185	179	165	147	104	108	109	168	180	104	118	112	230	194	147	162	158	156	97	86	109	146	103	127	147	146
Total	1356	1078	934	1074	1007	1147	840	729	1989	1476	1576	1397	883	531	1236	1444	1160	415	1402	1038	2018	1139	1181	1039	974	745	512	682	777	931	874	1063	1238	980

Table 5. Numbers of indigenous species and total mean densities per square meter (m²) of each functional feeding group[1] represented in benthic macroinvertebrates collected downstream and upstream of KIF for years sampled, 2010 and forward. All years represent the autumn season except when specified for summer

		2010		2011			Summer 2012			Autumn 2012			2013			2015			2017			Summer 2020			Autumn 2020			AUT. Average	
		CRM 1.5	CRM 3.5	CRM 1.5	CRM 2.2	CRM 3.5	CRM 1.5	CRM 2.2	CRM 3.5	CRM 1.5	CRM 2.2	CRM 3.75	CRM 1.5	CRM 2.2	CRM 3.75	CRM 1.5	CRM 2.2	CRM 3.75	CRM 1.5	CRM 2.2	CRM 3.75	CRM 1.5	CRM 2.2	CRM 3.75	CRM 1.5	CRM 2.2	CRM 3.75		
		D	U	D	U	D	D	D	U	D	D	U	D	D	U	D	D	U	D	D	U	D	D	U	D	D	U	D	U
# Species	CF	3	4	3	4	6	4	4	5	5	6	5	5	2	5	2	6	4	3	6	6	4	6	5	4	3	6	**5**	**4**
	CG	6	11	12	21	13	12	14	15	10	19	19	22	14	23	10	12	11	11	18	17	13	16	17	21	15	25	**17**	**15**
	PA	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	**0.1**	**0**
	PR	7	9	7	11	8	9	10	8	8	10	10	12	10	9	10	9	10	12	13	9	12	12	10	10	11	12	**10**	**10**
	SC	2	3	1	2	2	1	1	3	2	2	4	3	2	4	3	2	3	2	2	3	6	5	6	6	3	4	**3**	**2**
	SH	1	2	1	1	2	1	2	2	1	3	1	2	2	2	2	2	1	2	4	3	1	1	2	3	2	2	**2**	**2**
	PI	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	1	0	1	0	0	**0.1**	**0**
	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	**0.1**	**0**
	Sum	**19**	**29**	**24**	**40**	**31**	**27**	**31**	**33**	**26**	**40**	**39**	**44**	**31**	**45**	**27**	**31**	**29**	**31**	**43**	**38**	**37**	**41**	**40**	**45**	**35**	**50**	**37**	**34**
Total Mean Density/m²	CF	122	73	400	265	347	202	243	1157	515	322	487	1218	555	478	293	178	863	672	288	438	308	60	53	33	92	143	**404**	**381**
	CG	398	398	1072	1148	1312	648	725	552	695	985	868	950	747	1235	1273	1162	952	542	1255	827	632	663	548	1643	848	983	**939**	**978**
	PA	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	3	0	0	0	0	0	**0.3**	**0**
	PR	243	252	312	307	407	330	382	328	327	478	373	367	315	445	278	223	298	310	478	330	357	517	362	423	463	248	**336**	**348**
	SC	5	27	2	3	3	10	15	25	5	10	73	13	20	53	17	22	93	5	27	215	22	142	277	38	120	148	**87**	**22**
	SH	3	12	35	52	37	103	185	142	23	77	42	90	17	30	28	23	28	48	75	32	80	38	23	38	13	27	**30**	**40**
	PI	0	0	0	5	0	0	0	0	0	0	0	0	2	7	0	0	0	2	0	0	0	2	0	3	0	0	**1**	**0.9**
	Other	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2	**0.3**	**0.2**
	Sum	**771**	**762**	**1821**	**1780**	**2106**	**1293**	**1550**	**2204**	**1565**	**1872**	**1843**	**2638**	**1656**	**2250**	**1889**	**1608**	**2234**	**1579**	**2123**	**1842**	**1402**	**1422**	**1263**	**2178**	**1538**	**1551**	**1798**	**1771**
% Composition	% CF	15.8	9.6	22.0	14.9	16.5	15.6	15.7	52.5	32.9	17.2	26.4	46.2	33.5	21.2	15.5	11.1	38.6	42.6	13.6	23.8	21.9	4.2	4.2	1.5	6.0	9.2	**21**	**21**
	% CG	51.6	52.2	58.9	64.5	62.3	50.1	46.8	25.0	44.4	52.6	47.1	36.0	45.1	54.9	67.4	72.3	42.6	34.3	59.1	44.9	45.1	46.6	43.4	75.4	55.1	63.4	**52**	**55**
	% PA	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	**0**	**0**
	% PR	31.5	33.1	17.1	17.2	19.3	25.5	24.6	14.9	20.9	25.5	20.2	13.9	19.0	19.8	14.7	13.9	13.3	19.6	22.5	17.9	25.4	36.2	28.7	19.4	30.1	16.0	**20**	**20**
	% SC	0.6	3.5	0.1	0.2	0.1	0.8	1.0	1.1	0.3	0.5	4.0	0.5	1.2	2.4	0.9	1.4	4.2	0.3	1.3	11.7	1.6	10.0	21.9	1.7	7.8	9.5	**5**	**1**
	% SH	0.4	1.6	1.9	2.9	1.8	8.0	11.9	6.4	1.5	4.1	2.3	3.4	1.0	1.3	1.5	1.4	1.3	3.0	3.5	1.7	5.7	2.7	1.8	1.7	0.8	1.7	**2**	**2**
	% PI	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	**0**	**0**
	% Oth	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	**0**	**0**

[1]Functional Feeding Groups: CF-collector/filterer; CG-collector/gatherer; PA-parasitic; PR-predator; SC-scraper; SH-shredder; PI-piercer

'Other' in this presentation represents two caddisfly families, Hydroptilidae and Leptoceridae

Microcrustaceans - Ostracoda, Copepoda, and Cladocera; water mites (Chelicerata); and Insect family Chaoboridae as well as taxa considered to be nonindigenous are not included

Table 6. Comparison of select RFAI metrics (gears combined) for fish collected upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during summer and autumn 2020

	Downstream				Upstream			
Metrics	**Summer**	**Autumn**	**P-value**	**Significant?**	**Summer**	**Autumn**	**P-value**	**Significant?**
RFAI Score	43	39	--	--	42	42	--	--
Number of Indigenous Spp	28	28	0.81	No	33	29	0.98	No
Abundance (# individuals)	549	814	0.01	Yes	852	1,081	0.14	No
Number of Non-Indigenous Spp	4	5	0.89	No	5	5	0.94	No
Number of Benthic Invertivore Spp	5	5	0.81	No	6	5	0.95	No
Number of Intolerant Spp	6	6	0.56	No	6	7	0.04	Yes
Percent Individuals as Omnivores	23.3	12.0	0.01	Yes	36.5	5.7	<0.0001	Yes
Percent Individuals as Tolerant	49.7	63.5	0.98	No	63.4	59.7	0.07	No
Percent Individuals with Anomalies	0.8	4.0	0.21	No	1.0	4.0	0.15	No

Table 7. Observed (Obs.) values and ratings for individual metrics, and total scores (lab-processed) of the benthic macroinvertebrate index for sampling sites upstream and downstream of Kingston Fossil Plant, Watts Bar Reservoir, summer and autumn 2020

	Upstream (CRM 3.75)				Within Thermal Plume (CRM 2.2)				Downstream (CRM 1.5)			
	Summer 2020		Autumn 2020		Summer 2020		Autumn 2020		Summer 2020		Autumn 2020	
Metric	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**
1. Average number of taxa	13.4	5	15.1	5	16.6	5	14.5	5	13.4	5	13.2	5
2. Proportion of samples with long-lived organisms	0.9	3	0.8	3	1.0	5	0.9	3	0.9	3	1.0	5
3. Average number of EPT taxa	2.0	5	0.8	3	1.8	5	1.7	5	1.4	3	1.5	5
4. Average proportion of oligochaete individuals	17.9	3	43.4	1	21.5	3	19.4	3	27.5	1	45.2	1
5. Average proportion of total abundance comprised by the two most abundant taxa	72.5	5	79.7	3	66.1	5	73.5	5	72.9	5	80.1	3
6. Average density excluding chironomids and oligochaetes	768.3	5	510.0	3	603.3	3	718.3	5	720.0	5	348.3	3
7. Zero-samples – proportion of samples containing no organisms	0	5	0	5	0	5	0	5	0	5	0	5
Benthic Index Score		**31**		**23**		**31**		**31**		**27**		**27**
Ecological Health Rating		**Excellent**		**Fair**		**Excellent**		**Excellent**		**Good**		**Good**

Reservoir Benthic Index Score Range: 7-12 (“Very Poor”), 13-18 (“Poor”), 19-23 (“Fair”), 24-29 (“Good”), 30-35 (“Excellent”)

Table 8. Numbers of species and numbers of individuals of indigenous fishes with upper incipient lethal limits (UILT) of 95°F to 102°F (considered "heat tolerant") collected upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during summer 2012 and 2020 and autumn 2001 through 2020

	Number of Species		Number of Individuals	
	Downstream	**Upstream**	**Downstream**	**Upstream**
2001	13	12	1,034	792
2003	13	14	719	788
2005	13	13	818	804
2007	13	14	751	610
2009	13	13	1,705	1,102
2010	13	12	1,210	1,115
2011	12	13	667	333
Summer 2012	13	13	847	750
2012	14	10	862	249
2013	13	10	1,150	826
2015	15	13	658	729
2017	13	15	910	696
2019	11	13	521	438
Summer 2020	12	14	234	442
2020	13	14	477	613
Autumn AVG	**13**	**13**	**883**	**700**

Note: UILTs (sourced from Yoder et al. 2006) known for 73% (38 of 52) of indigenous fish species (Table 9) observed at KIF during 2001 through 2020

Table 9. Relative abundance of fish considered "heat tolerant" (upper incipient lethal limits of 95-102°F) and "heat sensitive" (upper incipient lethal limits ≤ 91°F) collected upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during summer 2012 and 2020 and autumn 2001 through 2020

	Relative Abundance of Heat-Tolerant Species		Relative Abundance of Heat-Sensitive Species	
Year	**Downstream**	**Upstream**	**Downstream**	**Upstream**
2001	76.3	73.5	5.8	3.9
2003	77.0	73.4	4.5	7.2
2005	81.2	70.1	4.1	8.9
2007	89.4	83.7	0.2	3.4
2009	85.7	74.7	3.0	9.1
2010	76.8	79.8	5.8	3.4
2011	75.5	62.7	8.5	6.8
Summer 2012	68.5	51.9	3.2	3.9
2012	74.3	60.0	6.6	7.2
2013	82.0	79.6	5.1	3.7
2015	32.6	64.0	4.1	15.1
2017	77.1	67.0	8.4	9.6
2019	53.5	58.8	9.8	14.8
Summer 2020	42.4	54.4	26.4	20.3
2020	57.9	62.5	14.0	11.3
Autumn AVG	**72.3**	**70.0**	**6.1**	**8.0**

Table 10. For indigenous fishes occurring in the vicinity of Kingston Fossil Plant (based on samples from 2001 through 2020), upper incipient lethal limits (UILT) (Yoder et.al. 2006) and thermal tolerance designations* (heat sensitive/ intermediate/ heat tolerant) used to determine results in Tables 7 and 8

Common Name	UILT (°F)	Thermal Tolerance Designation
Logperch	87	Heat sensitive
Spotted sucker	88	Heat sensitive
Bluntnose minnow	90	Heat sensitive
Emerald shiner	90	Heat sensitive
Greenside darter	90	Heat sensitive
Mooneye	90	Heat sensitive
Northern hog sucker	91	Heat sensitive
Sauger	91	Heat sensitive
Walleye	91	Heat sensitive
Warmouth	91	Heat sensitive
White crappie	91	Heat sensitive
Freshwater drum	92	Intermediate
Golden redhorse	92	Intermediate
Paddlefish	92	Intermediate
Striped shiner	92	Intermediate
Golden shiner	93	Intermediate
Black crappie	94	Intermediate
Largemouth bass	94	Intermediate
Redear sunfish	94	Intermediate
Skipjack herring	94	Intermediate
Smallmouth bass	94	Intermediate
Brook silverside	95	Heat tolerant
Quillback	95	Heat tolerant
River carpsucker	95	Heat tolerant
Rock bass	95	Heat tolerant
Gizzard shad	96	Heat tolerant
Green sunfish	96	Heat tolerant
White bass	96	Heat tolerant
Longear sunfish	97	Heat tolerant
Spotfin shiner	97	Heat tolerant
Spotted bass	97	Heat tolerant
Bluegill	98	Heat tolerant
Blue catfish	99	Heat tolerant
Bullhead minnow	99	Heat tolerant
Smallmouth buffalo	99	Heat tolerant
Flathead catfish	100	Heat tolerant
Longnose gar	100	Heat tolerant
Channel catfish	101	Heat tolerant

Table 10. (Continued)

Common Name	UILT (°F)	Thermal Tolerance Designation
Banded sculpin		No UILT data
Black buffalo		No UILT data
Black redhorse		No UILT data
Chestnut lamprey		No UILT data
Lake sturgeon		No UILT data
Largescale stoneroller		No UILT data
Redline darter		No UILT data
River redhorse		No UILT data
Silver redhorse		No UILT data
Snubnose darter		No UILT data
Spotted gar		No UILT data
Steelcolor shiner		No UILT data
Threadfin shad		No UILT data
Yellow bass		No UILT data

***Heat sensitive – UILT ≤ 91°F; Intermediate – UILT 92–94°F; Heat tolerant – UILT ≥ 95°F**

Table 11. Numbers of species and numbers of individuals of non-indigenous fishes collected upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during summer 2012 and 2020 and autumn samples from 2001 through 2020

	Number of Species		Number of Individuals	
	Downstream	**Upstream**	**Downstream**	**Upstream**
2001	4	4	42	53
2003	4	3	34	42
2005	4	4	146	48
2007	4	4	18	47
2009	5	5	253	118
2010	4	5	348	406
2011	4	5	62	26
Summer 2012	4	4	56	101
2012	5	4	63	15
2013	4	5	157	99
2015	5	4	285	322
2017	4	4	129	152
2019	4	4	31	26
Summer 2020	4	5	36	45
2020	5	5	74	169
Autumn AVG	**4**	**4**	**126**	**117**

Table 12. List of non-indigenous fish species occurring in the vicinity of KIF based on seasonal sampling during summer 2012 and 2020 and autumn 2001 to 2020, with associated upper incipient lethal limits (UILT) from Yoder et.al. (2006)

Common Name	UILT (°F)	Thermal Tolerance Designation
Striped bass	90	Heat sensitive
Muskellunge	91	Heat sensitive
Yellow perch	91	Heat sensitive
Common carp	99	Heat tolerant
Mississippi silverside		No UILT data
Redbreast sunfish		No UILT data

***Heat sensitive – UILTs ≤ 91°F; Heat tolerant – UILTs ≥ 95°F**

Table 13. Records of federal and Tennessee state-listed aquatic animal species in the vicinity[1,2,3] of the Kingston Fossil Plant CCW intake (ERM 1.9)

Source	Scientific Name	Common Name	Element Rank[5]	Federal Status[4]	State Status[4]
TVA Natural Heritage Database[1]	**FISHES**				
	Etheostoma cinereum	Ashy darter	E		T
	Cycleptus elongatus	Blue sucker	H?		T
	Hemitremia flammea	Flame chub	H		D
	Erimonax monachus	Spotfin chub	E	LT	T
	Percina aurantiaca	Tangerine darter	E		D
	Chrosomus tennesseensis	Tennessee dace	H?		D
	Acipenser fulvescens	Lake sturgeon			E
	MUSSELS				
	Lampsilis virescens	Alabama lampmussel	H	LE	E
	Medionidus conradicus	Cumberland moccasinshell	E		
	Fusconaia cuneolus	Fine-rayed pigtoe	H	LE	E
	Plethobasus cooperianus	Orange-foot pimpleback	H	LE	E
	Epioblasma capsaeformis	Oyster mussel	E	LE	E
	Lampsilis abrupta	Pink mucket	H?	LE	E
	Villosa perpurpurea	Purple bean	E	LE	E
	Pleurobema rubrum	Pyramid pigtoe	H?		
	Fusconaia cor	Shiny pigtoe pearlymussel	X	LE	E
	Cumberlandia monodonta	Spectaclecase	H	LE	
	Epioblasma turgidula	Turgid blossom pearlymussel	X	LE	E
ECOS/IPAC[2]	**FISHES**				
	Erimonax monachus	Spotfin Chub		LT	
	Percina tanasi	Snail darter		LT	
	Noturus flavipinnis	Yellowfin madtom		LT	
	Erimystax cahni	Slender chub		LT	
	MUSSELS				
	Hemistena lata	Cracking pearlymussel		LE	
	Obovaria retusa	Ring pink (mussel)		LE	
	Epioblasma torulosa gubernaculum	Green blossom (pearlymussel)		LE	
	Plethobasus cicatricosus	White wartyback (pearlymussel)		LE	
	Quadrula cylindrica strigillata	Rough rabbitsfoot		LE	
	Villosa perpurpurea	Purple bean		LE	
	Villosa trabalis	Cumberland Bean (pearlymussel)		LE	
	Cumberlandia monodonta	Spectaclecase (mussel)		LE	
	Fusconaia cuneolus	Finerayed pigtoe		LE	
	Lemiox rimosus	Birdwing pearlymussel		LE	
	Lampsilis abrupta	Pink mucket (pearlymussel)		LE	
	Lampsilis virescens	Alabama lampmussel		LE	
	Plethobasus cooperianus	Orangefoot pimpleback (pearlymussel)		LE	
	Plethobasus cyphyus	Sheepnose Mussel		LE	
	Pleurobema plenum	Rough pigtoe		LE	

Table 13. continued

Source	Scientific Name	Common Name	Element Rank[5]	Federal Status[4]	State Status[4]
	Dromus dromas	Dromedary pearlymussel		LE	
	Epioblasma turgidula	Turgid blossom (pearlymussel)		LE	
	Fusconaia cor	Shiny pigtoe		LE	
	Cyprogenia stegaria	Fanshell		LE	
	SNAILS				
	Athearnia anthonyi	Anthony's riversnail		LE	
TDEC[3]	**FISHES**				
	Cycleptus elongatus	Blue sucker			T
	Hemitremia flammea	Flame chub			D
	Erimonax monachus	Spotfin chub			T
	Percina aurantiaca	Tangerine darter			D
	Chrosomus tennesseensis	Tennessee dace			D
	MUSSELS				
	Lampsilis virescens	Alabama lampmussel			E
	Fusconaia cuneolus	Fine-rayed pigtoe			E
	Plethobasus cooperianus	Orange-foot pimpleback			E
	Lampsilis abrupta	Pink mucket			E
	Pleurobema rubrum	Pyramid pigtoe			RNSL
	Fusconaia cor	Shiny pigtoe pearlymussel			E
	Cumberlandia monodonta	Spectaclecase			E
	Plethobasus cyphyus	Sheepnose Mussel			E
	Obovaria retusa	Ring pink			E
	Venustaconcha trabalis	Tennessee bean			E
	Quadrula cylindrica strigillata	Rough rabbitsfoot			E
	Cyprogenia stegaria	Fanshell			E
	SNAILS				
	Io fluvalis	Spiny Riversnail			RNSL

[1]TVA Natural Heritage Database returns records **within the 10-digit Hydrologic Unit watershed that encompasses** KIF intake; queried by Todd Amacker (TVA) on 08/24/2021

[2] U.S. Fish and Wildlife Service (USFWS) Environmental Conservation Online System (ECOS) and the Information for Planning and Consultation (IPAC) internet resource pages returns records **by county**

[3] Tennessee Department of Environment and Conservation "Rare Species by County" database returns records **by county**

[4] Status Codes: LE or END = Listed Endangered; LT or THR - Listed Threatened; D or NMGT = Deemed in need of management; RNSL = Rare, Not State Listed.

[5] H? = Uncertain status; H = Historical record ≥ 25 years old; E = Extant record ≤ 25 years old; X = Extirpated

Table 14. Wildlife observed during visual surveys conducted upstream and downstream of Kingston Fossil Plant, 2011 through 2020

	CRM 4.4 RDB					CRM 4.4 LDB					CRM 1.5 RDB					CRM 1.5 LDB				
	2011	2012	2013	2015	2020	2011	2012	2013	2015	2020	2011	2012	2013	2015	2020	2011	2012	2013	2015	2020
Birds																				
American coot	30		1				40				1			1		35	1			
American crow		3	12	17		12	6	4	7		2	5	1	3		2		4	3	
American goldfinch																		2		
American robin				1																
Belted kingfisher	1		1					1			1		1							
Black crowned night heron															1					
Black duck		7																		
Black vulture								1					1							
Blue jay		1	3	19				3	5					3				1	17	
Canada goose							9		4			6		8					10	5
Cardinal				2																
Carolina chickadee			5				2	1	1				4	3				2	1	
Carolina wren									4											
Cliff swallow					5									10						
Common grackle														2					1	
Domestic duck																1	1			
Domestic goose							1													
Double-crested cormorant		4	4	28	20								6	2	6			1	63	4
Downy woodpecker			2															1	1	
Eastern bluebird							1											1		
Eastern kingbird												1								
Eastern phoebe			1																1	
European starling									4					3						
Great blue heron	3	4	5	2	4	2	4	4	1		1	2	2		2	1	4	2	4	1
Little blue heron																1				
Mallard	1	6	1	2		6	4	8				1				2	22	2		
Mockingbird			4	2				7					1	3				1	4	
Mourning Dove								2												
Osprey					2										2	1				
Pied-billed grebe				1									1				3			
Red-headed woodpecker				1						1									1	
Red-tailed hawk			1																	
Red-winged blackbird								6												
Ring-billed gull									1											
Rock dove											26	30		120			3	3		
Ruby-throated hummingbird		1																		
Rufous-sided towhee								1												

Table 14 (continued).

	CRM 4.4 RDB					CRM 4.4 LDB					CRM 1.5 RDB					CRM 1.5 LDB				
	2011	2012	2013	2015	2020	2011	2012	2013	2015	2020	2011	2012	2013	2015	2020	2011	2012	2013	2015	2020
Turkey vulture													1	10			1			
Unspecified duck	8																			
Unspecified perching bird	1	2	5	2			2	5	2				4	5				7		
Western kingbird																		1		
Wood duck			1	9												2				
Yellow-shafted flicker			6						1											
Reptile/Amphibian																				
Eastern spiny softshell turtle													1							
Common slider				1	5					5										
Map turtle			5	13				10	9				49	6				1		
Painted turtle									2				1							
Red-eared turtle														1						
Unspecified turtle											3									
Mammals																				
Eastern grey squirrel	1	1					2	1	4							1		4	1	
White-tailed deer				3				1												
Total Birds	35	26	47	84	31	20	67	38	28	1	31	45	18	168	11	45	35	21	106	10
Bird Species	4	7	14	11	4	3	8	11	9	1	5	6	9	12	4	8	7	12	11	3
Total Rept/Amph	-	-	5	14	5	-	-	10	11	5	-	-	51	7	-	-	-	1	-	-
Rept/Amph Species	-	-	1	2	1	-	-	1	2	1	-	-	3	2	-	-	-	1	-	-
Total Mammals	1	1	-	3	-	-	2	2	4	-	-	-	-	-	-	1	-	4	1	-
Mammal Species	1	1	-	1	-	-	1	2	1	-	-	-	-	-	-	1	-	1	1	-

Table 15. Shoreline aquatic habitat index (SAHI) scores for shoreline sections assessed within the RFAI sample reach upstream of Kingston Fossil Plant, autumn 2020

Left Descending Bank	Transects								
	1	2	3	4	5	6	7	8	Avg.
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	3	3	3	3	3	1	3	5	3
Substrate	3	1	1	1	5	3	5	3	3
Erosion	1	1	5	1	3	3	1	3	2
Canopy Cover	5	5	5	5	5	3	3	5	5
Riparian Zone	5	5	3	3	5	1	3	5	4
Habitat	3	3	3	3	3	1	1	3	3
Slope	5	5	5	5	3	5	3	1	4
Total	**25**	**23**	**25**	**21**	**27**	**17**	**19**	**25**	**23**
Rating	**Fair**	**Fair**	**Fair**	**Fair**	**Good**	**Fair**	**Fair**	**Fair**	**Fair**

Right Descending Bank	Transects								
	1	2	3	4	5	6	7	8	Avg.
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	5	3	1	3	5	3	3	3	3
Substrate	3	1	1	1	5	5	5	5	3
Erosion	1	5	5	1	3	3	5	3	3
Canopy Cover	3	1	1	5	3	5	5	5	4
Riparian Zone	1	1	1	1	3	5	5	5	3
Habitat	3	1	1	1	3	1	1	1	2
Slope	3	1	1	1	3	5	5	5	3
Total	**19**	**13**	**11**	**13**	**25**	**27**	**29**	**27**	**21**
Rating	**Fair**	**Poor**	**Poor**	**Poor**	**Fair**	**Good**	**Good**	**Good**	**Fair**

Scoring criteria: poor (7-16), fair (17-26), good (27-35)

Table 16. Shoreline aquatic habitat index (SAHI) scores for shoreline sections assessed within the RFAI sample reach downstream of Kingston Fossil Plant, autumn 2020

Left Descending Bank	Transects								Avg.
	1	2	3	4	5	6	7	8	
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	1	1	5	3	3	1	1	1	2
Substrate	3	5	3	3	5	5	5	1	4
Erosion	1	1	1	3	3	1	3	5	2
Canopy Cover	1	1	3	5	5	1	3	5	3
Riparian Zone	1	1	3	5	5	1	5	5	3
Habitat	1	1	3	3	3	1	1	1	2
Slope	1	3	1	1	1	1	5	1	2
Total	**9**	**13**	**19**	**23**	**25**	**11**	**23**	**19**	**18**
Rating	**Poor**	**Poor**	**Fair**	**Fair**	**Fair**	**Poor**	**Fair**	**Fair**	**Fair**

Right Descending Bank	Transects								Avg.
	1	2	3	4	5	6	7	8	
Aquatic Macrophytes	0%	0%	0%	0%	0%	0%	0%	0%	0%
SAHI Variables									
Cover	1	1	1	1	3	5	3	1	2
Substrate	5	5	5	1	3	1	5	1	3
Erosion	5	5	5	5	1	5	3	3	4
Canopy Cover	3	1	1	1	1	3	1	1	2
Riparian Zone	3	1	1	1	1	1	1	1	1
Habitat	1	1	1	1	1	3	3	1	2
Slope	3	3	3	1	1	1	3	3	2
Total	**21**	**17**	**17**	**11**	**11**	**19**	**19**	**11**	**16**
Rating	**Fair**	**Fair**	**Fair**	**Poor**	**Poor**	**Fair**	**Fair**	**Poor**	**Poor**

**Scoring criteria: poor (7-16), fair (17-26), good (27-35)*

Table 17. Substrate composition and average water depth (ft) per transect upstream and downstream of Kingston Fossil Plant, autumn 2020

	% Substrate per transect upstream of KIF								
Substrate Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Avg.**
Silt	71.5	35.0	40.7	50.0	25.5	36.0	68.0	60.0	48.3
Detritus	11.5	47.5	45.9	19.0	7.0	9.5	8.5	12.0	20.1
Gravel	17.0	1.5	7.5	1.8	19.8	6.5	11.7	11.0	9.6
Sand	-	-	-	19.0	14.5	14.0	2.3	8.0	7.2
Mollusk	-	1.5	0.4	0.7	5.2	20.5	8.5	9.0	5.7
Bedrock	-	-	-	-	25.0	13.5	-	-	4.8
Clay	-	14.5	5.0	9.5	-	-	-	-	3.6
Wood	-	-	0.5	-	3.0	-	1.0	-	0.6
Average depth (ft)	15.2	23.3	18.7	14.7	22.7	24.1	21.9	20.7	20.2
Actual depth range: 1.7 to 42.6 ft									

	% Substrate per transect downstream of KIF								
Substrate Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**Avg.**
Silt	49.0	28.3	42.0	77.0	61.8	82.9	74.2	67.9	60.4
Detritus	43.0	3.0	34.0	22.0	15.3	4.4	10.0	12.6	18.0
Clay	-	43.0	8.0	-	-	-	8.0	-	7.4
Gravel	4.0	1.7	9.0	-	9.0	9.2	5.6	12.2	6.3
Mollusk	1.0	16.6	2.0	1.0	13.9	3.5	2.2	3.8	5.5
Sand	-	3.5	5.0	-	-	-	-	3.5	1.5
Cobble	3.0	2.6	-	-	-	-	-	-	0.7
Bedrock	-	1.3	-	-	-	-	-	-	0.2
Average depth (ft)	18.0	13.2	21.3	25.3	25.2	23.6	27.0	26.3	22.5
Actual depth range: 2.6 to 44.1 ft									

Table 18. Depth profiles of water temperature (°F) collected to determine the extent of the thermal plume* discharged from TVA's Kingston Fossil Plant during summer and autumn 2020

	Ambient														
	CRM 5					CRM 4					ERM 3.1				
Depth (m)	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%
August 2020															
0.3	78.9	79.7	79.7	79.8	80.4	80.3	80.4	79.7	79.7	80.4	82.5	82.5	82.4	82.3	80.4
1.5	76.1	77.5	75.7	73.1	76.0	79.9	80.0	78.2	77.4	79.1	82.3	81.8	81.7	81.9	79.7
3	71.8	72.7	72.1	72.2	-	-	74.0	72.8	73.8	-	-	80.7	80.6	80.0	-
4	-	71.6	71.7	72.1	-	-	72.1	72.3	-	-	-	77.8	79.8	-	-
5	-	71.5	71.5	71.8	-	-	-	72.1	-	-	-	73.7	-	-	-
6	-	71.5	71.5	71.7	-	-	-	72.0	-	-	-	-	-	-	-
7	-	71.5	71.5	71.6	-	-	-	71.9	-	-	-	-	-	-	-
8	-	71.5	71.5	71.6	-	-	-	71.8	-	-	-	-	-	-	-
9	-	71.5	71.5	-	-	-	-	71.9	-	-	-	-	-	-	-
10	-	71.5	71.5	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	71.6	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
October 2020															
0.3	65.4	65.4	65.3	65.3	65.2	66.2	66.2	66.1	65.8	65.5	68.6	68.7	68.5	68.4	67.8
1.5	65.1	65.1	65.1	65.1	65.1	-	66.1	66.1	65.8	65.3	68.2	67.7	67.2	66.5	65.4
3	65.0	64.9	65.0	64.9	-	-	65.7	65.7	65.6	65.4	-	65.4	65.4	65.2	65.1
4	64.9	64.9	64.9	64.9	-	-	65.4	65.3	-	-	-	65.2	65.1	-	-
5	64.7	64.7	64.7	64.6	-	-	-	65.3	-	-	-	-	-	-	-
6	-	64.7	64.7	64.7	-	-	-	65.3	-	-	-	-	-	-	-
7	-	64.7	64.7	64.7	-	-	-	65.3	-	-	-	-	-	-	-
8	-	64.7	64.7	64.7	-	-	-	65.4	-	-	-	-	-	-	-
9	-	64.7	64.6	64.7	-	-	-	65.3	-	-	-	-	-	-	-
10	-	-	64.7	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

	Discharge																				
	CRM 3					CRM 2					CRM 1					CRM 0					
Depth (m)	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	
August 2020																					
0.3	80.4	80.9	80.9	80.1	80.4	81.3	81.7	72.5	72.6	79.3	72.6	72.8	73.7	79.1	80.0	80.2	81.2	72.9	79.1	82.0	
1.5	79.7	79.7	80.0	80.1	80.2	80.5	80.7	81.1	81.1	81.6	82.0	82.5	82.5	81.4	81.6	81.8	81.9	81.7	82.2	82.7	
3	-	79.5	79.7	79.6	80.1	-	79.8	80.2	80.4	80.7	80.3	80.9	80.7	81.1	81.0	80.5	80.9	-	81.6	82.3	
4	-	-	78.0	76.6	-	-	76.7	79.1	79.2	79.7	-	79.5	79.3	79.1	79.7	-	-	-	80.1	79.9	
5	-	-	73.2	-	-	-	75.4	77.5	78.7	78.7	-	79.4	79.0	78.5	-	-	-	-	80.0	79.7	
6	-	-	-	-	-	-	74.2	76.0	76.3	77.1	-	77.4	77.8	76.0	-	-	-	-	79.8	-	
7	-	-	-	-	-	-	74.0	73.5	73.1	72.8	-	74.5	74.6	74.1	-	-	-	-	78.8	-	
8	-	-	-	-	-	-	-	73.1	72.7	72.7	-	73.0	73.0	73.9	-	-	-	-	78.4	-	
9	-	-	-	-	-	-	-	72.7	72.6	-	-	72.7	72.8	-	-	-	-	-	74.0	-	
10	-	-	-	-	-	-	-	72.6	72.6	-	-	72.6	72.7	-	-	-	-	-	73.0	-	
11	-	-	-	-	-	-	-	72.5	72.6	-	-	-	-	-	-	-	-	-	72.9	-	
12	-	-	-	-	-	-	-	72.6	-	-	-	-	-	-	-	-	-	-	-	-	
October 2020																					
0.3	69.5	69.9	69.9	70.2	69.7	68.9	69.0	68.8	69.0	69.4	70.8	69.0	72.3	71.2	70.3	70.9	-	-	-	71.9	
1.5	69.5	69.4	69.3	70.0	68.3	67.8	68.3	68.1	68.2	68.7	68.3	36.4	70.4	69.4	69.0	70.3	-	-	-	69.9	
3	-	-	-	-	-	-	65.8	66.7	66.5	65.7	66.9	67.6	69.8	68.5	68.5	70.2	-	-	-	-	
4	-	-	-	-	-	-	65.7	66.3	66.3	-	-	66.6	68.6	68.0	-	70.1	-	-	-	-	
5	-	-	-	-	-	-	65.5	66.1	66.0	-	-	66.5	67.1	67.7	-	-	-	-	-	-	
6	-	-	-	-	-	-	65.4	65.9	65.4	-	-	66.5	66.8	67.7	-	-	-	-	-	-	
7	-	-	-	-	-	-	65.4	65.8	65.4	-	-	66.3	66.5	-	-	-	-	-	-	-	
8	-	-	-	-	-	-	65.4	65.5	65.2	-	-	66.1	66.2	-	-	-	-	-	-	-	
9	-	-	-	-	-	-	65.4	65.3	65.2	-	-	66.0	66.0	-	-	-	-	-	-	-	
10	-	-	-	-	-	-	-	65.3	65.2	-	-	65.5	66.0	-	-	-	-	-	-	-	
11	-	-	-	-	-	-	-	65.3	-	-	-	-	65.6	-	-	-	-	-	-	-	
12	-	-	-	-	-	-	-	65.2	-	-	-	-	-	-	-	-	-	-	-	-	

^Plume extended downstream of CRM 0, but was not mapped below this point. Lower end of thermal plume in 2013 was CRM 1.8. No plume was detected at any transect in 2015.
***Shaded numbers represent temperatures 3.6°F (2°C) or greater above ambient temperature.**

Table 19. Water quality parameters collected along vertical depth profiles at transects within the RFAI sample reaches upstream and downstream of Kingston Fossil Plant during summer and autumn 2020

August 2020	LDB						Mid-channel						RDB					
CRM 4.4	**Depth**	**°C**	**°F**	**pH**	**Cond**	**DO**	**Depth**	**°C**	**°F**	**pH**	**Cond**	**DO**	**Depth**	**°C**	**°F**	**pH**	**Cond**	**DO**
	3.4	26.4	79.6	7.6	173.2	7.6	5.9	22.8	73.1	7.4	239.2	6.5	2.1	27.7	81.9	7.4	127.1	6.6
Upstream	3.0	26.9	80.5	7.5	167.2	7.2	5.0	23.6	74.4	7.4	229.0	6.5	1.5	27.8	82.0	7.5	124.5	7.3
Boundary	1.5	27.2	81.0	7.9	123.3	8.7	3.0	27.1	80.7	7.6	152.9	7.7	0.3	28.2	82.8	7.7	120.7	8.0
(Emory Arm)	0.3	28.0	82.3	8.0	102.1	8.5	1.5	27.7	81.8	8.0	116.3	8.5						
							0.3	28.0	82.5	7.9	98.2	8.4						
Upstream	1.5	24.5	76.0	7.6	205.8	7.1	11.1	22.0	71.6	7.4	243.2	6.5	3.5	22.0	71.6	7.4	242.8	6.4
Boundary	0.3	26.9	80.4	8.2	164.4	9.2	9.0	21.9	71.5	7.4	242.8	6.4	3.0	22.3	72.1	7.4	238.4	6.4
(Clinch Arm)							7.0	21.9	71.5	7.4	242.5	6.4	1.5	24.5	76.1	7.6	204.4	7.6
							5.0	22.0	71.5	7.3	242.1	6.4	0.3	26.1	78.9	7.9	178.4	8.8
							3.0	22.3	72.1	7.4	232.8	6.7						
							1.5	24.3	75.7	7.5	207.4	7.6						
							0.3	26.5	79.7	8.1	178.0	9.2						
Mid-station	4.2	22.3	72.2	7.5	243.1	6.6	11.5	22.1	71.8	7.4	243.7	6.6	2.6	22.5	72.5	7.4	238.4	6.6
	3.0	22.9	73.1	7.4	237.3	6.4	11.0	22.0	71.7	7.4	242.7	6.4	1.5	26.4	79.6	7.7	187.3	8.2
	1.5	27.4	81.3	8.1	137.8	8.5	9.0	22.0	71.7	7.4	243.2	6.4	0.3	27.6	81.7	7.9	128.4	8.4
	0.3	27.7	81.9	8.2	128.7	9.0	7.0	22.1	71.8	7.4	242.9	6.5						
							5.0	22.1	71.8	7.3	242.5	6.4						
							3.0	23.0	73.4	7.4	226.8	6.8						
							1.5	26.7	80.0	8.0	168.3	8.8						
							0.3	27.7	81.8	8.1	156.3	8.8						
Downstream Boundary	2.0	25.7	78.2	7.6	211.8	7.9	9.7	22.2	71.9	7.4	242.9	6.6	1.5	26.6	79.9	7.9	184.5	8.6
	1.5	26.6	79.9	7.9	200.5	8.8	9.0	22.1	71.8	7.4	243.3	6.5	0.3	26.8	80.3	8.0	177.7	9.0
	0.3	26.9	80.4	8.0	184.1	9.1	7.0	22.2	71.9	7.4	243.3	6.5						
							5.0	22.3	72.1	7.4	242.8	6.5						
							3.0	22.7	72.8	7.4	234.7	6.7						
							1.5	25.7	78.2	7.7	212.7	8.1						
							0.3	27.1	80.8	8.0	166.6	8.4						

Table 19. (Continued)

August 2020	LDB						Mid-channel						RDB					
CRM 1.5	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO
Upstream Boundary	8.6	22.6	72.6	7.6	239.6	5.8	12.1	22.6	72.6	7.4	240.3	6.0	2.4	26.8	80.2	7.6	224.3	7.4
	7.0	22.6	72.7	7.3	239.0	5.8	11.0	22.5	72.5	7.4	240.2	6.0	1.5	27.1	80.8	7.7	222.3	8.1
	5.0	25.1	77.1	7.4	228.0	6.3	9.0	22.5	72.6	7.3	240.0	6.0	0.3	27.4	81.3	7.7	221.2	8.1
	3.0	26.5	79.7	7.5	223.4	7.1	7.0	22.8	73.1	7.4	237.5	6.2						
	1.5	27.1	80.7	7.8	223.1	8.3	5.0	24.5	76.0	7.4	225.5	6.5						
	0.3	27.6	81.6	7.8	220.1	8.7	3.0	26.2	79.1	7.4	227.7	6.7						
							1.5	26.8	80.2	7.6	222.8	7.5						
							0.3	27.3	81.1	7.7	222.3	8.2						
Mid-station	4.0	26.2	79.1	7.5	184.3	6.9	10.6	22.6	72.8	7.4	238.8	6.1	3.4	26.3	79.3	7.5	211.1	6.8
	3.0	26.5	79.7	7.5	179.9	6.9	9.0	22.6	72.7	7.4	239.9	6.0	3.0	26.8	80.2	7.6	196.3	7.3
	1.5	27.2	81.0	7.7	197.3	7.9	7.0	22.8	73.0	7.4	238.6	6.1	1.5	27.0	80.5	7.6	216.3	7.7
	0.3	27.6	81.6	7.8	208.2	8.6	5.0	25.5	77.8	7.4	226.4	6.5	0.3	27.8	82.0	7.9	215.3	8.8
							3.0	26.3	79.3	7.5	202.7	7.1						
							1.5	27.0	80.7	7.6	214.5	7.8						
							0.3	28.1	82.5	7.9	216.7	8.9						
Downstream Boundary	5.8	26.1	79.1	7.5	154.7	7.1	2.2	27.3	81.2	8.0	204.7	9.1	3.3	26.7	80.0	7.6	165.3	7.6
	5.0	26.5	79.6	7.6	149.0	7.6	1.5	27.3	81.2	7.9	207.8	8.9	3.0	26.7	80.1	7.7	169.4	7.8
	3.0	26.6	79.9	7.6	165.2	7.7	0.3	27.9	82.2	8.0	211.3	9.2	1.5	27.1	80.8	7.8	194.4	8.6
	1.5	28.0	82.3	8.1	211.5	9.8							0.3	27.7	81.8	7.9	202.4	9.0
	0.3	28.2	82.7	8.1	213.7	9.7												

Table 19. (continued)

October 2020	LDB						Mid-channel						RDB					
CRM 4.4	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO
Upstream Boundary (Emory Arm)	0.3	20.1	68.2	8.0	212.1	10.0	0.3	20.2	68.3	8.1	203.7	10.0	0.3	20.4	68.7	8.0	199.3	9.8
	1.5	18.9	66.0	7.8	239.9	9.1	1.5	19.6	67.2	7.9	223.6	9.4	1.3	19.9	67.9	7.9	207.9	9.4
	3	18.4	65.2	7.7	253.6	8.5	2	19.0	66.2	7.7	247.6	9.0						
	4	18.4	65.0	7.7	253.3	8.4												
	5	18.4	65.1	7.7	253.0	8.4												
	6	18.4	65.1	7.7	253.3	8.4												
Upstream Boundary (Clinch Arm)	0.3	18.5	65.3	7.2	248.7	8.7	0.3	18.5	65.3	7.7	249.0	8.8	0.3	18.4	65.1	7.7	250.2	9.0
	1.3	18.4	65.2	7.7	247.7	8.7	1.5	18.4	65.1	7.7	250.1	8.8	1.5	18.4	65.0	7.7	250.0	8.9
							3	18.3	64.9	7.7	252.2	8.6	3	18.3	64.9	7.7	249.7	8.8
							4	18.2	64.8	7.7	251.8	8.6	4	18.3	64.9	7.7	249.7	8.7
							5	18.2	64.8	7.7	253.2	8.5	5	18.2	64.8	7.7	250.3	8.6
							7	18.2	64.7	7.7	254.1	8.5	7	18.2	64.8	7.6	251.9	8.6
													9	18.2	64.7	7.6	253.1	8.5
													11	18.2	64.7	7.6	254.2	8.5
													13	18.2	64.7	7.6	254.0	8.3
Mid-station	0.3	18.9	65.9	7.8	248.7	8.5	0.3	18.4	65.1	7.7	253.7	8.5	0.3	19.0	66.1	7.7	247.7	9.0
	1.5	18.4	65.2	7.7	250.8	8.5	1.5	18.4	65.0	7.7	253.7	8.5	1.2	18.6	65.6	7.7	246.8	8.9
	3	18.3	65.0	7.7	252.7	8.5	3	18.4	65.0	7.7	251.9	8.5						
	4	18.3	65.0	7.7	253.3	8.4	4	18.4	65.0	7.7	251.4	8.5						
	5	18.3	65.0	7.7	253.0	8.4	5	18.3	65.0	7.7	251.4	8.5						
	7	18.3	64.9	7.7	253.1	8.4	7	18.3	64.9	7.6	252.4	8.3						
	9	18.3	65.0	7.7	253.1	8.4	9	18.3	64.9	7.6	253.3	8.3						
	11	18.3	64.9	7.7	253.9	8.4												
Downstream Boundary	0.3	19.6	67.2	7.7	248.0	8.7	0.3	19.0	66.1	7.7	250.4	8.6	0.3	19.6	67.3	7.6	249.7	8.7
	1.5	19.1	66.4	7.7	249.4	8.5	1.5	18.8	65.9	7.7	251.2	8.5	1.5	18.6	65.5	7.5	249.2	9.0
	2.5	18.5	65.2	7.7	252.8	8.5	3	18.8	65.8	7.6	250.1	8.5						
							4	18.7	65.7	7.7	250.8	8.6						
							5	18.6	65.4	7.6	251.2	8.5						
							7	18.3	64.9	7.6	253.3	8.3						
							9	18.2	64.8	7.6	252.4	8.2						
							11	18.3	64.9	7.6	253.1	8.2						

Table 19. (continued)

October 2020	LDB						Mid-channel						RDB					
CRM 1.5	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO	Depth	°C	°F	pH	Cond	DO
Upstream Boundary	0.3	21.0	69.8	7.8	244.0	8.6	0.3	20.9	69.6	7.7	285.9	8.5	0.3	21.0	69.7	7.7	290.9	8.3
	1.5	19.9	67.8	7.8	246.1	8.8	1.5	20.4	68.7	7.8	246.3	8.7	1.5	19.5	67.0	7.7	269.1	8.2
	3	19.4	66.9	7.2	247.9	8.6	3	19.4	67.0	7.7	248.0	8.6	3	18.7	65.6	7.7	251.3	8.2
	3.5	19.3	66.8	7.7	248.6	8.5	4	19.2	66.6	7.7	248.6	8.4	4	18.6	65.4	7.6	251.8	8.2
							6	18.4	65.1	7.6	252.9	7.9	5	18.4	65.2	7.6	251.6	8.0
							8	18.4	65.1	7.6	253.2	8.0	7	18.4	65.1	7.6	253.5	8.1
							10	18.4	65.1	7.6	252.3	8.0	9	18.4	65.1	7.6	253.7	8.1
													11	18.4	65.1	7.6	253.1	8.1
													11.4	18.4	65.1	7.6	252.8	8.1
Mid-station	0.3	22.1	71.9	8.0	152.7	10.1	0.3	21.5	70.6	7.8	216.7	8.0	0.3	20.8	69.4	7.8	218.0	9.0
	1.5	21.4	70.4	7.8	155.3	9.6	1.5	21.4	70.6	7.7	246.7	7.7	1.5	20.2	68.4	7.7	241.5	8.6
	2.15	21.1	69.9	7.8	157.4	9.5	3	21.2	70.2	7.7	247.4	7.6	3	20.2	68.3	7.7	234.6	8.4
							4	20.3	68.6	7.7	240.8	7.4	4	19.8	67.6	7.6	240.9	8.3
							5	19.8	67.6	7.7	240.9	7.3	6	19.1	66.3	7.6	248.8	8.1
							7	18.6	65.4	7.6	251.9	7.3	8	18.8	65.8	7.6	250.3	8.0
							9	18.6	65.5	7.6	251.6	7.4	10	18.8	65.8	7.6	249.7	8.0
							11	18.6	65.5	7.6	251.4	7.6	12	18.7	65.7	7.6	250.3	8.0
Downstream Boundary	0.3	21.5	70.7	7.5	135.2	8.6	0.3	22.3	72.2	7.8	142.3	9.7	0.3	22.7	72.9	7.7	146.8	9.2
	1.5	21.5	70.7	7.5	136.7	8.7	1.5	22.0	71.6	7.8	142.5	9.8	1.5	21.8	71.2	7.6	147.5	9.0
	3	21.4	70.5	7.6	148.2	8.8	2.65	21.5	70.7	7.7	144.8	9.2	2.8	21.3	70.4	7.6	147.6	8.9
	4	21.3	70.3	7.7	151.0	9.1												
	5	21.2	70.1	7.7	153.7	9.2												
	7	20.4	68.7	7.6	172.5	8.4												
	9	19.2	66.6	7.6	236.2	8.1												
	11	18.9	66.0	7.6	246.1	8.1												

Abbreviations: °C – Temperature (degrees Celsius), °F – Temperature (degrees Fahrenheit), Cond – Conductivity, DO – Dissolved Oxygen

APPENDICES

Appendix A. Field study design, sampling methods, and Reservoir Fish Assemblage Index methodology used by TVA to monitor biological communities in the vicinity of Kingston Fossil Plant from 2001 through 2020

Evaluation of Plant Operating Conditions

Data describing the operation of KIF during the course of biological monitoring—specifically daily averages of power generation, water temperatures at the CCW system intake and discharge, and the flow rate of water through the CCW system—were collected, compiled, analyzed and compared to available historical operations data to assist in the interpretation of thermal plume characteristics and biological community information.

Aquatic Habitat in the Vicinity of KIF

Shoreline and river bottom habitat data presented in this report were collected during autumn 2020. TVA assumes habitat data to be valid for five years, barring any major changes to the river/reservoir (e.g. major flood event). No significant changes have occurred in the river system from the initial characterization, but in the event of such a change, habitat will be re-evaluated during the following sample period.

Shoreline Aquatic Habitat Assessment

An integrative multi-metric index (Shoreline Aquatic Habitat Index or SAHI), including several habitat parameters important to resident fish species, was used to measure existing fish habitat quality in the vicinity of KIF. Using the general format developed by Plafkin et al. (1989), seven metrics were established to characterize selected physical habitat attributes important to reservoir resident fish populations which rely heavily on the littoral (shoreline) zone for reproductive success, juvenile development, and adult feeding (Table A-1). Habitat Suitability Indices (US Fish and Wildlife Service), along with other sources of information on biology and habitat requirements (Etnier and Starnes 1993), were consulted to develop "reference" criteria or "expected" conditions from a high quality environment for each parameter. Some generalizations were necessary in setting up scoring criteria to cover the various requirements of all species into a single index.

When possible, the quality of shoreline aquatic habitat was assessed while traveling parallel to the shoreline in a boat and evaluating the habitat within 10 vertical feet of full pool. Transects were established across the width of Watts Bar reservoir within the fish community sampling areas upstream and downstream of KIF (Figure 12). At each transect, near-shore aquatic habitat was assessed along sections of shoreline corresponding to the left descending bank (LDB) and right descending bank (RDB). For each shoreline section (16 upstream and 16 downstream of KIF) percentages of aquatic macrophytes in the littoral areas were estimated, then each section was scored by comparing the observed conditions associated with each individual metric to the "reference" conditions and assigning the metric a corresponding value: "Good"-5; "Fair"-3; or "Poor"-1 (Table A-1). The scores for each of the seven metric were summed to obtain the SAHI value for the shoreline section, and this value was assigned a habitat quality descriptor based on trisecting the range of potential SAHI values ("Poor" 7-16, "Fair" 17-26, and "Good" 27-35).

River Bottom Habitat

Along each transect described above, a benthic grab sample was collected with a Ponar sampler at each of 10 points equally spaced from the LDB to the RDB. Substrate material collected with the Ponar was emptied into a screen, and percentage composition of each substrate was estimated to determine existing benthic habitat across the width of the river. Water depths (feet) at each sample location were recorded (Figure 15). If no substrate was collected after multiple Ponar drops, it was assumed that the substrate was bedrock. For example, when the Ponar was pulled shut, collectors could feel substrate consistency. If it shut easily and was not embedded in the substrate on numerous drops within the same location, substrate was recorded as bedrock.

Fish Community Sampling Methods and Data Analysis for Sites Upstream and Downstream of KIF

Thermal discharge from KIF enters Watts Bar Reservoir in the Clinch River at CRM 2.6 (Figure 2). To evaluate the fish community in the vicinity of KIF, one sample reach was established downstream of the discharge, centered at CRM 1.5 (Figure 4). A second sample reach was established at CRM 4.4 upstream of the plant, with sample sites beginning downstream of the confluence of the Emory and Clinch Rivers and extending into each river approximately 0.5 mile above the confluence (Figure 5). TVA's Reservoir Ecological Health (REH) monitoring program uses four additional sample areas on Watts Bar Reservoir: Forebay, TRM 531.0; Transition, TRM 560.8; Tennessee River Inflow, TRM 601; and Clinch River Inflow, CRM 22.0.

Fish sampling methods utilized include boat electrofishing and gill netting (Hubert, 1996; Reynolds, 1996). Electrofishing methodology consisted of fifteen electrofishing boat runs near the shoreline, each 300 meters long and approximately 10 minutes in duration. The total near-shore area sampled was approximately 4,500 meters (15,000 feet).

Experimental gill nets (so called because of their use for research as opposed to commercial fishing) were used as an additional gear type to collect fish from deeper habitats not effectively sampled by electrofishing. Each experimental gill net consists of five 6.1-meter panels for a total length of 30.5 meters (100.1 feet). The distinguishing characteristic of experimental gill nets is mesh size that varies between panels. For this application, each net has panels with mesh sizes of 2.5, 5.1, 7.6, 10.2, and 12.7 cm. Experimental gill nets are typically set perpendicular to river flow extending from near-shore toward the main channel of the reservoir. Ten experimental gill nets were set overnight in each sample reach.

Fish collected were identified by species, counted, and examined for anomalies (such as disease, deformations, parasites or hybridization). The resulting data were analyzed using RFAI methodology.

The RFAI uses 12 fish community metrics from four general categories: Species Richness and Composition; Trophic Composition; Abundance; and Fish Health. Individual species can be utilized for more than one metric, though hybrid species and non-indigenous species are excluded from metrics counting numbers of individual species. Together, these 12 metrics provide a balanced evaluation of fish community integrity. The individual metrics are shown below, grouped by category:

Species Richness and Composition

(1) **Total number of species** – Greater numbers of species are considered representative of healthier aquatic ecosystems. As conditions degrade, numbers of species at an area decline.

(2) **Number of centrarchid species** – Sunfish species (excluding black basses) are invertivores and a high diversity of this group is indicative of reduced siltation and suitable sediment quality in littoral areas.

(3) **Number of benthic invertivore species** – Due to the special dietary requirements of this species group and the limitations of their food source in degraded environments, numbers of benthic invertivore species increase with better environmental quality.

(4) **Number of intolerant species** – A category of species that are particularly intolerant of physical, chemical, and thermal habitat degradation. Higher numbers of intolerant species suggest the presence of fewer environmental stressors.

(5) **Percentage of tolerant individuals** (excluding young-of-year) – An increased proportion of individuals tolerant of degraded conditions signifies poorer water quality.

(6) **Percent dominance by one species** – Ecological quality is considered reduced if one species inordinately dominates the resident fish community.

(7) **Percentage of non-indigenous species** – Based on the assumption that non-indigenous species reduce the quality of resident fish communities.

(8) **Number of top carnivore species** – Higher diversity of piscivores is indicative of the availability of diverse and plentiful forage species and the presence of suitable habitat.

Trophic Composition

(9) **Percent top carnivores** – A measure of the functional aspect of top carnivores which feed on major planktivore populations.

(10) **Percent omnivores** – Omnivores are less sensitive to environmental stresses due to their ability to vary their diets. As trophic links are disrupted due to degraded conditions, specialist species such as insectivores decline while opportunistic omnivorous species increase in relative abundance.

Abundance

(11) Average number per run (number of individuals) – Based on the assumption that high quality fish assemblages support large numbers of individuals.

Fish Health

(12) Percent anomalies – Incidence of diseases, lesions, tumors, external parasites, deformities, blindness, and natural hybridization is noted for all fish collected, with higher incidence indicating less favorable environmental conditions.

RFAI methodology addresses all four attributes or characteristics of a "balanced indigenous population" (BIP), defined by the CWA as described below:

(1) A biotic community characterized by diversity appropriate to the ecoregion: Diversity is addressed by the metrics in the Species Richness and Composition category, especially metric 1 – "Number of species." Determination of reference conditions based on the transition zones of upper mainstem Tennessee River reservoirs (as described below) ensures appropriate species expectations for the ecoregion.

(2) The capacity for the community to sustain itself through cyclic seasonal change: TVA uses an autumn data collection period for biological indicators, both REH and upstream/downstream monitoring. Autumn monitoring is used to document community condition or health after being subjected to the wide variety of stressors throughout the year.

One of the main benefits of using biological indicators is their ability to integrate stressors through time. Examining the condition or health of a community at the end of the "biological year" (i.e., autumn) provides insights into how well the community has dealt with the stresses through an annual seasonal cycle. Likewise, evaluation of the condition of individuals in the community (in this case, individual fish as reflected in Metric 12) provides insights into how well the community can be expected to withstand stressors through winter. Further, multiple sampling years during the permit renewal cycle add to the evidence of whether the autumn monitoring approach has correctly demonstrated the ability of the community to sustain itself through repeated seasonal changes.

(3) The presence of necessary food chain species: Integrity of the food chain is measured by the Trophic Composition metrics, with support from the Abundance metric and Species Richness and Composition metrics. A healthy fish community is comprised of species that utilize complex feeding mechanisms extending into multiple levels of the aquatic food web. Three dominant fish trophic levels exist within upper mainstem reservoirs; insectivores, omnivores, and top carnivores. To determine the presence of necessary food chain species, these three groups should be well represented within the overall fish community. Other fish trophic levels include benthic invertivores, planktivores, herbivores, and parasitic species. Insectivores include most sunfish, minnows, and silversides. Omnivores include gizzard shad, common carp, carpsuckers, buffalo, and channel and blue catfish. Top carnivores include bass, gar, skipjack herring, crappie, flathead catfish, sauger, and walleye. Benthic invertivores include freshwater drum, suckers, and darters. Planktivores include alewife, threadfin shad, and paddlefish. Herbivores include largescale stonerollers. Lampreys in the genus *Ichthyomyzon* are the only parasitic species occurring in Tennessee River reservoirs.

To establish expected proportions of each trophic guild and the expected number of species included in each guild occurring in transition zones in upper mainstem Tennessee River reservoirs (Chickamauga, Watts Bar, and Fort Loudon reservoirs), data collected from 1993 to 2020 from transition zones in upper mainstem reservoirs were analyzed for each reservoir zone (inflow, transition, forebay). Samples collected in the downstream vicinity of thermal discharges were not included in this analysis so that accurate expectations could be calculated with the assumption that these data represent what should occur in upper mainstem Tennessee River reservoirs absent from point source effects (i.e. power plant discharges). Data from 930 electrofishing runs (a total of 279,000 meters of shoreline sampled) and from 620 overnight experimental gill net sets were included in this analysis for transition areas in upper mainstem Tennessee River reservoirs. From these data, the range of proportional values for each trophic level and the range of the number of species included in each trophic level were trisected. These trisections were intended to show less than expected, expected and above expected values for trophic level proportions and species occurring within each reservoir zone in upper mainstem Tennessee River reservoirs. The data were also averaged and bound by confidence intervals (95%) to further evaluate expectations for proportions of each trophic level and the number of species representing each trophic level (Table A-2).

(4) A lack of domination by pollution-tolerant species: Domination by pollution-tolerant species is measured by metrics 3 (“Number of benthic invertivore species”), 4 (“Number of intolerant species”), 5 (“Percent tolerant individuals”), 6 (“Percent dominance by one species”), and 10 (“Percent omnivores”).

Scoring categories are based on “expected” fish community characteristics in the absence of human-induced impacts other than impoundment of the reservoir. These categories were developed from historical REH fish assemblage data representative of transition zones from upper mainstream Tennessee River reservoirs (Hickman and McDonough 1996). Attained values for each of the 12 metrics were compared to the scoring criteria and assigned scores to represent relative degrees of degradation: least degraded (5); intermediately degraded (3); and most degraded (1). Scoring criteria for upper mainstem Tennessee River reservoirs are shown in Table A-3.

If a metric was calculated as a percentage (e.g., “Percent tolerant individuals”), the data from electrofishing and gill netting were scored separately and allotted half the total score for that individual metric. Individual metric scores for a sample reach (i.e., upstream or downstream) were summed to obtain the RFAI score for the reach.

TVA uses RFAI results to determine maintenance of BIP using two approaches. One is “absolute” in that it compares the RFAI scores and individual metrics to predetermined values. The other is “relative” in that it compares RFAI scores attained downstream to scores at the upstream control site. The “absolute” approach is based on Jennings et al. (1995) who suggested that favorable comparisons of the attained RFAI score from the potential impact zone to a predetermined criterion can be used to identify the presence of normal community structure and function, and hence existence of BIP. For multi-metric indices, TVA uses two criteria to ensure a conservative screening of BIP. First, if an RFAI score reaches 70% of the highest attainable score of 60 (adjusted upward to include sample variability as described below), and second, if fewer than half of RFAI metrics receive a low (1) or moderate (3) score, then community structure and function are considered normal, indicating that BIP had been maintained and no further evaluation would be needed.

RFAI scores range from 12 to 60. Ecological health ratings (12-21 "Very Poor", 22-31 "Poor", 32-40 "Fair", 41-50 "Good", or 51-60 "Excellent") are then applied to scores. As discussed in detail below, the average variation for RFAI scores in TVA reservoirs is 6 (± 3). Therefore, any location that attains a RFAI score of 45 (75% of the highest score) or higher would be considered to have BIP. It must be stressed that scores below this threshold do not necessarily reflect an adversely impacted fish community. The threshold is used to serve as a conservative screening level; i.e., any fish community that meets these criteria is obviously not adversely impacted. RFAI scores below this level require a more in-depth look to determine if BIP exists. An inspection of individual RFAI metric results and species of fish used in each metric is an initial step to help identify if operation of KIF is a contributing factor. This approach is appropriate because a validated multi-metric index is being used and scoring criteria applicable to the zone of study are available.

A comparison of RFAI scores from the area downstream of KIF to those from the upstream (control) area is one basis for determining if operation of the plant has had any impacts on the resident fish community. The definition of "similar" is integral to accepting the validity of these interpretations. The Quality Assurance (QA) component of the REH monitoring program deals with how well the RFAI scores can be repeated and is accomplished by collecting a second set of samples at 15%-20% of the areas each year. Comparison of paired-sample QA data collected over seven years shows that the difference in RFAI index scores ranges from 0 to 18 points. The mean difference between these 54 paired scores is 4.6 points with 95% confidence limits of 3.4 and 5.8. The 75th percentile of the sample differences is 6, and the 90th percentile is 12. Based on these results, a difference of 6 points or less in the overall RFAI scores is the value selected for defining "similar" scores between upstream and downstream fish communities. That is, if the downstream RFAI score is within 6 points of the upstream score and if there are no major differences in overall fish community composition, then the two locations are considered similar. It is important to bear in mind that differences greater than 6 points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). An examination of the 12 metrics (with emphases on fish species used for each metric) is conducted to analyze any difference in scores and the potential for the difference to be thermally related.

Benthic Macroinvertebrate Community Sampling Methods and Data Analysis for Sites Upstream and Downstream of KIF

To assess the benthic macroinvertebrate community around KIF, three transects were established across the width of the Clinch River. One transect was established upstream of the KIF intake at CRM 3.75 (Figure 4) and was used as a control site for comparison to benthic community composition potentially affected by the KIF thermal effluent. One downstream transect was established at CRM 2.2 within the thermal plume, and a second was established at CRM 1.5, just below the downstream extent of the plume (Figure 5). A Ponar dredge (area per sample 0.06 m^2) was used to collect benthic samples at ten points equally spaced along each transect. When heavier substrate was encountered, a Peterson dredge (area per sample 0.11 m^2) was used. Sediments from each sample were washed on a 533µ screen, and organisms were picked from the screen and from any remaining substrate. Samples were fixed in formalin and sent to an independent consultant who identified each organism collected to the lowest possible taxonomic level.

Benthic samples were evaluated using seven metrics that represent characteristics of the benthic community. Results for each metric were assigned a rating of 1, 3, or 5, based on comparison to reference conditions developed for REH reservoir inflow sample sites (Table A-4). For each sample site, the ratings for the seven metrics were then summed to produce an RBI score. Potential RBI scores ranged from 7 to 35. Ecological health ratings derived from the range of potential values (7-12 “Very Poor”, 13-18 “Poor”, 19-23 “Fair”, 24-29 “Good”, or 30-35 “Excellent”) were then applied to scores (Table A-4). The individual metrics are described below:

(1) Average number of taxa — Calculated by averaging the total number of taxa present in each sample at a site. Greater taxa richness indicates better conditions than lower taxa richness.

(2) Proportion of samples with long-lived organisms — A presence/absence metric that is evaluated based on the proportion of samples with at least one long-lived organism (*Corbicula, Hexagenia*, mussels, or snails) present. The presence of long-lived taxa is indicative of conditions that allow long-term survival.

(3) Average number of EPT taxa — Calculated by averaging the number of *Ephemeroptera* (mayfly), *Plecoptera* (stonefly), and *Trichoptera* (caddis fly) taxa present in each sample at a site: Higher diversity of these taxa indicates good water quality and better habitat conditions.

(4) Percentage of oligochaetes — Calculated by averaging the percentage of oligochaetes in each sample at a site. Oligochaetes are considered tolerant organisms, so a higher proportion indicates poorer water quality.

(5) Percentage as dominant taxa — Used as an evenness indicator, this metric is calculated by selecting the two most abundant taxa in a sample, summing the number of individuals in those two taxa, dividing that sum by the total number of animals in the sample, and converting to a percentage for that sample. The percentage is then averaged for the 10 samples at each site. Because the most abundant taxa often differ among the 10 samples at a site, this approach allows more discretion to identify imbalances at a site than developing an average for a single dominant taxon for all samples a site. Dominance of one or two taxa indicates poor conditions.

(6) Average density excluding chironomids and oligochaetes — Calculated by first summing the number of organisms – excluding chironomids and oligochaetes – present in each sample and then averaging these densities for the 10 samples at a site. This metric examines the community, excluding taxa which often dominate under adverse conditions. Higher abundance of taxa other than chironomids and oligochaetes indicates good water quality conditions.

(7) Zero-samples: Proportion of samples containing no organisms — For each site, the proportion of samples in which no organisms are present. “Zero-samples” indicate living conditions unsuitable to support aquatic life (i.e. toxicity, unsuitable substrate, etc.). A site with no zero samples was assigned a score of five. Any site with one or more zero samples was assigned a score of one.

A similar or higher benthic index score at the downstream site compared to the upstream sites was used as the basis for determining absence of impact on the benthic macroinvertebrate community related to KIF's thermal discharge. The QA component of REH monitoring compared benthic index scores from 49 paired sample sets collected over seven years. Differences between these paired sets ranged from 0 to 14 points; the 75th percentile was four points, the 90th percentile was six points. The mean difference between these 49 paired scores was 3.1 points with 95% confidence limits of 2.2 and 4.1. Based on these results, a difference of four points or less was the value selected for defining "similar" scores between upstream and downstream benthic communities. That is, if the benthic score at the downstream site is within four points of the upstream score, the communities are considered similar. However, differences greater than four points can be expected simply due to method variation (25% of the QA paired sample sets exceeded that value). Any difference in scores of four points or greater between communities is examined on a metric-by-metric basis to determine what caused the difference and the potential for the difference to be thermally related.

Visual Encounter Surveys (Wildlife Observations)

Permanent survey sites were established on both the right and left descending banks at one location upstream of the KIF thermal discharge, centered around CRM 4.4 just below the confluence of the Emory and Clinch Rivers (Figure 4), and at a second location downstream of the discharge, centered around CRM 1.5 (Figure 5). Each survey site spanned a distance of 2,100 m along the shoreline, and the beginning and ending points were marked with GPS for relocation.

Surveys were conducted by steadily traversing the site by boat, at approximately 30 m offshore and parallel to the shoreline, and simultaneously recording observations of wildlife. The sampling frame of each survey generally followed the strip or belt transect concept: from the center-line of each transect landward to an area that included the shoreline and riparian zone (i.e., belt width generally averages 60 m where vision is not obscured), all individuals observed were enumerated. Wildlife observed visually or detected audibly was identified to the lowest taxonomic trophic level, and a direct count of individuals observed per trophic level was recorded. If a flock of a species or a mixed flock of a group of species was observed, numbers of individuals present of each species were estimated. Time was recorded at the start and end points of each site to provide a general measure of effort expended. Variation of observation times among sites was primarily due to the difficulty of approaching some wildlife species without inadvertently flushing them from basking or perching sites.

The principal objective of the surveys was to provide a preliminary set of observations to verify that trophic levels of birds, mammals and reptiles were not affected by thermal effects from the KIF discharge. If expected trophic levels were not represented, further investigation will be used to target particular species or species groups (guilds) in an attempt to determine the cause.

Watts Bar Reservoir Flow

Daily average discharges from Melton Hill Dam were added to daily flows measured at the USGS stream gage at ERM 18 (Oakdale, TN) to describe the amount of water flowing past KIF. Values were obtained from TVA's River Operations database and the USGS website, respectively.

Thermal Plume Characterization

Physical measurements to characterize and map the KIF thermal plume were collected concurrent with biological field sampling. The plume was characterized under representative thermal maxima and seasonally-expected low flow conditions. Measurements were collected during periods of normal operation of KIF, as reasonably practicable, to capture the thermal plume under existing river flow/reservoir elevation conditions. This effort evaluated potential impacts on recreation and water supply uses and allowed general delineation of the "Primary Study Area" – per the EPA (1977) draft guidance defined as the "*entire geographic area bounded annually by the locus of the 2°C above ambient surface isotherms as these isotherms are distributed throughout an annual period*" – ensuring placement of the biological sampling locations within thermally influenced areas.

However, it is important to emphasize that the ≥2ºC isopleth boundary is not a bright line; it is dynamic, changing geometrically in response to changes in ambient river flows and temperatures and KIF operations. As such, samples collected outside of, but generally proximate to the Primary Study Area boundary cannot be considered free of thermal influence and thus should not be discounted. Every effort was made to collect biological samples in thermally affected areas as guided by the Primary Study Area definition.

Depth profiles of temperature from the river surface to the bottom were collected at points along transects crossing the plume. One transect was located proximate to the thermal discharge point; subsequent downstream transects were concentrated in the near field area of the plume where the change in plume temperature was expected to be most rapid. The distance between transects in the remainder of the Primary Study Area increased with distance downstream (or away from the discharge point). The farthest downstream transect was just outside of the Primary Study Area. A transect upstream of the discharge, in an area not affected by the thermal plume, was included for determining ambient temperature conditions. The total number of transects needed to fully characterize and delineate the plume was determined in the field.

Collection of temperature profiles along a given transect began at or near the shoreline from which the discharge originated and continued until the far shore was reached. Measurements across a transect were typically conducted at points 10%, 30%, 50%, 70%, and 90% from the originating shoreline, though the number of measurement points along transects was sometimes increased in proportion to the magnitude of the temperature change across a given transect. The distances between transects, and between points of measurement along each transect, depended on the size of the discharge plume.

Temperature data were compiled and analyzed to present the horizontal and vertical dimensions of the KIF thermal plume, using spatial analysis techniques to yield plume cross-sections which can be used to demonstrate the existence of a zone of passage for fish and other aquatic species under or around the plume.

Water Quality Parameters at Fish Sampling Sites during RFAI Samples

Water quality conditions were measured using a Hydrolab® that provided readings for water temperature (°C), conductivity (µS/cm), dissolved oxygen (ppm), and pH. Within each of the electrofishing sample reaches upstream and downstream of KIF, transects were established across the river at the most upstream boundary, at mid-reach, and at the most downstream boundary. Along each transect, samples were collected at the RDB, in mid-channel, and at the LDB by recording readings at one- to two-meter intervals along a vertical gradient from just above the bottom of the river to approximately 0.3 meters from the surface.

Water Supply and Recreational Use Support Evaluation

Water temperature data collected as part of the thermal mapping, and collection of supporting water quality information were used to evaluate potential thermal impacts to water supply and recreational uses in the vicinity (within 10 river miles downstream) of KIF. Locations of public water supply intakes or established public recreational areas (if any) were determined and their positions were mapped relative to the KIF thermal plume. The existence of any relevant water temperature data collected by the owners of these water supply intake(s) will be determined; and if available, requested to augment the data collected in the field. As necessary (limited or no available owner-supplied temperature data), direct measurements of water temperature may also be conducted specifically at these locations to evaluate potential thermal effects of the KIF discharge.

Table A-1. Shoreline Aquatic Habitat Index (SAHI) metrics and scoring criteria

Metric	Scoring Criteria	Score
Cover	Stable cover (boulders, rootwads, brush, logs, aquatic vegetation, artificial structures) in 25 to 75 % of the drawdown zone	5
	Stable cover in 10 to 25 % or > 75 % of the drawdown zone	3
	Stable Cover in < 10 % of the drawdown zone	1
Substrate	Percent of drawdown zone with gravel substrate > 40	5
	Percent of drawdown zone with gravel substrate between 10 and 40	3
	Percent substrate gravel < 10	1
Erosion	Little or no evidence of erosion or bank failure. Most bank surfaces stabilized by woody vegetation.	5
	Areas of erosion small and infrequent. Potential for increased erosion due to less desirable vegetation cover (grasses) on > 25 % of bank surfaces.	3
	Areas of erosion extensive, exposed or collapsing banks occur along > 30% of shoreline.	1
Canopy Cover	Tree or shrub canopy > 60 % along adjacent bank	5
	Tree or shrub canopy 30 to 60 % along adjacent bank	3
	Tree or shrub canopy < 30 % along adjacent bank	1
Riparian Zone	Width buffered > 18 meters	5
	Width buffered between 6 and 18 meters	3
	Width buffered < 6 meters	1
Habitat	Habitat diversity optimum. All major habitats (logs, brush, native vegetation, boulders, gravel) present in proportions characteristic of high quality, sufficient to support all life history aspects of target species. Ready access to deeper sanctuary areas present.	5
	Habitat diversity less than optimum. Most major habitats present, but proportion of one is less than desirable, reducing species diversity. No ready access to deeper sanctuary areas.	3
	Habitat diversity is nearly lacking. One habitat dominates, leading to lower species diversity. No ready access to deeper sanctuary areas.	1
Gradient	Drawdown zone gradient abrupt (> 1 meter per 10 meters). Less than 10 percent of shoreline with abrupt gradient due to dredging.	5
	Drawdown zone gradient abrupt. (> 1 meter per 10 meters) in 10 to 40 % of the shoreline resulting from dredging. Rip-rap used to stabilize bank along > 10 % of the shoreline.	3
	Drawdown zone gradient abrupt in > 40 % of the shoreline resulting from dredging. Seawalls used to stabilize bank along > 10 % of the shoreline.	1

Table A-2. Expected trophic guild proportions* and expected numbers of fish species* in upper mainstem Tennessee River reservoir transition zones, compared to values observed during monitoring conducted in autumn 2017 at Kingston Fossil Plant.

	Transition Zones in Upper Mainstem Tennessee River								**Observed Downstream of KIF (CRM 1.5) – Autumn 2017**		**Observed Upstream of KIF (CRM 4.4) – Autumn 2017**	
	Proportion (%)				**Number of species**							
	Trisected range [a]			**Average [b]**	**Trisected range [a]**			**Average [b]**				
Trophic Guild	**-**	**Expected**	**+**		**-**	**Expected**	**+**		**Proportion (%)**	**Number of Species**	**Proportion (%)**	**Number of Species**
Benthic Invertivore	< 2.6	2.6 to 5.3	> 5.3	3.2 $\pm$ 0.2	< 2	2 to 4	> 4	3.9 $\pm$ 0.2	4.34	5	5.45	6
Insectivore	< 25.3	25.3 to 50.7	> 50.7	46.6 $\pm$ 2.3	< 4	4 to 9	> 9	9.8 $\pm$ 0.5	61.04	11	65.02	12
Top Carnivore	< 18.8	18.8 to 37.6	> 37.6	17.1 $\pm$ 0.9	< 5	5 to 9	> 9	10.9 $\pm$ 0.5	9.46	13	12.03	13
Omnivore	> 40.3	20.2 to 40.3	< 20.2	28.5 $\pm$ 1.4	> 6	3 to 6	< 3	6.8 $\pm$ 0.3	24.68	7	17.40	7
Planktivore	> 21.0	10.5 to 21.0	< 10.5	3.1 $\pm$ 0.2	0	1	> 1	1.1 $\pm$ 0.1	0.32	1	0.09	1
Herbivore	< 0.2	0.2 to 0.4	> 0.4	0.2 $\pm$ 0.0	0	1	> 1	1.1 $\pm$ 0.1	--	--	--	--
Specialized Insectivore	--	--	--	--	--	--	--	--	0.16	1	--	--
Parasitic	--	--	--	--	--	--	--	--	--	--	--	--

**Expected values were calculated from data collected over 750 electrofishing runs and 500 overnight experimental gill net sets in transition areas of upper mainstem Tennessee River Reservoirs.*

[a] Trisected ranges are intended to show below expected (-), expected, and above expected (+) values for trophic level proportions and species occurring within the transition zones in upper mainstem Tennessee River reservoirs.

[b] Average expected values are bound by 95% confidence intervals.

Table A-3. RFAI scoring criteria (2002) for forebay, transition, and inflow sections of upper mainstem reservoirs* in the Tennessee River system

		Scoring Criteria								
		Forebay			Transition			Inflow		
Metric	**Gear**	**1**	**3**	**5**	**1**	**3**	**5**	**1**	**3**	**5**
1. Total number of indigenous species	Combined	<14	14-27	>27	<15	15-29	>29	<14	14-27	>27
2. Number of centrarchid species	Combined	<2	2-4	>4	<2	2-4	>4	<3	3-4	>4
3. Number of benthic invertivores	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
4. Number of intolerant species	Combined	<2	2-4	>4	<2	2-4	>4	<2	2-4	>4
5. Percent of tolerant individuals	Electrofishing	>62%	31-62%	<31%	>62%	31-62%	<31%	>58%	29-58%	<29%
	Gill netting	>28%	14-28%	<14%	>32%	16-32%	<16%			
6. Percent dominance by one species	Electrofishing	>50%	25-50%	<25%	>40%	20-40%	<20%	>46%	23-46%	<23%
	Gill netting	>29%	15-29%	<15%	>28%	14-28%	<14%			
7. Percent of non-indigenous species	Electrofishing	>4%	2-4%	<2%	>6%	3-6%	<3%	>17%	8-17%	<8%
	Gill netting	>16%	8-16%	<8%	>9%	5-9%	<5%			
8. Number of top carnivore species	Combined	<4	4-7	>7	<4	4-7	>7	<3	3-6	>6
9. Percent of individuals as top carnivores	Electrofishing	<5%	5-10%	>10%	<6%	6-11%	>11%	<11%	11-22%	>22%
	Gill netting	<25%	25-50%	>50%	<26%	26-52%	>52%			
10. Percent of individuals as omnivores	Electrofishing	>49%	24-49%	<24%	>44%	22-44%	<22%	>55%	27-55%	<27%
	Gill netting	>34%	17-34%	<17%	>46%	23-46%	<23%			
11. Average number per run	Electrofishing	<121	121-241	>241	<105	105-210	>210	<51	51-102	>102
	Gill netting	<12	12-24	>24	<12	12-24	>24			
12. Percent of individuals with anomalies	Electrofishing	>5%	2-5%	<2%	>5%	2-5%	<2%	>5%	2-5%	<2%
	Gill netting	>5%	2-5%	<2%	>5%	2-5%	<2%			

**Upper mainstem reservoirs include Chickamauga, Fort Loudon, Melton Hill, Nickajack, Tellico, and Watts Bar. Transition scoring criteria were used for sites upstream and downstream of Kingston Fossil Plant.*

Table A-4. Scoring criteria for laboratory-processed benthic macroinvertebrate community samples from inflow, transition, and forebay sections of mainstem Tennessee River reservoirs

Benthic Community Metrics	Scoring Criteria								
	Inflow			Transition Zone			Forebay		
	1	3	5	1	3	5	1	3	5
1. Average number of taxa	<4.2	4.2-8.3	>8.3	<3.3	3.3-6.6	>6.6	<2.8	2.8-5.5	>5.5
2. Proportion of samples with long-lived organisms	<0.6	0.6-0.8	>0.8	<0.6	0.6-0.9	>0.9	<0.6	0.6-0.8	>0.8
3. Average number of EPT taxa	<0.9	0.9-1.9	>1.9	<0.6	0.6-1.4	>1.4	<0.6	0.6-0.9	>0.9
4. Average proportion of oligochaete individuals	>23.9	23.9-12.0	<12.0	>21.9	21.9-11.0	<11.0	>41.9	41.9-21.0	<21.0
5. Average proportion of total abundance comprised by the two most abundant taxa	>86.2	86.2-73.1	<73.1	>87.9	87.9-77.8	<77.8	>90.3	90.3-81.7	<81.7
6. Average density excluding chironomids and oligochaetes	<400.0	400.0-799.9	>799.9	<305.0	305.0-609.9	>609.9	<125.0	125.0-249.9	>249.9
7. Zero Samples: proportion of samples containing no organisms	>0	-	0	>0	-	0	>0	-	0

Transition scoring criteria were used to score sites upstream and downstream of KIF.

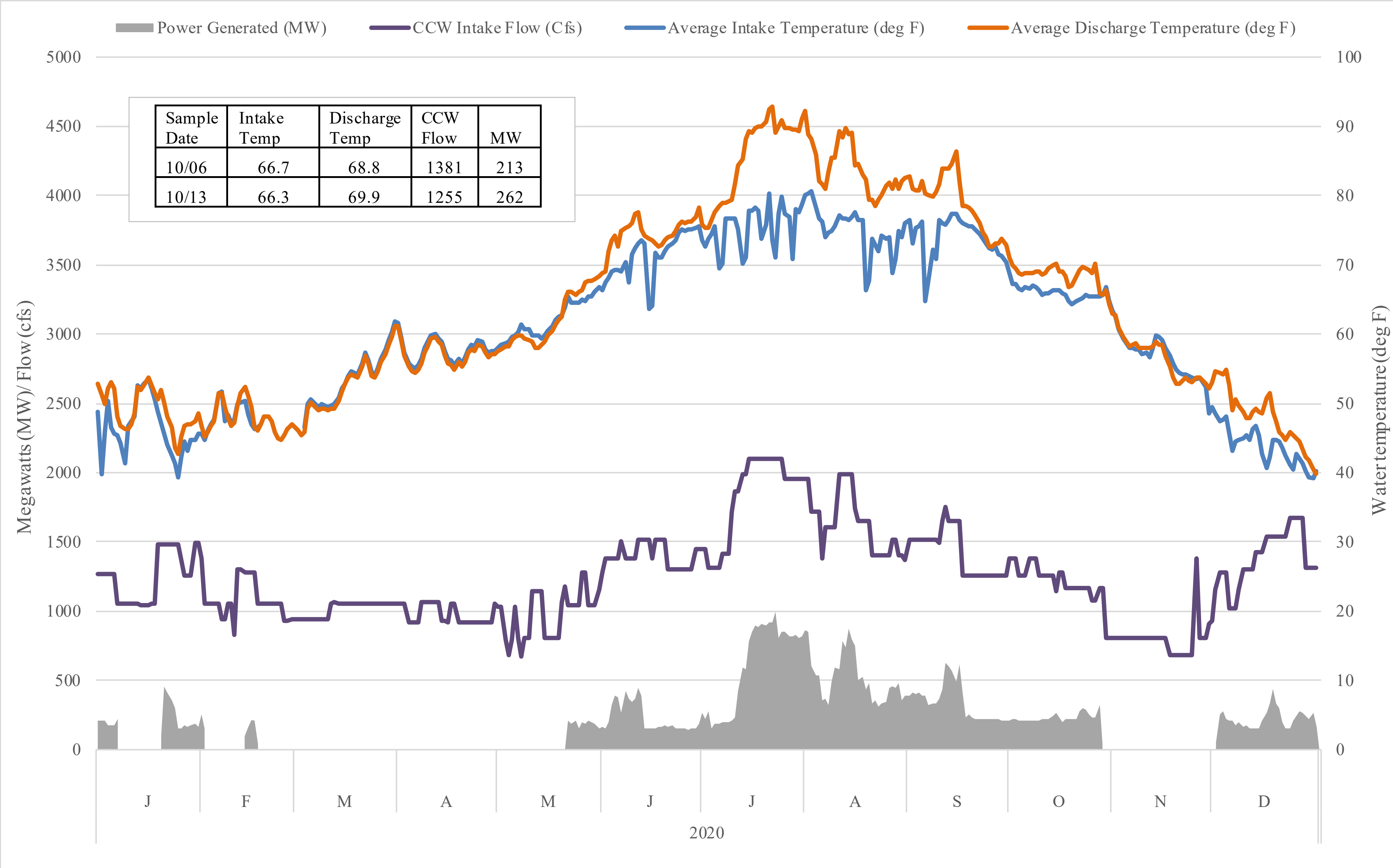
Appendix B. Evaluation of Kingston Fossil Plant operating conditions during 2014-2020

Evaluation of Plant Operating Conditions

Relevant KIF operations data—mean daily temperatures at the CCW intake and discharge, mean daily flow through the CCW system, and mean daily power generation by the fossil units at KIF—were compiled from 2014 through 2020.

During 2020, biological monitoring was conducted upstream and downstream of KIF on October 6 and 13. Respective to these dates, daily mean generation on these dates were 213 and 262 MW; mean daily flow through the condenser circulating water (CCW) system was 1381 and 1255 cfs; average intake temperatures were 66.7 and 66.3 °F; and average discharge temperatures 68.8 and 69.9 °F (Figure B-1, Table B-1).

Generation at KIF has decreased significantly since 2014 and has remained well below the historic average (TVA 2018). During 2020, daily mean generation ranged from 56 to 638 MW. Daily intake temperatures ranged from 43.7 to 75.5 °F and averaged 60.8 °F; discharge temperatures ranged from 47.7 to 85.9 °F and averaged 63.7 °F. Daily flow through the CCW system was, on average, 12% of mean daily river flows and ranged from 804 to 1845 cfs (Figure B-2).



Sample Date	Intake Temp	Discharge Temp	CCW Flow	MW
10/06	66.7	68.8	1381	213
10/13	66.3	69.9	1255	262

Figure B-1. Daily average intake and discharge temperatures, flow through the condenser cooling water (CCW) system, and daily average power generated by Kingston Fossil Plant during 2020

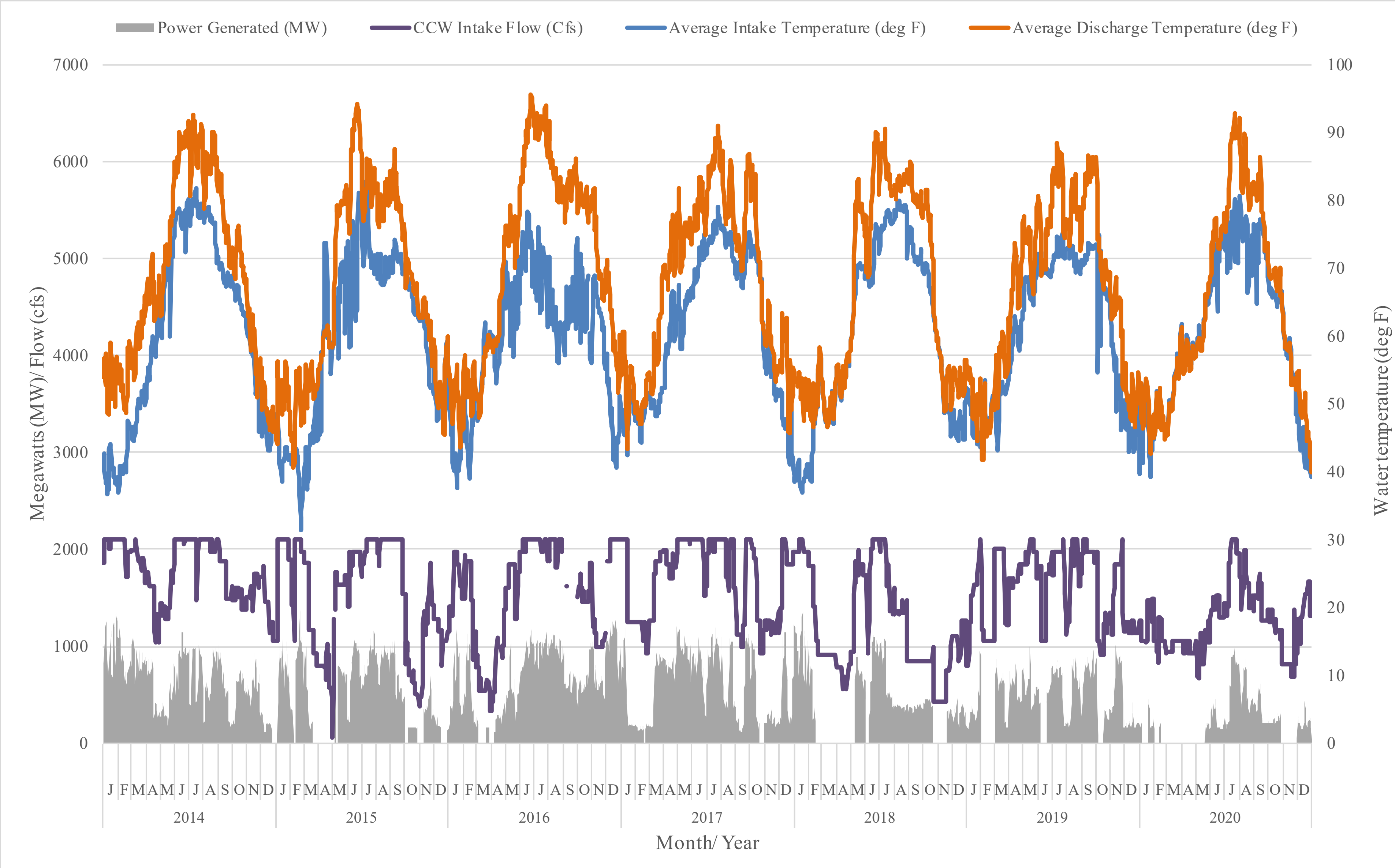


Figure B-2. Daily average intake and discharge temperatures and flow through the condenser cooling water (CCW) system, and daily average power generated by Kingston Fossil Plant from 2014 through 2020

Table B-1. Intake and discharge water temperatures (°F), megawatts generated, and flow* (cfs) of the condenser circulating water (CCW) system at Kingston Fossil Plant and flow past the plant, 2014-2020

		Intake Temperature (°F)	Discharge Temperature (°F)	CCW Flow	Total Generation	Flow Past KIF
2014	January	40.0	54.3	2075	1013	11012
	February	42.1	53.8	2001	838	10611
	March	48.7	59.6	1921	826	7101
	April	57.7	66.4	1452	580	4514
	May	67.8	72.6	1472	392	2568
	June	77.7	87.9	2095	865	1931
	July	78.9	88.3	2064	762	2259
	August	76.6	85.4	2059	653	3570
	September	68.9	77.0	1736	566	4229
	October	65.2	71.3	1488	526	7103
	November	55.0	58.6	1619	585	9426
	December	46.6	49.1	1388	195	9550
	AVG	**60.5**	**68.8**	**1780**	**659**	**6132**
2015	January	42.8	50.7	1946	750	9882
	February	39.8	48.5	1881	744	7366
	March	43.8	52.6	1342	458	17889
	April	59.2	58.7	751	-	9418
	May	65.1	75.7	1937	954	2287
	June	70.0	87.1	1855	752	2074
	July	74.9	82.2	2018	831	7833
	August	69.7	79.9	2073	839	6479
	September	71.3	80.0	2006	690	4236
	October	65.7	67.8	708	158	4652
	November	57.9	61.8	1182	377	4157
	December	52.0	53.1	1157	188	14327
	AVG	**59.5**	**66.6**	**1570**	**647**	**7580**
2016	January	44.1	50.4	1630	564	9913
	February	46.5	52.5	1513	563	16034
	March	55.3	54.8	599	157	6254
	April	60.1	63.3	879	256	1706
	May	64.7	75.3	1686	542	2335
	June	72.8	89.5	2063	911	4415
	July	69.0	90.8	2051	957	5309
	August	61.8	83.4	2051	997	5458
	September	64.3	82.0	1693	624	2399
	October	63.0	80.0	1602	687	2176
	November	63.2	71.4	1079	700	1024
	December	47.3	61.0	2050	1049	5513
	AVG	**59.3**	**71.2**	**1567**	**700**	**5183**

Table B-1 (continued).

		Intake Temperature (°F)	Discharge Temperature (°F)	CCW Flow	Total Generation	Flow Past KIF
2017	January	48.3	52.9	1635	454	9790
	February	48.4	50.3	1137	161	6003
	March	50.3	59.0	1703	623	6762
	April	60.7	72.1	1861	833	10803
	May	64.1	75.0	2099	959	12084
	June	70.9	78.7	1987	736	5179
	July	75.5	85.9	2073	927	4191
	August	73.5	80.1	1906	616	7289
	September	70.8	77.0	1482	517	3920
	October	68.6	73.5	1503	554	3718
	November	54.2	58.0	1233	237	4333
	December	47.2	55.7	1831	583	5065
	AVG	**61.1**	**68.3**	**1709**	**609**	**6605**
2018	January	39.3	52.2	2006	1025	2883
	February	47.9	51.8	1369	585	20267
	March	49.7	50.0	906	-	13757
	April	54.6	54.7	719	-	6872
	May	68.7	74.2	1604	689	3495
	June	71.0	79.8	1836	824	5372
	July	76.6	84.6	1803	680	2880
	August	78.3	82.6	1314	374	2522
	September	72.5	81.0	853	371	5470
	October	66.2	72.9	734	418	5161
	November	51.8	53.8	592	318	11573
	December	46.9	53.5	1116	312	15100
	AVG	**60.4**	**66.0**	**1239**	**573**	**7835**
2019	January	47.3	51.4	1491	358	16649
	February	47.8	47.3	1119	367	27632
	March	50.6	56.0	1797	491	21499
	April	59.6	68.2	1729	594	4181
	May	67.3	73.4	1957	561	6247
	June	70.1	75.0	1570	489	5283
	July	72.6	82.3	1877	609	5142
	August	71.4	77.9	1758	510	5319
	September	72.3	82.9	1981	721	3763
	October	68.3	72.3	1209	369	1933
	November	54.0	62.8	1618	615	5989
	December	46.7	50.9	1172	202	73983
	AVG	**60.7**	**66.8**	**1609**	**505**	**14788**

Table B-1 (continued).

		Intake Temperature (°F)	Discharge Temperature (°F)	CCW Flow	Total Generation	Flow Past KIF
2020	January	46.4	49.2	1248	222	15060
	February	47.9	47.7	1080	146	24950
	March	53.7	52.8	1014	-	17577
	April	57.5	56.9	977	-	16816
	May	62.2	62.4	987	172	10658
	June	71.5	74.7	1407	236	3455
	July	75.5	85.9	1845	638	2956
	August	74.9	83.7	1625	495	4081
	September	73.7	78.5	1424	334	4059
	October	65.8	68.4	1192	228	6502
	November	56.2	56.2	804	56	7303
	December	43.7	47.8	1390	219	7320
	AVG	**61.2**	**63.7**	**1251**	**331**	**9983**
2014-2019	Range	39.3–78.9	47.3–90.8	592–2099	157–1049	1024–73983
	Average	60.2	67.9	1579	598	8043
2020	Range	43.7–75.5	47.7–85.9	804–1845	56–638	2956–24950
	Average	64.9	66.9	1249	275	10061

Appendix C. Letter from TDEC to TVA dated September 17, 2001, approving use of RFAI as methodology in determining BIP status of aquatic community at TVA power plants

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LKP
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EDMS, BR 5G-C, Env. Doc. Type: NPDES Correspondence

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
401 CHURCH STREET
L & C ANNEX 6TH FLOOR
NASHVILLE TN 37243-1534

September 17, 2001

Ms. Janet K. Watts
Department Manager
1101 Market Street, LP 5D
Chattanooga, TN 37402

Subject: **TVA Studies Planned for Clean Water Act Section 316 purposes Cumberland River system – Cumberland (TN0005789), Gallatin (TN0005428) fossil plants; and Tennessee River system - Kingston (TN0005452), Bull Run (TN0005410), Johnsonville (TN0005444) fossil plants, and Mississippi River - Allen (TN0005355) fossil plant**

Dear Ms. Watts:

The Division of Water Pollution Control (the Division) has received the letter proposing studies for Section 316(a) thermal variances for the fossil plants in Tennessee. The Division agrees with evaluation of the reservoirs in the area of the discharges in the Cumberland and Tennessee River systems using TVA's Reservoir Fish Assemblage Index (RFAI). Sampling both upstream and downstream of the discharges that can be compared to the data from the Reservoir Vital Signs program will indicate whether adverse instream effects are seen in the outfall discharge areas. Tennessee agrees that any adverse impacts should be promptly investigated. Determination of any conclusion of adverse impact should be validated and the potential causes identified as quickly as possible.

The Division has some reservations concerning the Cumberland River system where there appears to be less data and where the TVA Vital Signs program has not been doing baseline sampling. However, the Division recognizes that over time, more data can be added for these reservoirs.

Tennessee agrees that monitoring of the fish assemblage for the three zonal areas (inflow, transition and forebay) and major embayments that have been identified will reflect the ecological health of the reservoir. In addition to the fish sampling, the Division would like to see the benthos be included in assessment of reservoir health. However, the Division recognizes that an acceptable methodology suitable for the reservoir systems is not available at this time. Perhaps the benthos can be evaluated under the Vital Signs program and a methodology developed for the aquatic sub-environments of the major reservoir systems. The Division believes using three zonal areas and major embayments for the evaluation of the reservoir system is a better approach than simply viewing the reservoirs as either "stream" or "lacustrine" environments.

For the John Sevier fossil plant, the Division agrees that no further biological study is called for at this time. However, it is anticipated that some sampling will be required prior to the permit expiration in 2004.

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FOSSIL POWER GROUP

The Division of Water Pollution Control anticipates that the collection of physical data on the Allen fossil plant discharge and near field Mississippi River characteristics should suffice to show that the discharge is not likely to have an adverse impact in the river below the discharge point.

The Division would like to see annual data collected in the Cumberland River system for the next three years. After that period, the Division would expect that the RFAI data be collected once every two years. The Tennessee River system may be sampled with a frequency of once every two years. The Division considers the long history of reservoir operation and the history of plant operations indicate that annual frequency is not necessary except where there are significant changes to either reservoir operations or to discharges made to the reservoirs.

If you have questions, please contact Mr. Larry Bunting at (615) 532-0665 or by E-mail at *lbunting@mail.state.tn.us.*

Sincerely,

Saya Ann Qualls

Saya Ann Qualls, P.E.
Manager, Permit Section
Division of Water Pollution Control

SAQ/LCBu
TVA316a_2001.doc
cc: Division of Water Pollution Control, Permit Section, Vojin Janjic
Division of Water Pollution Control, Environmental Assistance Centers-Memphis, Knoxville, Nashville, Johnson City
Permit files

> *[t]he Congress intended that there be a very limited waiver for those major sources of thermal effluents which could establish beyond any question the lack of relationship between federally established effluent limitations and that water quality which assures the protection of public water supplies and the protection and propagation of a balanced, indigenous population of fish, shellfish, and wildlife, and allows recreational activities, in and on the water.*

Congressional Research Service, "A Legislative History of the Water Pollution Control Act Amendments of 1977," Vol. IV, 95th Cong., 2nd Session, (cited hereinafter as the "1977 Legislative History"), at 642 (Senate Report); *see also id.* at 457.

EPA has not, however, interpreted § 316(a) to require absolute certainty before a variance could be granted. *Seabrook*, 1977 EPA App. LEXIS 16, at *32. In reality, achieving absolute certainty about a § 316(a) determination is likely to be impossible. *See id.* EPA has stated, however, that "[t]he greater the risk, the greater the degree of certainty that should be required." *Id. See also* 44 Fed. Reg. at 32,894.

The above material suggests that EPA should take a conservative approach to assessing variance applications in order to ensure that the standard of assuring the protection and propagation of the BIP is satisfied. Such an approach is also appropriate in light of the fact that the applicant for a § 316(a) variance is asking to be excused from the otherwise applicable limitations, and given the CWA's overarching goal of restoring and maintaining the "biological integrity of the Nation's waters," 33 U.S.C. § 1251(a), and attaining "water quality which provides for the protection and propagation of fish, shellfish and wildlife." 33 U.S.C. § 1251(a)(2).

While the variance applicant's burden is a stringent one, EPA's NPDES permit decisions are subject to the "arbitrary and capricious" standard of review under the Administrative Procedures Act. 5 U.S.C. §§ 701–706. Thus, EPA decisions regarding whether a permit applicant has carried its burden in seeking a § 316(a) variance, and in setting the thermal discharge limits included in the permit, must have a rational basis and be consistent with applicable law.

With respect to the question of how much evidence is needed to support a § 316(a) variance, EPA has explained that, "no hard and fast rule can be made as to the amount of data that must be furnished . . . and much depends on the circumstances of the particular discharge and receiving waters." *Seabrook*, 1977 EPA App. LEXIS 16, at *31. At the same time, information requirements are likely to increase to the extent that there is greater reason for concern over the protection and propagation of the BIP. As EPA stated in the preamble to its current § 316(a)-related regulations in 40 C.F.R. Part 125, Subpart H:

> *Section 125.72 accordingly gives the Director the flexibility to require substantially less information in the case of renewal requests. This does not mean, however, that the Director may not require a full demonstration for a*

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Table 5-2. Species identified by Merrimack Station as being representative of the fish community in Hooksett Pool

1. Alewife	(Alosa pseudoharengus)
2. American shad	(Alosa sapidissima)
3. Atlantic salmon	*(Salmo salar)*
4. Fallfish	(Semotilus corporalis)
5. Largemouth bass	(*Micropterus salmoides*)
6. Pumpkinseed	(*Lepomis gibbosus*)
7. Smallmouth bass	(*Micropterus dolomieu*)
8. White sucker	(Catostomus commersoni)
9. Yellow perch	(*Perca flavescens*)

EPA agrees that the species listed were part of the balanced, indigenous fish community in 1967. Merrimack Station's data and analyses of these species are an important component of EPA's assessment of thermal impacts. However, while it is appropriate to identify and focus on representative important species for "predictive" § 316(a) demonstrations, non-predictive (*i.e.*, retrospective, or "Type I") demonstrations, which are designed to assess prior appreciable harm, should not be restricted to assessing the status of representative important species. In fact, EPA's Draft 1977 316(a) Technical Guidance recommends that references to Representative Important Species be eliminated from Type I demonstrations (EPA 1977a). Merrimack Station's § 316(a) demonstration is largely retrospective (Type I). Therefore, EPA's assessment of the balanced, indigenous fish community of Hooksett Pool encompassed all species present in 1967. This does not mean that every species of fish present in 1967 requires an in-depth review, but when assessing community-wide impacts, there is no reason to exclude any resident species that was present prior to the increase in discharges of heated effluent to Hooksett Pool.

5.3.2 Other Aquatic Communities

Assessing changes in the resident fish community of a water body often provides the most conspicuous evidence of impacts to the overall aquatic community, but a complete §316(a) variance demonstration is not limited to fish. Planktonic organisms (*e.g.* phytoplankton, zooplankton, meroplankton), macroinvertebrates (*e.g.*, shellfish), habitat formers (*e.g.*, subaquatic vegetation), and wildlife are all supposed to be assessed at the level of detail appropriate to the facility's potential to impact these communities. EPA provides specific guidance for facilities developing demonstrations in its Draft 1977 316(a) Technical Guidance.

Merrimack Station does not assess impacts to aquatic communities other than fish in the Fisheries Analysis Report. However, it does state that the Station's past and current operations have resulted in no appreciable harm to the balanced, indigenous populations of fish and other aquatic organisms in the segment of the Merrimack River receiving the Station's thermal discharge. Merrimack Station bases this conclusion on all reports, past and present, prepared by

Appendix E. Results from fish community monitoring upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil Plant during summer and autumn 2020

Table E-1. Individual metric scores and the total Reservoir Fish Assemblage Index scores upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil plant for samples collected during summer 2020

Summer 2020 Metric		CRM 1.5 Obs	CRM 1.5 Score	CRM 4.4 Obs	CRM 4.4 Score
A. Species richness and composition					
1. Number of indigenous species (Tables E-3 and E-4)	Combined	**28**	**3**	**33**	**5**
2. Number of centrarchid species (less *Micropterus*)	Combined	**6** Black crappie Bluegill Green sunfish Longear sunfish Redear sunfish Warmouth	**5**	**4** Black crappie Bluegill Longear sunfish Redear sunfish	**3**
3. Number of benthic invertivore species	Combined	**5** Black redhorse Freshwater drum Golden redhorse Logperch Spotted sucker	**3**	**6** Black redhorse Freshwater drum Golden redhorse Logperch Silver redhorse Spotted sucker	**3**
4. Number of intolerant species	Combined	**6** Black redhorse Brook silverside Longear sunfish Skipjack herring Smallmouth bass Spotted sucker	**5**	**7** Black redhorse Brook silverside Longear sunfish Rock bass Skipjack herring Smallmouth bass Spotted sucker	**5**

Table E-1. (Continued)

Summer 2020 Metric		CRM 1.5 Obs		Score	CRM 4.4 Obs		Score
5. Percent tolerant individuals	Electrofishing	**56.3%**		**1.5**	**69.0%**		**0.5**
		Bluegill	22.8%		Bluegill	27.9%	
		Bluntnose minnow	9.9%		Bluntnose minnow	13.9%	
		Common carp	1.7%		Common carp	0.4%	
		Gizzard shad	10.2%		Gizzard shad	20.8%	
		Green sunfish	1.2%		Largemouth bass	3.1%	
		Largemouth bass	4.2%		Redbreast sunfish	0.1%	
		Redbreast sunfish	2.7%		Spotfin shiner	2.7%	
		Spotfin shiner	3.5%				
	Gill Netting	**19.9%**		**1.5**	**9.6%**		**2.5**
		Bluegill	0.7%		Common carp	1.0%	
		Common carp	2.7%		Gizzard shad	6.7%	
		Gizzard shad	5.5%		Longnose gar	1.9%	
		Largemouth bass	3.4%				
		Longnose gar	6.8%				
		River carpsucker	0.7%				
6. Percent dominance by one species	Electrofishing	**23.3%**		**1.5**	**27.9%**		**1.5**
		Logperch			Bluegill		
	Gill Netting	**24.0%**		**1.5**	**21.2%**		**1.5**
		Yellow bass			Yellow bass		
7. Percent non-indigenous species	Electrofishing	**7.7%**		**0.5**	**5.9%**		**1.5**
		Common carp	1.7%		Common carp	0.4%	
		Mississippi silverside	3.2%		Mississippi silverside	5.2%	
		Redbreast sunfish	2.7%		Redbreast sunfish	0.1%	
					Yellow perch	0.1%	
	Gill Netting	**3.4%**		**2.5**	**2.9%**		**2.5**
		Common carp	2.7%		Common carp	1.0%	
		Striped bass	0.7%		Striped bass	1.9%	

Table E-1. (Continued)

Summer 2020 Metric		CRM 1.5 Obs		Score	CRM 4.4 Obs		Score
8. Number of top carnivore species	Combined	**8**		**5**	**13**		**5**
		Black crappie			Black crappie		
		Largemouth bass			Flathead catfish		
		Longnose gar			Largemouth bass		
		Skipjack herring			Longnose gar		
		Smallmouth bass			Rock bass		
		Walleye			Sauger		
		White bass			Skipjack herring		
		Yellow bass			Smallmouth bass		
					Spotted bass		
					Spotted gar		
					Walleye		
					White bass		
					Yellow bass		
B. Trophic composition							
9. Percent top carnivores	Electrofishing	**5.5%**		**0.5**	**5.2%**		**0.5**
		Hybrid bass	0.2%		Black crappie	0.4%	
		Largemouth bass	4.2%		Largemouth bass	3.1%	
		Skipjack herring	0.2%		Smallmouth bass	0.3%	
		Smallmouth bass	0.7%		Spotted bass	0.1%	
		Black crappie	0.7%		Spotted gar	1.1%	
		Hybrid bass	0.2%		Yellow bass	0.1%	
					Black crappie	0.4%	
					Largemouth bass	3.1%	
					Smallmouth bass	0.3%	
	Gill Netting	**52.7%**		**2.5**	**49.2%**		**1.5**
		Black crappie	0.7%		Black crappie	1.0%	
		Largemouth bass	3.4%		Flathead catfish	1.0%	
		Longnose gar	6.8%		Longnose gar	1.9%	
		Skipjack herring	3.4%		Rock bass	3.8%	
		Smallmouth bass	0.7%		Sauger	1.0%	
		Striped bass	0.7%		Skipjack herring	1.0%	
		Walleye	0.7%		Spotted gar	1.0%	
		White bass	12.3%		Striped bass	1.9%	
		Yellow bass	24.0%		Walleye	7.7%	
					White bass	7.7%	
					Yellow bass	21.2%	

Table E-1. (Continued)

Summer 2020 Metric		CRM 1.5 Obs		Score	CRM 4.4 Obs		Score
10. Percent omnivores	Electrofishing	**24.1%**		**1.5**	**39.3%**		**1.5**
		Black buffalo	0.2%		Black buffalo	0.8%	
		Bluntnose minnow	9.9%		Bluntnose minnow	13.9%	
		Channel catfish	1.7%		Channel catfish	0.7%	
		Common carp	1.70%		Common carp	0.4%	
		Gizzard shad	10.2%		Gizzard shad	20.8%	
		Smallmouth buffalo	0.2%		Smallmouth buffalo	2.5%	
	Gill Netting	**27.4%**		**1.5**	**32.7%**		**1.5**
		Black buffalo	1.4%		Blue catfish	15.4%	
		Blue catfish	5.5%		Channel catfish	5.8%	
		Channel catfish	9.6%		Common carp	1.0%	
		Common carp	2.7%		Gizzard shad	6.7%	
		Gizzard shad	5.5%		Quillback	1.0%	
		River carpsucker	0.7%		Smallmouth buffalo	2.9%	
		Smallmouth buffalo	2.1%				
C. Fish abundance and health							
11. Average number per run	Electrofishing	**26.9**		**0.5**	**47.3**		**0.5**
	Gill Netting	**14.6**		**1.5**	**10.4**		**0.5**
12. Percent anomalies	Electrofishing	**1.5%**		**2.5**	**1.4%**		**2.5**
	Gill Netting	**0.0%**		**2.5**	**0.0%**		**2.5**
Overall RFAI Score				**43 Good**			**42 Good**

Table E-2. Individual metric scores and the total Reservoir Fish Assemblage Index scores upstream (CRM 4.4) and downstream (CRM 1.5) of Kingston Fossil plant for samples collected during autumn 2020

Fall 2020		CRM 1.5		CRM 4.4	
Metric		Obs	Score	Obs	Score
A. Species richness and composition					
1. Number of indigenous species (Tables E-5 and E-6)	Combined	**28**	**3**	**29**	**3**
2. Number of centrarchid species (less *Micropterus*)	Combined	**5** Bluegill Green sunfish Longear sunfish Redear sunfish Warmouth	**5**	**5** Bluegill Green sunfish Longear sunfish Redear sunfish Warmouth	**5**
3. Number of benthic invertivore species	Combined	**5** Black redhorse Freshwater drum Golden redhorse Logperch Spotted sucker	**3**	**5** Black redhorse Freshwater drum Golden redhorse Logperch Spotted sucker	**3**
4. Number of intolerant species	Combined	**6** Black redhorse Brook silverside Longear sunfish Skipjack herring Smallmouth bass Spotted sucker	**5**	**7** Black redhorse Brook silverside Longear sunfish Rock bass Skipjack herring Smallmouth bass Spotted sucker	**5**

Table E-2. (Continued)

Fall 2020		CRM 1.5			CRM 4.4		
Metric		Obs		Score	Obs		Score
5. Percent tolerant individuals	Electrofishing	**65.4%**		**0.5**	**62.2%**		**0.5**
		Bluegill	32.0%		Bluegill	40.0%	
		Bluntnose minnow	1.8%		Bluntnose minnow	0.4%	
		Common carp	0.6%		Common carp	0.3%	
		Gizzard shad	7.4%		Gizzard shad	1.7%	
		Green sunfish	1.6%		Green sunfish	1.7%	
		Largemouth bass	9.3%		Largemouth bass	7.8%	
		Redbreast sunfish	1.8%		Longnose gar	0.1%	
		Spotfin shiner	11.0%		Redbreast sunfish	0.1%	
					Spotfin shiner	10.1%	
	Gill Netting	**11.5%**		**2.5**	**14.3%**		**2.5**
		Common carp	3.8%		Bluegill	2.2%	
		Gizzard shad	5.8%		Common carp	2.2%	
		Largemouth bass	1.9%		Gizzard shad	9.9%	
6. Percent dominance by one species	Electrofishing	**32.0%**		**1.5**	**40.0%**		**1.5**
		Bluegill			Bluegill		
	Gill Netting	**15.4%**		**1.5**	**20.9%**		**1.5**
		Blue catfish			Skipjack herring		
7. Percent non-indigenous species	Electrofishing	**8.6%**		**0.5**	**16.6%**		**0.5**
		Common carp	0.6%		Common carp	0.3%	
		Mississippi silverside	6.1%		Mississippi silverside	15.7%	
		Redbreast sunfish	1.8%		Redbreast sunfish	0.1%	
		Yellow perch	0.1%		Yellow perch	0.5%	
	Gill Netting	**9.6%**		**0.5**	**5.5%**		**1.5**
		Common carp	3.8%		Common carp	2.2%	
		Striped bass	5.8%		Striped bass	3.3%	

Table E-2. (Continued)

Fall 2020 Metric		CRM 1.5 Obs		Score	CRM 4.4 Obs		Score
8. Number of top carnivore species	Combined	**7**		**3**	**10**		**5**
		Largemouth bass			Flathead catfish		
		Skipjack herring			Largemouth bass		
		Smallmouth bass			Longnose gar		
		Spotted bass			Rock bass		
		Walleye			Skipjack herring		
		White bass			Smallmouth bass		
		Yellow bass			Spotted bass		
					Walleye		
					White bass		
					Yellow bass		
B. Trophic composition							
9. Percent top carnivores	Electrofishing	**11.4%**		**2.5**	**5.2%**		**1.5**
		Largemouth bass	9.3%		Largemouth bass	7.8%	
		Smallmouth bass	1.5%		Longnose gar	0.1%	
		Spotted bass	0.6%		Rock bass	0.1%	
					Smallmouth bass	0.8%	
					Spotted bass	0.9%	
					Walleye	0.1%	
					White bass	0.2%	
	Gill Netting	**40.4%**		**1.5**	**54.9%**		**2.5**
		Largemouth bass	1.9%		Flathead catfish	2.2%	
		Skipjack herring	1.9%		Skipjack herring	20.9%	
		Striped bass	5.8%		Smallmouth bass	2.2%	
		Walleye	5.8%		Striped bass	3.3%	
		White bass	11.5%		Walleye	16.5%	
		Yellow bass	13.5%		White bass	3.3%	
					Yellow bass	6.6%	

Table E-2. (Continued)

Fall 2020 Metric		CRM 1.5 Obs		Score	CRM 4.4 Obs		Score
10. Percent omnivores	Electrofishing	**11.1%**		**2.5**	**3.9%**		**2.5**
		Bluntnose minnow	1.8%		Bluntnose minnow	0.4%	
		Channel catfish	0.6%		Channel catfish	0.7%	
		Common carp	0.6%		Common carp	0.3%	
		Gizzard shad	7.4%		Gizzard shad	1.7%	
		Smallmouth buffalo	0.8%		Smallmouth buffalo	0.8%	
	Gill Netting	**36.5%**		**1.5**	**29.7%**		**1.5**
		Blue catfish	15.4%		Blue catfish	11.0%	
		Channel catfish	3.8%		Channel catfish	5.5%	
		Common carp	3.8%		Common carp	2.2%	
		Gizzard shad	5.8%		Gizzard shad	9.9%	
		Quillback	1.9%		Smallmouth buffalo	1.1%	
		Smallmouth buffalo	5.8%				
C. Fish abundance and health							
11. Average number per run	Electrofishing	**53.3**		**0.5**	**66.0**		**0.5**
	Gill Netting	**5.2**		**0.5**	**9.1**		**0.5**
12. Percent anomalies	Electrofishing	**4.6%**		**1.5**	**2.1%**		**1.5**
	Gill Netting	**0.0%**		**2.5**	**0.0%**		**2.5**
Overall RFAI Score				**39 Fair**			**42 Good**

Table E-3. Species collected, ecological and recreational designation and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 1.5) of Kingston Fossil Plant discharge – summer 2020

Common Name	Scientific name	Trophic level	Native species	Tolerance	Heat Sensitive	Comm. Valuable	Rec. Valuable	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	.	.	.	1.00	10	10	1.8
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	.	2.73	11.42	41	0.80	8	49	8.9
Common carp	*Cyprinus carpio*	OM	.	TOL	.	X	.	0.47	1.95	7	0.40	4	11	2.0
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	0.93	3.90	14	.	.	14	2.6
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	X	X	.	2.67	11.14	40	.	.	40	7.3
River carpsucker	*Carpiodes carpio*	OM	X	TOL	.	X	.	.	.	.	0.10	1	1	0.2
Redbreast sunfish	*Lepomis auritus*	IN	.	TOL	.	.	X	0.73	3.06	11	.	.	11	2.0
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.33	1.39	5	.	.	5	0.9
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	6.13	25.63	92	0.10	1	93	16.9
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	1.13	4.74	17	0.50	5	22	4.0
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	0.07	0.28	1	0.50	5	6	1.1
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	0.20	0.84	3	0.60	6	9	1.6
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	X	.	.	.	.	0.10	1	1	0.2
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	0.60	2.51	9	.	.	9	1.6
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.20	0.84	3	0.10	1	4	0.7
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	.	0.13	0.56	2	.	.	2	0.4
Lake sturgeon	*Acipenser fulvescens*	IN	X	.	.	.	X	.	.	.	0.10	1	1	0.2
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.07	0.28	1	0.30	3	4	0.7
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.07	0.28	1	0.20	2	3	0.5
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	.	.	.	0.20	2	2	0.4
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	0.80	8	8	1.5
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.47	1.95	7	1.40	14	21	3.8
White bass	*Morone chrysops*	TC	X	.	.	.	X	.	.	.	1.80	18	18	3.3
Yellow bass	*Morone mississippiensis*	TC	X	.	.	.	X	.	.	.	3.50	35	35	6.4
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	0.10	1	1	0.2
Warmouth	*Lepomis gulosus*	IN	X	.	X	.	X	0.13	0.56	2	.	.	2	0.4
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	2.53	10.58	38	0.80	8	46	8.4
Hybrid bass	Hybrid *Micropterus* sp.	TC	.	.	.	.	X	0.07	0.28	1	.	.	1	0.2
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	X	.	X	.	.	.	0.10	1	1	0.2
Logperch	*Percina caprodes*	BI	X	.	X	.	.	6.27	26.18	94	.	.	94	17.1
Walleye	*Sander vitreus*	TC	X	.	X	.	X	.	.	.	0.10	1	1	0.2
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	0.07	0.28	1	1.00	10	11	2.0
Mississippi silverside	*Menidia audens*	IN	.	.	.	X	.	0.87	3.62	13	.	.	13	2.4
Total			**28**		**6**	**16**	**17**	**26.87**	**112.27**	**403**	**14.60**	**146**	**549**	
Number of Samples								**15**			**10**			
Species Collected								**22**			**23**			

Table E-4. Species collected, ecological and recreational designation and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 4.4) of Kingston Fossil Plant discharge – summer 2020

Common Name	Scientific name	Trophic level	Native species	Tolerance	Heat Sensitive	Comm. Valuable	Rec. Valuable	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	.	.	.	0.20	2	2	0.2
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	.	9.87	42.41	148	0.70	7	155	19.0
Common carp	*Cyprinus carpio*	OM	.	TOL	.	X	.	0.20	0.86	3	0.10	1	4	0.5
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	1.27	5.44	19	.	.	19	2.3
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	X	X	.	6.60	28.37	99	.	.	99	12.2
Redbreast sunfish	*Lepomis auritus*	IN	.	TOL	.	.	X	0.07	0.29	1	.	.	1	0.1
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	13.20	56.73	198	.	.	198	24.3
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	1.47	6.30	22	.	.	22	2.7
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	.	.	.	0.10	1	1	0.1
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	1.20	5.16	18	0.10	1	19	2.3
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	X	.	.	.	.	0.20	2	2	0.2
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	.	.	.	0.40	4	4	0.5
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	0.20	0.86	3	.	.	3	0.4
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.13	0.57	2	.	.	2	0.2
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	.	0.07	0.29	1	.	.	1	0.1
Lake sturgeon	*Acipenser fulvescens*	IN	X	.	.	.	X	.	.	.	0.20	2	2	0.2
Spotted gar	*Lepisosteus oculatus*	TC	X	.	.	X	.	0.53	2.29	8	0.10	1	9	1.1
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	.	0.53	2.29	8	.	.	8	1.0
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X	.	.	.	.	0.10	1	1	0.1
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	1.20	5.16	18	0.30	3	21	2.6
Black buffalo	*Ictiobus niger*	OM	X	.	.	X	.	0.40	1.72	6	.	.	6	0.7
Silver redhorse	*Moxostoma anisurum*	BI	X	.	.	X	.	.	.	.	0.10	1	1	0.1
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	.	.	.	0.50	5	5	0.6
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	1.60	16	16	2.0
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.33	1.43	5	0.60	6	11	1.4
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	.	.	.	0.10	1	1	0.1
White bass	*Morone chrysops*	TC	X	.	.	.	X	.	.	.	0.80	8	8	1.0
Yellow bass	*Morone mississippiensis*	TC	X	.	.	.	X	0.07	0.29	1	2.20	22	23	2.8
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	0	0.20	2	2	0.2
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	4.40	18.91	66	0.10	1	67	8.2
Hybrid sunfish	Hybrid *Lepomis* spp.	IN	X	.	.	.	X	0.07	0.29	1	.	.	1	0.1
Spotted bass	*Micropterus punctulatus*	TC	X	.	.	.	X	0.07	0.29	1	.	.	1	0.1
Black crappie	*Pomoxis nigromaculatus*	TC	X	.	X	.	X	0.20	0.86	3	0.10	1	4	0.5
Yellow perch	*Perca flavescens*	IN	.	.	.	.	X	0.07	0.29	1	.	.	1	0.1
Logperch	*Percina caprodes*	BI	X	.	X	.	.	2.53	10.89	38	.	.	38	4.7
Sauger	*Sander canadensis*	TC	X	.	X	.	X	.	.	.	0.10	1	1	0.1
Walleye	*Sander vitreus*	TC	X	.	X	.	X	.	.	.	0.80	8	8	1.0
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	0.20	0.86	3	0.70	7	10	1.2
Mississippi silverside	*Menidia audens*	IN	.	.	.	X	.	2.47	10.60	37	.	.	37	4.5
Total			**33**		**6**	**20**	**20**	**47.35**	**203.45**	**710**	**10.40**	**104**	**814**	
Number of Samples								**15**			**10**			
Species Collected								**25**			**24**			

Table E-5. Species collected, ecological and recreational designation and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 1.5) of Kingston Fossil Plant discharge – autumn 2020

Common Name	Scientific name	Trophic level	Native species	Tolerance	Heat Sensitive	Comm. Valuable	Rec. Valuable	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	.	3.93	17.93	59	0.30	3	62	7.3
Common carp	*Cyprinus carpio*	OM	.	TOL	.	X	.	0.33	1.52	5	0.20	2	7	0.8
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	5.87	26.75	88	.	.	88	10.3
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	X	X	.	0.93	4.26	14	.	.	14	1.6
Redbreast sunfish	*Lepomis auritus*	IN	.	TOL	.	.	X	0.93	4.26	14	.	.	14	1.6
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	0.87	3.95	13	.	.	13	1.5
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	17.07	77.81	256	.	.	256	30.0
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	4.93	22.49	74	0.10	1	75	8.8
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	.	.	.	0.10	1	1	0.1
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	1.60	7.29	24	0.10	1	25	2.9
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	X	.	0.33	1.52	5	.	.	5	0.6
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	1.00	4.56	15	.	.	15	1.8
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.80	3.65	12	.	.	12	1.4
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	.	0.33	1.52	5	.	.	5	0.6
Lake sturgeon	*Acipenser fulvescens*	IN	X	.	.	.	X	.	.	.	0.50	5	5	0.6
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	.	0.07	0.30	1	.	.	1	0.1
Bullhead minnow	*Pimephales vigilax*	IN	X	.	.	X	.	0.13	0.61	2	.	.	2	0.2
Quillback	*Carpiodes cyprinus*	OM	X	.	.	X	.	.	.	.	0.10	1	1	0.1
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.40	1.82	6	0.30	3	9	1.1
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.27	1.22	4	.	.	4	0.5
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	0.80	8	8	0.9
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.33	1.52	5	0.20	2	7	0.8
White bass	*Morone chrysops*	TC	X	.	.	.	X	.	.	.	0.60	6	6	0.7
Yellow bass	*Morone mississippiensis*	TC	X	.	.	.	X	.	.	.	0.70	7	7	0.8
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	0.30	3	3	0.4
Warmouth	*Lepomis gulosus*	IN	X	.	X	.	X	0.40	1.82	6	.	.	6	0.7
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	4.00	18.24	60	0.20	2	62	7.3
Hybrid sunfish	Hybrid *Lepomis* sp.	IN	X	.	.	.	X	0.07	0.30	1	.	.	1	0.1
Spotted bass	*Micropterus punctulatus*	TC	X	.	.	.	X	0.33	1.52	5	.	.	5	0.6
Yellow perch	*Perca flavescens*	IN	.	.	.	.	X	0.07	0.30	1	.	.	1	0.1
Logperch	*Percina caprodes*	BI	X	.	X	.	.	4.47	20.36	67	.	.	67	7.9
Walleye	*Sander vitreus*	TC	X	.	X	.	X	.	.	.	0.30	3	3	0.4
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	0.60	2.74	9	0.40	4	13	1.5
Mississippi silverside	*Menidia audens*	IN	.	.	.	X	.	3.27	14.89	49	.	.	49	5.8
Total			**28**		**5**	**16**	**18**	**53.33**	**243.15**	**800**	**5.20**	**52**	**852**	
Number of Samples								**15**			**10**			
Species Collected								**26**			**16**			

Table E-6. Species collected, ecological and recreational designation and corresponding electrofishing (EF) and gill net (GN) catch per unit effort downstream (CRM 4.4) of Kingston Fossil Plant discharge – autumn 2020

Common Name	Scientific name	Trophic level	Native species	Tolerance	Heat Sensitive	Comm. Valuable	Rec. Valuable	EF Catch Per Run	EF Catch Per Hr	Total Fish EF	GN Catch Per Net	Total Fish GN	Total fish Combined	Percent Composition
Longnose gar	*Lepisosteus osseus*	TC	X	TOL	.	X	.	0.07	0.28	1	.	.	1	0.1
Gizzard shad	*Dorosoma cepedianum*	OM	X	TOL	.	X	.	1.13	4.71	17	0.90	9	26	2.4
Common carp	*Cyprinus carpio*	OM	.	TOL	.	X	.	0.20	0.83	3	0.20	2	5	0.5
Spotfin shiner	*Cyprinella spiloptera*	IN	X	TOL	.	.	.	6.67	27.70	100	.	.	100	9.3
Bluntnose minnow	*Pimephales notatus*	OM	X	TOL	X	X	.	0.27	1.11	4	.	.	4	0.4
Redbreast sunfish	*Lepomis auritus*	IN	.	TOL	.	.	X	0.07	0.28	1	.	.	1	0.1
Green sunfish	*Lepomis cyanellus*	IN	X	TOL	.	.	X	1.13	4.71	17	.	.	17	1.6
Bluegill	*Lepomis macrochirus*	IN	X	TOL	.	.	X	26.40	109.70	396	0.20	2	398	36.8
Largemouth bass	*Micropterus salmoides*	TC	X	TOL	.	.	X	5.13	21.33	77	.	.	77	7.1
Skipjack herring	*Alosa chrysochloris*	TC	X	INT	.	X	.	.	.	.	1.90	19	19	1.8
Spotted sucker	*Minytrema melanops*	BI	X	INT	X	X	.	4.00	16.62	60	0.10	1	61	5.6
Black redhorse	*Moxostoma duquesnei*	BI	X	INT	.	X	.	0.07	0.28	1	.	.	1	0.1
Rock bass	*Ambloplites rupestris*	TC	X	INT	.	.	X	0.07	0.28	1	.	.	1	0.1
Longear sunfish	*Lepomis megalotis*	IN	X	INT	.	.	X	1.00	4.16	15	.	.	15	1.4
Smallmouth bass	*Micropterus dolomieu*	TC	X	INT	.	.	X	0.53	2.22	8	0.20	2	10	0.9
Brook silverside	*Labidesthes sicculus*	IN	X	INT	.	X	.	0.20	0.83	3	.	.	3	0.3
Lake sturgeon	*Acipenser fulvescens*	IN	X	.	.	.	X	.	.	.	0.40	4	4	0.4
Threadfin shad	*Dorosoma petenense*	PK	X	.	.	X	.	0.07	0.28	1	.	.	1	0.1
Smallmouth buffalo	*Ictiobus bubalus*	OM	X	.	.	X	.	0.53	2.22	8	0.10	1	9	0.8
Golden redhorse	*Moxostoma erythrurum*	BI	X	.	.	X	.	0.20	0.83	3	.	.	3	0.3
Blue catfish	*Ictalurus furcatus*	OM	X	.	.	X	X	.	.	.	1.00	10	10	0.9
Channel catfish	*Ictalurus punctatus*	OM	X	.	.	X	X	0.47	1.94	7	0.50	5	12	1.1
Flathead catfish	*Pylodictis olivaris*	TC	X	.	.	X	X	.	.	.	0.20	2	2	0.2
White bass	*Morone chrysops*	TC	X	.	.	.	X	0.13	0.55	2	0.30	3	5	0.5
Yellow bass	*Morone mississippiensis*	TC	X	.	.	.	X	.	.	.	0.60	6	6	0.6
Striped bass	*Morone saxatilis*	TC	.	.	.	.	X	.	.	.	0.30	3	3	0.3
Warmouth	*Lepomis gulosus*	IN	X	.	X	.	X	0.47	1.94	7	.	.	7	0.6
Redear sunfish	*Lepomis microlophus*	IN	X	.	.	.	X	4.27	17.73	64	0.30	3	67	6.2
Spotted bass	*Micropterus punctulatus*	TC	X	.	.	.	X	0.60	2.49	9	.	.	9	0.8
Yellow perch	*Perca flavescens*	IN	.	.	.	.	X	0.33	1.39	5	.	.	5	0.5
Logperch	*Percina caprodes*	BI	X	.	X	.	.	1.53	6.37	23	.	.	23	2.1
Walleye	*Sander vitreus*	TC	X	.	X	.	X	0.07	0.28	1	1.50	15	16	1.5
Freshwater drum	*Aplodinotus grunniens*	BI	X	.	.	X	.	0.07	0.28	1	0.40	4	5	0.5
Mississippi silverside	*Menidia audens*	IN	.	.	.	X	.	10.33	42.94	155	.	.	155	14.3
Total			**29**		**5**	**16**	**19**	**66.01**	**274.28**	**990**	**9.10**	**91**	**1,081**	
Number of Samples								**15**			**10**			
Species Collected								**28**			**17**			

Trophic level: benthic invertivore (BI), insectivore (IN), omnivore (OM), top carnivore (TC); Tolerance: tolerant species (TOL), intolerant species (INT); Comm.-Commercially, Rec.-Recreationally. An asterisk (*) next to the common name denotes an aquatic nuisance species. All species are considered representative important species. No species collected have a Federal Threatened or Endangered status

Table E-7. Spatial statistical comparisons of the fish community samples collected upstream and downstream of Kingston Fossil Plant during summer 2020

Parameter	Mean Upstream (CRM 4.4)	Mean Downstream (CRM 1.5)	Standard Deviation Upstream (CRM 4.4)	Standard Deviation Downstream (CRM 1.5)	t-test Statistic [β]	z-test Statistic [γ]	P-value	Significant Difference?
Species (per run)								
Total (species richness)	10.5	10.2	3.9	2.7	-0.22	-	0.83	No
Benthic invertivores	1.9	1.8	1.6	1.0	-0.27	-	0.79	No
Insectivores	3.4	4.0	1.4	1.1	-	0.80	0.42	No
Omnivores	3.0	2.9	1.3	1.4	-	-0.45	0.66	No
Top carnivores	3.3	2.9	2.2	1.8	-	0.40	0.80	No
Non-indigenous	1.1	1.3	1.0	1.0	-	0.57	0.57	No
Tolerant	3.7	4.8	1.0	1.3	-	2.34	0.02	Yes
Intolerant	1.2	1.6	1.3	1.1	-	1.05	0.29	No
Heat Sensitive	1.3	1.5	1.0	0.6	-	0.41	0.68	No
CPUE (per effort)								
Total	3.8	2.8	2.2	1.1	-	0.96	0.34	No
Benthic invertivores	0.4	0.6	0.4	0.3	-	1.56	0.12	No
Insectivores	1.5	0.9	1.7	0.4	-	-1.25	0.21	No
Omnivores	1.5	0.7	1.8	0.5	-	-2.06	0.04	Yes
Top carnivores	0.7	0.8	0.5	0.7	-	0.14	0.88	No
Non-indigenous	0.2	0.2	0.3	0.2	-	0.25	0.80	No
Tolerant	2.4	1.4	2.4	0.7	-	-1.36	0.17	No
Intolerant	0.2	0.2	0.2	0.2	-	0.57	0.57	No
Heat Sensitive	0.7	0.6	1.6	0.5	-	2.13	0.03	Yes
Simpson Diversity Index	0.7	0.8	0.2	0.0	-	0.50	0.62	No
Shannon Diversity Index	7.8	8.2	4.1	2.0	-	0.29	0.77	No

β - Comparing two population means from normally distributed independent samples. $n_1=n_2=15$, degree of freedom$=n_1+n_2-2=28$, $\alpha=0.05$, $t_{\alpha/2}=2.048$. H_o: $\mu_1=\mu_2$; H_o rejected if $t>t_{\alpha/2}$.

γ - Non-parametric Wilcoxon Rank Sum test on large independent samples. $\alpha=0.05$, $z_{\alpha/2}=1.96$. H_o: two sampled populations have identical probability distributions. H_o rejected if $P<\alpha$ or $|z|>z_{\alpha/2}$.

Table E-8. Spatial statistical comparisons of the fish community samples collected upstream and downstream of Kingston Fossil Plant during autumn 2020

Parameter	Mean		Standard Deviation		t-test Statistic [β]	z-test Statistic [γ]	P-value	Significant Difference?
	Upstream (CRM 4.4)	Downstream (CRM 1.5)	Upstream (CRM 4.4)	Downstream (CRM 1.5)				
Species (per run)								
Total (species richness)	10.5	10.5	3.1	3.2	-	0.00	1.00	No
Benthic invertivores	1.7	2.0	1.0	1.4	-	0.32	0.75	No
Insectivores	4.3	4.6	1.1	1.5	-	1.03	0.30	No
Omnivores	1.9	2.4	1.5	1.3	-	0.73	0.47	No
Top carnivores	3.7	2.9	2.0	1.3	-	-0.97	0.33	No
Non-indigenous	1.2	1.4	1.0	1.0	-	0.53	0.60	No
Tolerant	3.5	4.6	1.0	1.2	-	2.51	0.01	Yes
Intolerant	2.1	1.9	1.2	1.4	-	-0.17	0.86	No
Heat Sensitive	1.3	1.5	0.8	0.7	-	0.57	0.57	No
CPUE (per effort)								
Total	4.6	3.8	2.2	1.4	-	-0.54	0.59	No
Benthic invertivores	0.4	0.5	0.5	0.5	-	0.33	0.74	No
Insectivores	3.5	2.3	2.5	0.8	-	0.54	0.59	No
Omnivores	0.4	0.5	0.3	0.5	-	0.92	0.36	No
Top carnivores	1.1	0.8	0.4	0.5	-1.95	-	0.06	No
Non-indigenous	0.8	0.3	1.3	0.5	-	0.06	0.95	No
Tolerant	3.1	2.6	2.1	1.1	-	-0.58	0.56	No
Intolerant	0.6	0.3	0.6	0.3	-	-0.73	0.46	No
Heat Sensitive	0.4	0.5	0.5	0.4	-	0.90	0.37	No
Simpson Diversity Index	0.7	0.8	0.2	0.1	-	-0.75	0.46	No
Shannon Diversity Index	6.0	6.6	1.5	2.7	-	0.12	0.90	No

β - Comparing two population means from normally distributed independent samples. $n_1=n_2=15$, degree of freedom=$n_1+n_2-2=28$, $\alpha=0.05$, $t_{\alpha/2}=2.048$. H_o: $\mu_1=\mu_2$; H_o rejected if $t>t_{\alpha/2}$.

γ - Non-parametric Wilcoxon Rank Sum test on large independent samples. $\alpha=0.05$, $z_{\alpha/2}=1.96$. H_o: two sampled populations have identical probability distributions. H_o rejected if $P<\alpha$ or $|z|>z_{\alpha/2}$.

Table E-9. Spatial statistical comparisons of the fish community samples collected downstream (CRM 1.5) of Kingston Fossil Plant during summer and autumn 2020

Parameter	Mean		Standard Deviation		t-test Statistic [β]	z-test Statistic [γ]	P-value	Significant Difference?
	Summer	Autumn	Summer	Autumn				
Species (per run)								
Total (species richness)	10.5	10.2	3.2	2.7	0.25	-	0.81	No
Benthic invertivores	2.0	1.8	1.4	1.0	-	-0.23	0.81	No
Insectivores	4.6	4.0	1.5	1.1	1.29	-	0.21	No
Omnivores	2.4	2.9	1.3	1.4	-	0.71	0.48	No
Top carnivores	2.9	2.9	1.3	1.8	-	-0.28	0.78	No
Non-indigenous	1.4	1.3	1.0	1.0	-	-0.13	0.89	No
Tolerant	4.6	4.8	1.2	1.3	-	0.47	0.64	No
Intolerant	1.9	1.6	1.4	1.1	-	-0.58	0.56	No
Heat Sensitive	1.5	1.5	0.7	0.6	-	0.48	0.63	No
CPUE (per effort)								
Total	3.8	2.8	1.4	1.1	2.22	-	0.03	Yes
Benthic invertivores	0.5	0.6	0.5	0.3	-0.31	-	0.76	No
Insectivores	2.3	0.9	0.8	0.4	-	-4.15	<0.0001	Yes
Omnivores	0.5	0.7	0.5	0.5	-	0.81	0.42	No
Top carnivores	0.8	0.8	0.5	0.7	-	-0.21	0.83	No
Non-indigenous	0.3	0.2	0.5	0.2	-	-0.54	0.59	No
Tolerant	2.6	1.4	1.1	0.7	3.65	-	0.001	Yes
Intolerant	0.3	0.2	0.3	0.2	-	-1.55	0.12	No
Heat Sensitive	0.5	0.6	0.4	0.5	-	0.83	0.40	No
Simpson Diversity Index	0.8	0.8	0.1	0.0	-	1.95	0.05	Yes
Shannon Diversity Index	6.6	8.2	2.7	2.0	-1.74	-	0.09	No

β - Comparing two population means from normally distributed independent samples. $n_1=n_2=15$, degree of freedom$=n_1+n_2-2=28$, $\alpha=0.05$, $t_{\alpha/2}=2.048$. H_o: $\mu_1=\mu_2$; H_o rejected if $t>t_{\alpha/2}$.

γ - Non-parametric Wilcoxon Rank Sum test on large independent samples. $\alpha=0.05$, $z_{\alpha/2}=1.96$. H_o: two sampled populations have identical probability distributions. H_o rejected if $P<\alpha$ or $|z|>z_{\alpha/2}$.

Table E-10. Spatial statistical comparisons of the fish community samples collected downstream (CRM 4.4) of Kingston Fossil Plant during summer and autumn 2020

	Mean		Standard Deviation					
Parameter	**Summer**	**Autumn**	**Summer**	**Autumn**	**t-test Statistic** [β]	**z-test Statistic** [γ]	**P-value**	**Significant Difference?**
Species (per run)								
Total (species richness)	10.5	10.5	3.1	3.9	-	0.00	1.00	No
Benthic invertivores	1.7	1.9	1.0	1.6	-	0.06	0.95	No
Insectivores	4.3	3.4	1.1	1.4	-	-1.49	0.13	No
Omnivores	1.9	3.0	1.5	1.3	-	1.99	0.05	Yes
Top carnivores	3.7	3.3	2.0	2.2	-	-0.80	0.42	No
Non-indigenous	1.2	1.1	1.0	1.0	-	-0.18	0.86	No
Tolerant	3.5	3.7	1.0	1.0	-	0.87	0.38	No
Intolerant	2.1	1.2	1.2	1.3	-	-2.05	0.04	Yes
Heat Sensitive	1.3	1.3	0.8	1.0	-	0.27	0.79	No
CPUE (per effort)								
Total	4.6	3.8	2.2	2.2	-	-1.36	0.17	No
Benthic invertivores	0.4	0.4	0.5	0.4	-	-0.33	0.74	No
Insectivores	3.5	1.5	2.5	1.7	-	-2.61	0.01	Yes
Omnivores	0.4	1.5	0.3	1.8	-	3.78	0.0002	Yes
Top carnivores	1.1	0.7	0.4	0.5	2.28	-	0.03	Yes
Non-indigenous	0.8	0.2	1.3	0.3	-	-0.81	0.41	No
Tolerant	3.1	2.4	2.1	2.4	-	-1.45	0.15	No
Intolerant	0.6	0.2	0.6	0.2	-	-2.38	0.02	Yes
Heat Sensitive	0.4	0.7	0.5	1.6	-	-0.12	0.90	No
Simpson Diversity Index	0.7	0.7	0.2	0.2	-	0.00	1.00	No
Shannon Diversity Index	6.0	7.8	1.5	4.1	-	1.20	0.23	No

β - Comparing two population means from normally distributed independent samples. $n_1=n_2=15$, degree of freedom=$n_1+n_2-2=28$, $\alpha=0.05$, $t_{\alpha/2}=2.048$. H_o: $\mu_1=\mu_2$; H_o rejected if $t>t_{\alpha/2}$.

γ - Non-parametric Wilcoxon Rank Sum test on large independent samples. $\alpha=0.05$, $z_{\alpha/2}=1.96$. H_o: two sampled populations have identical probability distributions. H_o rejected if $P<\alpha$ or $|z|>z_{\alpha/2}$.

Table E-11. Comparison of RBI metric ratings and total scores for laboratory-processed samples collected from Watts Bar Reservoir upstream and downstream of Kingston Fossil Plant, summer and autumn 2020

	Summer 2020						Autumn 2020					
	Downstream				Upstream		Downstream				Upstream	
	CRM 1.5		CRM 2.2		CRM 3.75		CRM 1.5		CRM 2.2		CRM 3.75	
Metric	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**	**Obs**	**Rating**
1. Average number of taxa	13.4	5	16.6	5	13.4	5	13.2	5	14.5	5	15.1	5
2. Proportion of samples with long-lived organisms	0.9	3	1.0	5	0.9	3	1.0	5	0.9	3	0.8	3
3. Average number of EPT taxa	1.4	3	1.8	5	2.0	5	1.5	5	1.7	5	0.8	3
4. Average proportion of oligochaete individuals	27.5	1	21.5	3	17.9	3	45.2	1	19.4	3	43.4	1
5. Average proportion of total abundance comprised by the two most abundant taxa	72.9	5	66.1	5	72.5	5	80.1	3	73.5	5	79.7	3
6. Average density excluding chironomids and oligochaetes	720.0	5	603.3	3	768.3	5	348.3	3	718.3	5	510.0	3
7. Zero-samples – proportion of samples containing no organisms	0	5	0	5	0	5	0	5	0	5	0	5
Benthic Index Score		**27**		**31**		**31**		**27**		**31**		**23**
Ecological Health Rating		**Good**		**Excellent**		**Excellent**		**Good**		**Excellent**		**Fair**

*Reservoir Benthic Index Score Range: 7-12 (“Very Poor”), 13-18 (“Poor”), 19-23 (“Fair”), 24-29 (“Good”), 30-35 (“Excellent”)

Table E-12. Water temperature (°F) depth profiles collected to determine the extent of the thermal plume from KIF during 2012

Depth (m)	Clinch River Ambient CRM 4.0					Emory River Ambient ERM 2.0					Discharge CRM 2.8					Below Discharge CRM 0				
% Width from RDB	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%
Summer (8/13/2012)																				
0.3	69.5		70.3		72.5	84.3		83.6		83.6	83.6	81.7	81.8	82.3	81.8	80.6	81.7	82.0	81.3	82.3
1.5	69.0		69.2		70.2	81.5		81.6		81.6	81.3	81.4	80.6	79.9	80.4	79.3	79.4	79.0	78.6	78.9
3	68.2		68.4					80.7		79.9	80.4	79.6	77.9	76.3	78.8	79.0	77.5	78.4	78.1	77.9
4	68.1		68.2					79.3			79.6		77.0	76.1	78.2	77.1		78.1	77.8	77.6
5	68.0		67.7					72.8					73.0	70.6					77.3	77.2
6	68.0		67.6					70.8					71.9	70.0					77.2	76.9
7	68.0		67.6					70.5					70.1	70.0					76.1	75.7
8	67.9		67.5					70.7					70.1						74.2	72.5
9			67.5										70.0						71.4	71.7
10			67.5										70.0						70.5	
11			67.5										70.0						70.3	
12													70.1						70.3	
13													70.1						70.3	

Autumn (11/13/2012)	Clinch River Ambient CRM 4.0					Discharge CRM 2.8					Mid-plume CRM 1					Below Discharge CRM 0				
	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%	10%	30%	50%	70%	90%
0.3	55.6	55.8	55.7	55.7	55.4	66.8	67.8	64.5	62.2	63.1	57.8	62.4	62.9	62.3	61.4	59.7	60.0	60.2	60.7	61.2
1.5			55.7	55.7	55.4	66.4		56.2	57.6	58.2	56.5	56.4	58.4	60.8	60.2	59.6	59.8	59.2	59.8	60.9
3			55.7	55.6		66.0		55.7				56.3	56.4	56.5	56.7	59.4	58.9	58.7	59.2	58.9
4			55.6	55.6				55.5				56.3	56.3	56.4	56.6				58.9	
5			55.6	55.6				55.5					56.2	56.4					57.8	
6			55.6	55.6				55.5					56.2						57.5	
7			55.6	55.6				55.5					56.2						57.1	
8			55.6					55.5					56.2						57.2	
9								55.5					56.2						57.1	
10								55.5					56.2						56.4	
11								55.5											56.3	
12																			56.3	

Green numbers represent ambient temperatures. Blue numbers represent temperatures 3.6°F (2°C) or greater above ambient temperature.

Table E-13. Ecological designations and mean densities per square meter of benthic macroinvertebrate taxa collected downstream (CRMs 1.5 and 2.2) and upstream (CRM 3.75) of Kingston Fossil Plant (KIF) during summer and autumn 2020

				Estimated Mean Density							
				Summer 2020			Autumn 2020			FFG[1]	Invasive Species
Phylum (sub ph) Class	Order	Family (Subfamily)	Scientific Name	DS CRM 1.5	DS CRM 2.2	US CRM 3.75	DS CRM 1.5	DS CRM 2.2	US CRM 3.75		
Annelida											
Hirudinea	Rhynchobdellida	Glossiphoniidae	*Actinobdella inequiannulata*	5	3	3	---	5	2	PR	---
			Helobdella elongata	3	5	---	---	3	---	PR	---
			Helobdella stagnalis	15	43	68	20	18	32	PR	---
			Helobdella triserialis	3	---	---	---	---	---	PA	---
	Branchiobdellida			---	---	---	---	---	2	CG	---
Oligochaeta	Haplotaxida	Naididae (Naidinae)		2	---	---	18	2	28	CG	---
			Arcteonais lomondi	---	---	---	118	2	8	CG	---
			Branchiodrilus hortensis	3	5	---	---	---	---	CG	X
			Dero sp.	---	---	2	10	---	28	CG	---
			Nais bretscheri	---	---	---	---	---	5	CG	---
			Nais communis	---	---	---	---	---	7	CG	---
			Nais pardalis	---	---	---	---	---	18	CG	---
			Nais sp.	---	---	---	2	3	23	CG	---
			Slavina appendiculata	2	---	---	7	102	5	CG	---
			Stylaria lacustris	---	---	---	---	---	2	CG	---
		(Tubificinae whc)	immature Tubificinae whc	75	47	17	335	35	105	CG	---
			Aulodrilus pigueti	12	27	---	178	17	15	CG	---
			Branchiura sowerbyi	2	20	13	5	20	82	CG	X
		(Tubificinae wohc)	immature Tubificinae wohc	323	302	253	592	107	325	CG	---
			Limnodrilus cervix	---	---	12	---	---	20	CG	---
			Limnodrilus hoffmeisteri	70	53	10	93	113	80	CG	---
			Limnodrilus sp.	---	---	---	2	---	---	CG	---
	Lumbriculida	Lumbriculidae	*Stylodrilus heringianus*	---	12	---	---	---	---	CG	---
Arthropoda (Crustacea)											
Malacostraca	Amphipoda	Gammaridae	*Gammarus* sp.	3	2	---	2	---	---	CG	---

Table E-13. (Continued)

Phylum (sub ph) Class	Order	Family (Subfamily)	Scientific Name	Summer 2020 DS CRM 1.5	Summer 2020 DS CRM 2.2	Summer 2020 US CRM 3.75	Autumn 2020 DS CRM 1.5	Autumn 2020 DS CRM 2.2	Autumn 2020 US CRM 3.75	FFG[1]	Invasive Species
		Hyalellidae	*Hyalella azteca*	---	---	---	---	3	3	CG	---
		Crangonyctidae	*Crangonyx* sp.	2	---	---	---	---	---	CG	---
Insecta (Hexapoda)	Coleoptera	Elmidae	*Dubiraphia* sp.	2	2	2	---	---	5	CG	---
			Stenelmis sp.	---	---	2	2	---	---	SC	---
		Psephenidae	*Psephenus herricki*	2	---	3	---	---	---	SC	---
	Diptera	Ceratopogonidae		2	2	3	2	8	2	PR	---
		Chironomidae	*Ablabesmyia annulata*	43	65	57	20	55	33	PR	---
			Ablabesmyia janta	---	2	---	---	---	---	PR	---
			Ablabesmyia mallochi	---	5	---	18	---	---	PR	---
			Chironomus sp.	20	17	7	8	15	53	CG	---
			Cladopelma sp.	---	2	---	2	2	18	CG	---
			Cladotanytarsus sp.	---	3	3	---	---	5	CG	---
			Coelotanypus sp.	165	208	120	242	258	110	PR	---
			Cricotopus sp.	---	---	---	3	2	10	SH	---
			Cryptochironomus sp.	20	10	13	13	7	25	PR	---
			Dicrotendipes neomodestus	---	10	3	88	75	60	CG	---
			Dicrotendipes sp.	---	---	---	2	---	---	CG	---
			Epoicocladius flavens	---	---	---	2	2	2	CG	---
			Epoicocladius sp.	17	7	7	---	---	---	CG	---
			Fissimentum sp.	7	22	13	3	18	17	CG	---
			Glyptotendipes sp.	---	---	---	13	---	---	SH	---
			Microchironomus sp.	15	2	15	5	---	3	CG	---
			Microtendipes pedellus gp.	5	10	---	---	---	---	CF	---
			Nanocladius alternantherae	---	---	---	2	---	---	CG	---
			Nanocladius distinctus	---	---	---	3	---	---	CG	---
			Pagastiella sp.	---	5	---	2	---	---	CG	---
			Parachironomus sp.	---	---	---	5	7	3	PR	---

Table E-13. (Continued)

Phylum (sub ph) Class	Order	Family (Subfamily)	Scientific Name	Estimated Mean Density: Summer 2020 DS CRM 1.5	Summer 2020 DS CRM 2.2	Summer 2020 US CRM 3.75	Autumn 2020 DS CRM 1.5	Autumn 2020 DS CRM 2.2	Autumn 2020 US CRM 3.75	FFG[1]	Invasive Species
			Parametriocnemus sp.	---	---	2	---	---	---	CG	---
			Phaenopsectra obediens gp.	---	---	---	2	---	---	SC	---
			Polypedilum halterale gp.	80	37	20	3	10	17	SH	---
			Polypedilum sp.	---	2	---	---	---	---	SH	---
			Procladius sp.	80	122	65	88	68	30	PR	---
			Pseudochironomus sp.	---	---	2	---	---	2	CG	---
			Stempellina sp.	---	2	2	8	---	2	CG	---
			Stictochironomus caffrarius gp.	22	53	5	30	3	5	CG	---
			Stictochironomus sp.	---	---	---	2	---	---	CG	---
			Tanytarsus sp.	7	10	18	25	18	25	CF	---
			Thienemanniella lobapodema	---	---	---	17	---	---	CG	---
			Thienemanniella sp.	---	---	---	2	---	---	CG	---
			Thienemanniella xena	---	---	---	---	---	2	CG	---
	Ephemeroptera	Baetidae	*Baetis intercalaris*	2	---	---	---	---	---	CG	---
		Caenidae	*Caenis* sp.	---	---	---	15	3	---	CG	---
		Leptohyphidae	*Tricorythodes* sp.	---	---	2	---	---	---	CG	---
		Ephemeridae	*Hexagenia* sp. <10mm	40	70	143	80	258	108	CG	---
			Hexagenia sp. >10mm	20	28	43	17	85	23	CG	---
	Ephemeroptera	Heptageniidae	*Maccaffertium* sp.	2	---	---	---	---	---	SC	---
	Megaloptera	Sialidae	*Sialis* sp.	3	---	---	---	---	2	PR	---
	Odonata	Gomphidae		---	---	2	---	---	---	PR	---
			Arigomphus sp.	---	---	2	---	---	---	PR	---
			Dromogomphus sp.	2	---	---	---	---	---	PR	---
			Stylurus sp.	---	---	---	---	---	2	PR	---
	Plecoptera	Capniidae/Leuctridae		---	---	3	---	---	---	SH	---
	Trichoptera	Hydropsychidae	*Cheumatopsyche* sp.	---	---	5	---	---	---	CF	---

Table E-13. (Continued)

Phylum (sub ph) Class	Order	Family (Subfamily)	Scientific Name	Estimated Mean Density Summer 2020 DS CRM 1.5	DS CRM 2.2	US CRM 3.75	Autumn 2020 DS CRM 1.5	DS CRM 2.2	US CRM 3.75	FFG[1]	Invasive Species
		Hydroptilidae		---	---	---	---	2	---	PI, SC, CG	---
			Hydroptila sp.	---	2	---	3	---	---	PI	---
		Leptoceridae		---	---	2	---	---	---	C-G&F, SH, SC	---
			Oecetis sp.	8	47	22	13	28	2	PR	---
		Polycentropodidae	*Cyrnellus fraternus*	---	10	8	---	---	---	CF	---
Mollusca											
Bivalvia	Unionoida	Unionidae	*Toxolasma parvum*	---	2	---	---	---	---	CF	---
			Truncilla sp.	---	---	---	---	---	2	CF	---
			Utterbackia imbecillis	---	---	---	---	---	3	CF	---
	Veneroida	Corbiculidae	*Corbicula fluminea* <10mm	43	38	27	22	45	35	CF	X
			Corbicula fluminea >10mm	233	158	13	127	45	18	CF	X
		Dreissenidae	*Dreissena polymorpha*	5	17	108	3	2	---	CF	X
		Sphaeriidae		---	2	5	---	---	---	CF	---
			Musculium transversum	287	17	3	3	22	22	CF	---
			Pisidium compressum	---	2	5	---	13	15	CF	---
			Pisidium sp.	10	8	8	3	38	75	CF	---
Gastropoda				2	---	---	---	---	---	SC	---
	Architaenioglossa	Viviparidae	*Viviparus subpurpureus*	---	3	2	3	8	2	SC	---
			Viviparus sp.	2	3	---	---	---	---	SC	---
	Basommatophora	Ancylidae	*Ferrissia rivularis*	---	2	---	---	---	---	SC	---
		Planorbidae	*Gyraulus parvus*	---	---	---	---	10	---	SC	---
			Menetus dilatatus	3	---	---	---	---	---	SC	---
	Neotaenioglossa	Hydrobiidae		---	---	---	---	7	---	SC	---
			Amnicola limosa	7	118	257	23	97	142	SC	---
			Somatogyrus sp.	---	2	3	2	---	2	SC	---
		Pleuroceridae	*Pleurocera canaliculata*	5	13	10	7	8	3	SC	---

Table E-13. (Continued)

Phylum (sub ph) Class	Order	Family (Subfamily)	Scientific Name	Estimated Mean Density Summer 2020 DS CRM 1.5	DS CRM 2.2	US CRM 3.75	Autumn 2020 DS CRM 1.5	DS CRM 2.2	US CRM 3.75	FFG[1]	Invasive Species
Nematoda				---	---	7	---	3	5	CG	---
Platyhelminthes											---
Trepaxonemata	Neoophora	Planariidae	*Girardia tigrina*	10	5	7	2	5	7	PR	---
Number of Samples				**10**	**10**	**10**	**10**	**10**	**10**		
Mean Density/ meter²				**1688**	**1660**	**1426**	**2335**	**1660**	**1685**		
Taxa Richness				**41**	**45**	**44**	**47**	**40**	**52**		
Total area sampled (m²)				**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**		

[1]Functional Feeding Group (FFG): assigned using the Ecological Tables at the end of each taxonomic chapter in An Introduction to the Aquatic Insects of North America (Merritt et. al, 2019) and Appendix B of EPA's Rapid Bioassessment protocols. CG=collector/gatherer; CF=collector/filterer; PA=parasite; PR=predator; SC=scraper; SH=shredder; PI=piercer, C-G&F=collector-gatherer & filterer

Table E-14. Ecological designations and mean densities per square meter of benthic macroinvertebrate taxa collected but not included in individual RBI metrics or total scores for sites downstream (CRMs 1.5 and 2.2) and upstream (CRM 3.75) of Kingston Fossil Plant during summer and autumn 2020

				Estimated Mean Density (per m^2)							
				Summer 2020			Autumn 2020			FFG[1]	Invasive Species
Phylum (sub ph) Class (subclass)	**(Superorder) Order**	**Family (Subfamily)**	**Scientific Name**	**DS CRM 1.5**	**DS CRM 2.2**	**US CRM 3.75**	**DS CRM 1.5**	**DS CRM 2.2**	**US CRM 3.75**		
Arthropoda (Chelicerata)											
Arachnida	(Acariformes)			---	2	2	---	7	---	PR	---
	Trombidiformes	Arrenuridae	*Arrenurus* sp.	---	---	7	---	---	5	PR	---
		Hygrobatidae	*Atractides* sp.	---	3	---	---	---	---	PR	---
			Hygrobates sp.	---	---	3	---	---	---	NS	---
		Krendowskiidae	*Krendowskia* sp.	---	---	---	3	5	---	NS	---
		Unionicolidae	*Neumania* sp.	3	---	2	5	2	5	PR	---
			Unionicola sp.	3	2	3	2	12	7	PR	---
Arthropoda (Crustacea)											
Branchiopoda	Diplostraca	Daphniidae	*Ceriodaphnia* sp.	---	3	2	---	---	---	NS	---
			Daphnia lumholtzi	---	2	2	2	---	---	CF	X
		Sididae	*Diaphanosoma* sp.	---	---	2	---	---	---	NS	---
			Sida crystallina	5	5	12	---	45	42	NS	---
Maxillopoda (Copepoda)				---	---	---	5	---	---	NS	---
	Cyclopoida			---	---	---	77	3	20	CF	---
		Cyclopidae	*Macrocyclops albidus*	---	---	---	---	2	---	NS	---
			Mesocyclops edax	10	7	3	2	22	2	NS	---
	Harpacticoida	Canthocamptidae	*Attheyella* sp.	---	---	---	---	2	---	NS	---
Ostracoda				---	---	---	2	---	---	CG	---
	Podocopida	Candonidae	*Candona* sp.	---	8	10	---	2	---	CG	---
Arthropoda (Hexapoda)											
Insecta	Diptera	Chaoboridae	*Chaoborus punctipennis*	95	23	8	17	13	13	PR	---
Number of Samples				**10**	**10**	**10**	**10**	**10**	**10**		
Mean Density/ meter²				**117**	**55**	**55**	**113**	**113**	**93**		
Taxa Richness				**5**	**8**	**10**	**7**	**9**	**6**		
Total area sampled (m²)				**0.6**	**0.6**	**0.6**	**0.6**	**0.6**	**0.6**		

[1]Functional Feeding Group (FFG): assigned using the Ecological Tables at the end of each taxonomic chapter in An Introduction to the Aquatic Insects of North America (Merritt et. al, 2019) and Appendix B of EPA's Rapid Bioassessment protocols. CG=collector/gatherer; CF=collector/filterer; PA=parasite; PR=predator; SC=scraper; SH=shredder; PI=piercer; NS=none specified

Appendix F. Letter dated August 11, 2011 from Christopher B. Thomas, Chief, Pollution Control & Implementation Branch, Water Protection Branch, EPA Region 4 to Paul E. Davis, Director, Division of Water Pollution Control, TDEC, regarding EPA review and comments on the draft NPDES permit for TVA's Gallatin Fossil Plant (NPDES TN0005428)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

AUG 1 1 2011

Mr. Paul E. Davis
Director, Division of Water Pollution Control
Tennessee Department of Environment
and Conservation
6th Floor, L & C Annex
401 Church Street
Nashville, Tennessee 37243-1534

Dear Mr. Davis:

On May 19, 2011, the Environmental Protection Agency received for renewal the draft National Pollutant Discharge Elimination System (NPDES) permit for the Tennessee Valley Authority (TVA) Gallatin Fossil Plant, NPDES permit number TN0005428, which expired on November 29, 2009, and is being administratively continued. In a letter to you dated June 14, 2011, we requested up to 90 days to review the proposed permit in accordance with Section IV.B.6.c. of the Tennessee/EPA Memorandum of Agreement. We have completed our review and offer the following comments:

1. Technology-Based Limits for the Ash Pond

The NPDES permit must include numeric technology-based effluent limits (TBELs) for the ash pond (outfall 001) as required by the Clean Water Act (CWA) and implementing regulations. The CWA Section 301(a)(1) requires that permits include limitations based on the application of statutorily prescribed levels of treatment ("technology-based effluent limitations"). Where the EPA has not promulgated technology-based effluent guidelines for a particular class or category of industrial discharger, or where the technology-based effluent guidelines do not address all waste streams or pollutants discharged by the industrial discharger, the permitting authority must establish TBELs on a case-by-case basis in individual NPDES permits, based on its best professional judgment or "BPJ."

In October 2009, the EPA completed a study of wastewater discharges from both Flue Gas Desulfurization (FGD) and Coal Combustion Residuals (CCR) impoundments (i.e., ash ponds). Findings indicate the need for revised effluent guidelines (EGL) for these wastestreams to due to the potential for metals to exist in relatively high concentrations. The Agency plans to promulgate a revised EGL in 2013. In order to address these discharges during the interim period, on June 7, 2010, the EPA issued guidance entitled "*National Pollutant Discharge Elimination System (NPDES) Permitting of Wastewater Discharges from Flue Gas Desulfurization (FGD) and Coal Combustion Residuals (CCR) Impoundments at Steam Electric Power Plants.*" The record for the 1982 ELG indicates that Best Available Technology (BAT) was not established for fly ash or bottom ash transporter water in the final

1982 rule. These wastewaters discharge from CCR impoundments. Thus, BAT-based limits would currently need to be established through BPJ for discharges from CCR impoundments.

Based on our review of the fact sheet, it does not appear that the Tennessee Department of Environment and Conservation (TDEC) examined pollutants expected to be present in the discharge from the CCR impoundment (i.e., ash pond) to establish appropriate TBELs as required by CWA § 301(a)(1) and applicable federal regulations at 40 Code of Federal Regulations (CFR) § 125.3 (applicable to state NPDES permit programs per 40 CFR § 125.25). Therefore, TDEC should reconsider the guidance and the obligations under CWA § 301 in this permit reissuance by evaluating the costs for TVA to install, at a minimum, chemical precipitation or biological treatment for the ash pond discharge in order to reduce the effluent discharge of metals. If the revised analysis still concludes that the existing pond is BAT, TDEC could establish TBELs that reflect the performance of the pond using reported effluent characteristic data for metals contained in the facility's Discharge Monitoring Reports and/or recent permit application.

2. Section 316(a) Report and the Study Plan for the Subsequent Permit

The draft permit lacks detail and does not generate information sufficient to support a CWA Section 316(a) variance determination for the next permit cycle. The EPA's comments are submitted in order to ensure that the study plan to be developed during the next permit cycle will generate information sufficient to support a determination of whether the TVA Gallatin Plant's thermal variance under Section 316(a) of the CWA can be approved.

The EPA recognizes that, under 40 CFR § 125.73(c), existing sources seeking variance renewal are not typically required to conduct the same detailed, comprehensive studies required under § 125.72(a) and (b). Also, under § 125.73, existing sources can base their demonstration on a lack of appreciable harm instead of completing predictive studies. However, under § 125.72(c), the type of detailed studies contemplated under § 125.72(a) and (b) can be required whenever determined to be necessary. After examining the record of prior 316(a) variance determinations for the TVA Gallatin Plant, the EPA has concerns regarding the need for a more thorough examination and definition of the Balanced and Indigenous Population (BIP), the identification of Representative Important Species (RISs), and a closer examination of whether the variance is protective. Given the thinness of the available record to justify prior variance determinations, the EPA believes a more focused study is needed. The EPA acknowledges that TVA has in the past collected a substantial amount of data in support of its variance. TVA may use existing data in completing its study and may incorporate the existence of such data into the study plan design; however, the existing data needs to be evaluated and presented in the context of a BIP definition that the existing record does not adequately provide.

Section 316(a) of the CWA contains the term "BIP" but does not define it. However, 40 CFR § 125.71(c) defines the term "balanced, indigenous community"[1] as:

> "A biotic community typically characterized by diversity, the capacity to sustain itself through cyclic seasonal changes, presence of necessary food chain species and by a lack of domination

[1] "Balanced, indigenous community" and BIP are equivalent terms.

> by pollution tolerant species. Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the Act: and may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)."

The Environmental Appeals Board stated in its decision in In Re Dominion Energy Brayton Point, LLC, 12 Environmental Appeals Decision (E.A.D.) 490 (2006)("Brayton Point"), "this definition clearly envisions a consideration of more than the population of organisms currently inhabiting the water body. In this vein, although it permits inclusion of certain 'historically non-native species' that are currently present, it explicitly excludes certain currently present species whose presence or abundance is attributable to avoidable pollution or previously-granted section 316(a) variances."

Page 557 of the Brayton Point E.A.D. goes on to further state that a BIP "can be the indigenous population that existed prior to the impacts of pollutants, not solely the current populations of organisms."

To the question of how a permittee should identify a BIP in an area that has been altered by impacts from an existing thermal discharge, the Brayton Point E.A.D. points out that it may be appropriate to use a nearby water body unaffected by the existing thermal discharge as a reference area. Examination of an appropriate reference area may be applicable in this case.

The definition of "balanced, indigenous community" at 40 CFR § 125.71(c) contains several key elements. To be consistent with the regulations, each of these key elements should be specifically addressed in the demonstration, and the Study Plan should be designed to generate information relevant to these elements. Those elements include: (1) "a population typically characterized by diversity at all trophic levels;" (2) "the capacity to sustain itself through cyclic seasonal changes;" (3) "presence of necessary food chain species;" (4) "non-domination of pollution-tolerant species;" and (5) "indigenous." Each of these elements is discussed in more detail below:

a. "A population typically characterized by diversity at all trophic levels" means that all of the major trophic levels present in the unaffected portion of the water body should be present in the heat-affected portions. The EPA recognizes that community structure differences will occur, however, the number of species represented in each trophic level in the unaffected portions should be reasonably similar in the heat-affected portions of the water body. Sampling and analysis of fish and invertebrate communities should be done such that the major trophic levels are identified and represented by reasonably similar species distributions. Also, the study plan should be expanded to include some observations of wildlife (i.e., water fowl, mammals, amphibians, etc.) both upstream and immediately downstream of the discharge point that may be impacted by the thermal discharge.

In keeping with the requirements of CWA Section 316, the plant needs to address the BIP's of the phyletic groups (amphibians, reptiles, birds, mammals) in the "wildlife" category. This group should be restricted to animals that are dependent on the receiving waters. For example, the blackbird population needs to be included but waterfowl or Kingfishers might be. Mammals that only drink from the receiving waters (i.e., whitetail deer) don't need to be included, but the beaver population might be. Once those BIPs are identified, the permittee should come up with a list of the wildlife species from all phyletic groups that may be affected by the temp changes in the receiving waters. The effects could be either direct or indirect depending on their dependence on the receiving water for habitat, food, etc. There may be several species of turtles present but some may be highly vulnerable and others not as much. The U.S. Fish and Wildlife Service and state wildlife agency can supply most, or all, of the information. Specifically, the plant should describe what effects the temperature changes might have on organisms that have habitats located near the point of discharge and depend on the receiving water body for survival. For example, amphibians can be affected directly in terms of survival and development of eggs and early life stages that are water dependent. Later, juvenile stages and adults could be affected by changes in prey items (food distribution) in the thermal affected area. All stages could be affected by increases in predation if warmer areas attract more predators. So for species for each group, the permittee needs to discuss the effects the thermal variance might have in regards to maintain a BIP of these organisms.

b. "<u>The capacity to sustain itself through cyclic seasonal changes</u>" means that any additional thermal stress will not cause significant community instability during times of natural extremes in environmental conditions. Community data should be collected during normal seasonal extremes as well as during optimal seasonal conditions. Data should be compared between heat affected and unaffected portions of the receiving water body to account for normal community changes corresponding with a change in season.

c. "<u>Presence of necessary food chain species</u>" means that the necessary food webs remain intact so that communities will be sustaining. We believe that exhaustive food web studies are not necessary provided that invertebrate, fish and wildlife communities are otherwise healthy, i.e., represented by sufficiently high species diversity and abundance (appropriate for that portion of the receiving water body) for the identified trophic levels and sustaining through normal seasonal changes.

d. "<u>Non-domination of pollution-tolerant species</u>" means that in the case of a thermal effluent, community assemblages in heat affected portions of the water body dominated by heat-tolerant species do not constitute a BIP. The EPA recognizes that because all species have varying levels of thermal tolerance, communities in the heat affected portions of the receiving water body may possess altered assemblages in terms of species present and abundance. All community data should be collected, analyzed and presented to clearly demonstrate that affected communities have not shifted to primarily heat tolerant assemblages.

e. "Indigenous" has been further clarified in the regulations: "Such a community may include historically non-native species introduced in connection with a program of wildlife management and species whose presence or abundance results from substantial, irreversible environmental modifications. Normally, however, such a community will not include species whose presence is attributable to the introduction of pollutants that will be eliminated by compliance by all sources with section 301(b)(2) of the Act and may not include species whose presence or abundance is attributable to alternative effluent limitations imposed pursuant to section 316(a)." The EPA recognizes that non-indigenous species are present in most aquatic systems in the United States. All community data should be analyzed and presented to demonstrate that community assemblages in the heat-affected portions of the receiving water body are not significantly different from non-affected communities with regard to the number of non-indigenous species in the assemblages.

In addition to the foregoing components of the BIP definition, the Study Plan should also include provisions for the identification of RIS (e.g., a list of threatened, endangered, thermally sensitive, or commercially or recreationally valuable species up- and downstream of the study area), as contemplated in 40 CFR § 125.72(b). 40 CFR § 125.71(b) defines RIS as "species which are representative, in terms of their biological needs, of a balanced, indigenous community of shellfish, fish and wildlife in the body of water into which a discharge of heat is made."

The following EPA comments should be specifically addressed in the study plan prior to TVA commencing sampling. The plan should:

i) include available information on wildlife in the receiving water body areas based on communications with the state's wildlife agency. See item a) above.

ii) include a diagram depicting the thermal plume under the worst case scenario and address the presence or absence of a zone of passage for which fish can travel around the thermal plume.

iii) provide information of which fish collected are either heat-sensitive or nuisance species. See item d) above.

iv) provide a list of any receiving water body species that are endangered or threaten in accordance with federal and state regulations.

v) select more appropriate sampling locations in order to avoid data that is difficult to interpret.

vi) analyze and present data to clearly demonstrate that affected communities have not shifted to primarily heat tolerant assemblages.

vii) analyze and present all data to demonstrate that community assemblages in the heat-affected portions of the receiving water body are not significantly different from non-affected communities with regard to the number of non-indigenous species in the assemblages.

viii) include recent data or information on benthic macroinvertebrates. See item a) above.

To reiterate, in order to ensure that TVA's future Study Plan is adequate to demonstrate that the Gallatin Plant should get continuance of a Section 316(a) variance during the term of its next NPDES permit, the EPA requests the opportunity to review a draft 316(a) plan prior to TVA commencing the study. Note that the above study elements are required for all facilities subject to a thermal variance. If you have any questions, please contact Ms. Karrie-Jo Shell of my staff at (404) 562-9308.

Sincerely,

Christopher B. Thomas, Chief
Pollution Control and Implementation Branch
Water Protection Division

cc: Ms. Linden P. Johnson
Manager, Water Permitting and Compliance
TVA - Environmental Affairs

Appendix L – Wildlife and Vegetation Assessment Kingston Transmission Line

Wildlife and Vegetation Assessment - *Final*

Kingston Transmission Line

Kingston Fossil Plant

Roane, Cumberland, and Anderson Counties, Tennessee

December 2022

Contents

Tables

Appendices

1 Introduction

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units, and construction and operation of approximately 1,500 megawatts (MW) of replacement generation requiring extensive regional transmission system upgrades to be completed and operational prior to coal unit retirement. To recover the generation capacity lost from retirement of the KIF coal units, upgrades are planned for three existing transmission lines (TLs): (1) the easternmost TLs (L5108 and L5302) located north of the city of Kingston and west of the city of Oak Ridge, in Anderson and Roane Counties, Tennessee; and (2) the westernmost TL (L5383) located north of the city of Crossville, in Cumberland County, Tennessee. Upgrades may include uprating, reconductoring, or rebuilding TLs as well as replacing terminal equipment, bus work, or jumpers.

2 Vegetation Field Survey

2.1 Methods

For the purposes of this field survey, the Project Area of Potential Effect (Project Area) encompasses existing TVA TL right-of-way (ROW) and associated access routes necessary for crew and equipment access. The Project Area generally consists of maintained TVA ROW and unimproved and improved access roads with some forested edges.

Between June 6 and 10, June 13 and 17, and June 20 and 24, 2022, HDR conducted field surveys following TVA's *Guidelines for Conducting Biological and Cultural Surveys and Impact Analysis* (TVA 2020) to map vegetation and identify potential habitat for federally and state-listed threatened and endangered species within the Project Area. HDR conducted habitat assessments for rare plants in the Project Area between August 15 and 19, 2022. This report documents the results of these field surveys; see Appendix A for field maps and figures.

Following TVA (2020) guidelines, HDR reviewed the TVA Regional Natural Heritage Database (RNHD) for state-listed plants potentially occurring in the Project Area or the surrounding five-mile vicinity; the U.S. Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) for federally threatened and endangered plants; and the Tennessee Department of Environment and Conservation (TDEC) Rare Species Data Viewer (TDEC 2022) for federally and state-protected species. The resulting compiled species lists are included in Appendix B.

The HDR surveys were conducted by environmental scientists Jessica Tisdale, Jake Irvin, Lyranda Thiem, Johnathon Calderon-Brandt, Braxton Eden, Josh Mace, and Lindsey Hues to document plant communities and invasive plants and conduct habitat assessments for rare plant species and all other state- and federally listed species in the Project Area. Jessica Tisdale, HDR Senior Environmental Scientist, and Jake Irvin led surveys for rare plants species within the Project Area during the month of August 2022.

Biologists conducted pedestrian survey of the Project Area at a casual pace and plant communities observed were classified by type using the Grossman classification system (Table

1; Grossman et al. 1998). Plant communities were delineated using ArcMap and field notes, and the acreage occupied by each plant community type was calculated as a percentage of the total acreage of the Project Area. The general location and abundance of non-native invasive plants present within the Project Area was also noted.

2.2 Results

2.2.1 Vegetation Communities

The majority of the Project Area consists of maintained TVA ROW surrounded by a few agricultural fields and mixed deciduous forested areas outside of the TVA ROW. Current agricultural activities within the Project Area are focused on cultivating hay as well as providing pastureland for cows. Photograph 1 depicts typical agricultural land within the Project Area. Using the National Vegetation Classification System (Grossman et al. 1998), vegetation types found with the Project Area can be classified as a combination of herbaceous vegetation and mixed deciduous forest. The diversity of community types identified within the Project Area is a result of topography, landscape position, soil types, and current and previous land uses.

Both dry and wet types of deciduous forest are present within the Project Area. Forested areas comprise approximately 16.3 percent of the Project Area. The majority of large contiguous forest stands are located along streams, while smaller forested stands occur along the TVA ROW (Appendix A). Table 1 provides a summary of the vegetation community types as defined by Grossman et al. (1988).

Table 1. Vegetation Communities in the Project Area

Vegetation Community	Area (acres)	Percentage of Project Area
Pasture/Hay	119.5	10.3%
Lawn, Garden, and Recreational Vegetation	84.5	7.3%
Dry Deciduous	179.0	15.5%
Wet Deciduous	9.0	0.78%
Wet Herbaceous (TVA ROW)	77.4	6.7%
Dry Herbaceous (TVA ROW)	674.2	58.3%
Kudzu Infestation	12.1	1.05%

The western TL (L5383) and associated access roads exhibited the most botanical diversity, and includes areas of agricultural pastureland and open water ponds scattered throughout. The eastern TLs (L5108 and L5302) and access roads located near the City of Oak Ridge contained a higher density of invasive and opportunistic species which can be correlated to the high density urbanization of the area. The majority of herbaceous vegetation in the Project Area, defined as communities where herbaceous species account for greater than 70 percent of total cover, occurs in areas heavily disturbed by previous and current land uses (TVA ROW and agricultural fields). The agricultural fields are currently used for cultivating hay or as pastureland for cattle. Typical herbaceous species observed in this vegetation community include Johnson grass (*Sorghum halepense*), fescue species (*Festuca* spp.), grass species (*Poaceae* spp.), white clover (*Trifolium repens*), buttercup species (*Ranunculus* spp.), and dandelion species (*Taraxacum* spp.); see Appendix C, Photograph 1.

Vegetation throughout the TVA ROW (dry herbaceous and wet herbaceous communities) is routinely cleared to maintain the reliability of the transmission system. The purpose of periodic mowing and the use of herbicide is to remove tree species from the ROW, although these management actions can also foster grassland habitat. Weedy and early successional species like sericea lespedeza (*Lespedeza cuneata*) are distributed throughout the TL ROW. Other species observed distributed throughout the TVA ROW include tall goldenrod (*Solidago altissima*), mountain mint (*Pycnanthemum muticum*), velvet panicum (*Dichanthelium scoparium*), raspberry species (*Rubus* spp.), bladder sedge (*Carex lurida*), soft rush (*Juncus effusus*), Japanese stiltgrass (*Microstegium vimineum*), grass species, field thistle (*Cirsium discolor*), butterfly milkweed (*Asclepias tuberosa*), deer tongue (*Dichanthelium clandestinum*), American bur-reed *(Sparganium americanum*), ironweed *(Vernonia noveboracencis*), greater tickseed (*Coreopsis majo*r), multifloral rose (*Rosa multiflora*), seedbox (*Ludwigia alternifolia*), false nettle *(Boehmaria cylindrica)*, fogfruit (*Phyla lanceolata*), fescue species, and cinquefoil (*Potentilla simplex*); see Appendix C, Photograph 4 and 5. Additional species found throughout this community can be found in the Botany Report (Appendix D).

Comprising approximately 15 percent, dry deciduous forests are found on the edges of the Project Area. These larger stands have the potential to support forest dwelling species such as box turtles, woodpeckers, and other small mammals. Common overstory trees include southern red oak (*Quercus falcata*), white oak (*Quercus alba*), and other oak species (*Quercus* spp.) along with occasional mockernut hickory (*Carya tomentosa*), common hackberry (*Celtis occidentalis*), tulip poplar (*Liriodendron tulipifera*), Virginia pine (*Pinus virginiana*), and eastern red cedar (*Juniperus virginiana*). The shrub layer varies from dense to relatively open and contains hickory species (*Carya* spp.), white oak, red oak, and eastern red cedar. The herbaceous layer in this forest type includes greenbrier (*Smilax rotundifolia*), and a variety of grass species (Appendix C, Photograph 2).

Wet deciduous forests occupy approximately 0.78 percent of the Project Area and occur in bands along streams and other small drainages, as well as in association with very flat areas over a perched water table. Streamside riparian forest stands are typically narrow. Areas with this forest type had overstory trees up to 25" diameter at breast height (DBH). Typical canopy species observed in this vegetation community included red maple (*Acer rubrum*), Virginia pine, American sycamore (*Platanus occidentalis*), box elder (*Acer negundo*), tulip poplar, black cherry (*Prunus serotina*), and sweet gum (*Liquidambar styraciflua*). Understory shrubs, woody vines, and sapling species include, red maple, poison ivy (*Toxicodendron radicans*), greenbriers (*Smilax spp.*), spicebush (*Lindera benzoin*), and Chinese privet (*Ligustrum sinense*). Herbaceous cover in this vegetation community typically includes greenbriers, panic grass, fox sedge (*Carex vulpinodea*), bladder sedge, soft rush, and other grass species (Appendix C, Photograph 3).

Kudzu (*Pueraria montana*), a federal-noxious weed as defined by the U.S. Department of Agriculture, Natural Resources Conservation Service (2012), was observed throughout the eastern TLs (L5108 and L5302) and access road portions of the Project Area. Further, many non-native invasive plant species were observed throughout the Study Area. Invasive species observed include Japanese honeysuckle (*Lonicera japonica*), Japanese stiltgrass, Johnson grass, Chinese privet, and multiflora rose. These species are most often found in ruderal forested areas, along field edges, and in areas prone to disturbance. Japanese honeysuckle, Japanese stiltgrass, Chinese privet, and multiflora rose were also found in some of the forested stands. Where present, these species occur on less than 15 percent of the Project Area. Invasive plants were found in both forested and herbaceous vegetation areas.

2.2.2 Listed and Protected Plant Species

Table 2 identifies federally listed and state-listed endangered and threatened plant species that may occur within Roane, Anderson and Cumberland Counties based on the TVA RNHD (TVA 2021) and the TDEC Rare Species Data Viewer (TDEC 2022). Specific locations of the documented occurrence of these plants are not available from TVA RNHD or TDEC, but likelihood of species occurrence can be estimated by matching species habitat requirements with land cover types.

Table 2. Listed or Protected Plant Species in Roane, Anderson, and Cumberland Counties, Tennessee, and Likelihood of Occurrence in the Project Area

Scientific Name	Common Name	Federal and State Protected Status[1]	Habitat Requirements[2]	Species Observed In Project Area[2]
Agalinis auriculata	Earleaved False-foxglove	SE	Barrens	No
Amelanchier sanguinea	Roundleaf Shadbush	ST	Rocky slopes and riverbanks	No
Aspelnium scolopendrium var. americanum	Hart’s-tongue Fern	SE	Sinks	No
Aureolaria patula	Spreading False-foxglove	SSSC	*Oak woods and edges*	No
Berberis candadensis	American Barberry	SSSC	Rocky woods and river bars	No
Bolboschoenus fluviatilis	River Bulrush	SSSC	Marshes, openings in swamps, edges of ponds and streams, fresh tidal marshes, and inland salt marshes and ponds	No
Campanula aparinoides	Marsh Bellflower	SSSC	Bogs	No
Carex buxbaumii	Brown Bog Sedge	SE	Swamps	No
Conradina verticillata	Cumberland Rosemary	FT, ST	Sandy, rocky riverbanks and bars	No
Danthonia epilis	Bog Oat-grass	SSSC	Acidic seeps	No
Delphinium exaltatum	Tall Larkspur	SE	Glades and barrens	No
Diamorpha smallii	Small’s Stonecrop	SE	Sandstone outcrops	No

Scientific Name	Common Name	Federal and State Protected Status[1]	Habitat Requirements[2]	Species Observed In Project Area[2]
Diervilla lonicera	Northern Bush-honeysuckle	ST	Rooky woodlands and bluffs	No
Diervilla sessilifolia var. rivularis	Mountain Bush-honeysuckle	ST	Dry cliffs and bluffs	No
Draba ramosissima	Branching Whitlow-grass	SSSC	Calcareous bluffs	No
Drosera intermedia	Spoonleaf Sundew	SSSC	Acidic wetlands	No
Elodea nuttallii	Nuttall's Waterweed	SSSC	Streams and ponds	No
Epilobium ciliatum	Hairy Willow-herb	ST	Mountain balds	No
Eriophorum virginicum	Tawny Cotton-grass	SE	Bogs	No
Erysimum capitatum	Western Wallflower	SE	Rocky bluffs	No
Eupatorium godfreyanum	Godfrey's Thoroughwort	SSSC	Dry woods	No
Eurybia schreberi	Schreber's Aster	SSSC	Mesic woods and seepage slopes	No
Fothergilla major	Mountain Witch-alder	ST	Rocky slopes and river banks	No
Gratiola brevifolia	Sticky Hedge-hyssop	SSSC	Wet barrens and marshes	No
Helenium brevifolium	Shortleaf Sneezeweed	SE	Rocky, sandy streamsides	No
Helianthus occidentalis	Naked-stem Sunflower	SSSC	Limestone glades and barrens	No
Homaliadelphus sharpii	Sharp's Homaliadelphus	SE	Calcareous or dolomite bluffs	No
Hypericum nudiflorum	Early St. Johnswort	SSSC	Acidic wet and/or open areas	No
Iris fulva	Copper Iris	ST	Bottomlands	No
Juglans cinerea	Butternut	ST	Rich woods and hollows	No
Juncus brachycephalus	Small-headed Rush	SSSC	Seeps and wet bluffs	No
Lachnocaulon anceps	Bog-buttons	SSSC	Acidic open wetlands	No
Lejeunea sharpii	Sharp's Lejeunea	SE	Calcareous bluffs, rocks and logs of wet sinks	No

Scientific Name	Common Name	Federal and State Protected Status[1]	Habitat Requirements[2]	Species Observed In Project Area[2]
Leucothoe racemose	Fetter-bush	ST	Acidic wetlands and swamps	No
Liatris cylindracea	Slender Blazing Star	ST	Barrens and powerlines	No
Lilium philadelphicum	Wood Lily	SE	Dry openings, powerlines	No
Liparis loeselii	Fen Orchis	ST	Calcareous seeps	No
Lonicera diocia	Mountain Honeysuckle	SSSC	Mountain woods and thickets	No
Marshallia grandiflora	Large-fl. Barbara's-buttons	SE	Rocky river bars	No
Meehania cordata	Heartleaf Meehania	ST	Wooded mountain slopes	No
Myurella julacea	Myurella moss	SSSC	Shale bluffs	No
Oligoneuron album	Prairie Goldenrod	SE	Barrens	No
Panax quinquefolius	American Ginseng	SSSC	Rich woods; identified during 2021 field surveys in dry deciduous woods	No
Paronychia agryrocoma	Silverling	ST	Dry sandstone, granite outcrops	No
Parnassia grandifolia	Large-leaved Grass-of-Parnasssus	SSSC	Swampy open meadows	No
Pedicularis lanceolata	Swamp Lousewort	SSSC	Wet acidic barrens and seeps	No
Platanthera flava var. herbiola	Tubercled Rein-orchid	ST	Swamps and floodplains	No
Platanthera integrilabia	White Fringeless Orchid	FT, SE	Acidic seeps and stream heads	No
Poa saltuensis	Drooping Bluegrass	ST	Rich oak woods	No
Pogonia ophioglossoides	Rose Pogonia	SE	Wet acidic barrens	No
Potamogeton amplifolius	Large-leaf Pondweed	ST	Lakes and streams	No
Potamogeton epihydrus	Nuttall's Pondweed	SSSC	Lakes and streams	No
Potamogeton tennesseensis	Tennessee Pondweed	ST	Slow acidic streams	No
Preissia quadrata	Liverwort	ST	Seepy limestone cliffs and bluffs	No
Pseudognaphalium helleri	Heller's Catfoot	SSSC	Dry sandy woods	No

Scientific Name	Common Name	Federal and State Protected Status[1]	Habitat Requirements[2]	Species Observed In Project Area[2]
Pycanthemum torrei	Torrey's Mountain-mint	SE	Barrens	No
Oligoneuron album	Prairie Goldenrod	SE	Barrens and powerlines	No
Ribes curvatum	Granite Gooseberry	ST	Rocky woods	No
Ribes missouriense	Missouri Gooseberry	SSSC	Rocky woods	No
Sagittaria platyphylla	Ovate-leaved Arrowhead	SSSC	Swamps, emergent	No
Schoenoplectus subterminalis	Water Bulrush	SE	Ponds and stream margins	No
Scleria muehlenbergii	Muhlenberg's Nutrush	ST	Wet meadows	No
Spiraea virginiana	Virginia Spiraea	FT, ST	Openings in the floodplain woodlands, swamps, marshes, low areas along ponds, rivers, and ditches. This grass also prefers disturbed open fields.	No
Spiranthes lucida	Shining Ladies'-tresses	ST	Alluvial woods and moist slopes	No
Spiranthes ochroleuca	Yellow Nodding Ladies'-tresses	SE	Moist mountain woods	No
Sporobolus arcuatus	Cumberland Sand-grass	ST	Rocky and sandy river bars	No
Sullivantia sullivantii	Sullivantia	SE	Moist shaded cliffs	No
Symphyotrichum pratense	Barrens Silky Aster	SE	Barrens	No
Trillium pusillum	Least Trillium	SE	Alluvial/moist ravines in dry ridges	No
Utricularia subulata	Zigzag Bladderwort	ST	Wet barrens, ecotones	No

Source: TDEC 2022; TVA 2022.
1) Federal Status: FE- federal endangered, FT – federal threatened; State Status: SE – state endangered, ST – state threatened, SSSC – state species of special concern.
2) Habitat requirements described and species presence confirmed in Appendix D for all plant species.

During the field surveys, no federal and/or state listed plant species were observed within the Project Area; however, habitat exists throughout Project Area for several of the state listed species as described in the table above (Appendix D).

3 Wildlife Survey

3.1 Methods

Following TVA (2020) guidelines, HDR reviewed the TVA RNHD for state-listed wildlife within the Study Area and a three-mile radius, the USFWS IPaC for federally threatened and endangered wildlife in Anderson, Cumberland, and Roane Counties, and the TDEC Rare Species Data Viewer for a list of federally and state-protected species within Anderson, Cumberland, and Roane Counties. The resulting compiled species list is included in Appendix B.

Pedestrian surveys of the Project Area for terrestrial wildlife were conducted by HDR environmental scientists Lyranda Thiem, Braxton Eden, Jonathan Calderon-Brandt, Josh Mace, Lindsey Hue and Blake Hartshorn on June 6 and 10, June 13 and 17, and June 20 and 24, 2022. The pedestrian surveys were focused on forested edges, roadside edges, recently disturbed areas, and areas of former human use. The Project Area was also traversed by vehicle via roads. Transects were walked across forested stands and along streams, drainageways, and the perimeters of crops fields. A bat habitat assessment was performed in forested edges along the TL ROW.

3.2 Results

3.2.1 Observed Wildlife

Table 3 presents a list of species that were either directly observed within the Project Area, or whose evidence (e.g., tracks, scat, remains) was noted during the field survey.

Table 3. Wildlife Species Observed in the Project Area

Species Observed (Common Name)	Notes/Habitat Observed in Project Area
Birds	
Woodpecker spp.	Flying around a tree and pecking at tree within an upland forested habitat
Wild Turkey	Multiple times at forest edges and at the bottom of forested areas
Northern Cardinal	Flying around low hanging branches within scrub shrub habitat
American Crow	Flying overhead
Red-tailed Hawk	Flying overhead
Killdeer	In agricultural field on the western section of the TL and along roadbeds
Barred Owl	Heard within forested areas near ponds/wetlands
Black Vulture	Flying overhead along multiple areas of the TL
Blue Jay	Flying overhead within the TL
Osprey Nest	Observed on TL pole
Amphibians	
Leopard Frog	In multiple streams throughout the site
Green Frog	In multiple streams throughout the site
American Toad	In damper forested areas throughout the site
Cricket Frog	In streams and ponded areas throughout the site
Unidentified Tadpoles	In many puddles and streams throughout the site.

Species Observed (Common Name)	Notes/Habitat Observed in Project Area
Reptiles	
Eastern Box Turtle	In forests near streams multiple times throughout the site
Smooth Soft Shell	Found within East Fork Poplar Creek
Rat Snake	Within a forest edge along the TL
Pond Sliders	In multiple ponds across the site
Five-Lined Skinks	Along forested edges with downed trees near the TL
Insects	
Unidentified Damselfly	Flying over some of the smaller creek beds
Macroinvertebrates	
Caddisflies	In many drainages throughout the site
Midges	In many drainages throughout the site
Mayflies	In many drainages throughout the site
Scuds	In many drainages throughout the site
Mammals	
Armadillo	In forested area
Raccoon	In forested wetland
Tracks/Scat/Remains	
Deer Track and Scat	In several locations across the site
Raccoon Track	In several of the creek beds throughout the site

3.2.2 Listed and Protected Wildlife Species

"Listed" species are recognized by federal, state, or other agencies in an effort to protect them and their habitat under the federal Endangered Species Act (ESA) (1973), as well as under state laws and per local policies. These species are vulnerable to habitat loss and population decline because of their rarity. HDR's assessment also considered wildlife protected under the Migratory Bird Treaty Act (MBTA) of 1918 (16 U.S.C. §§ 703-712), Executive Order for Migratory Birds (E.O. 13186 of January 10, 2001), and the Bald and Golden Eagle Protection Act of 1940 (BGEPA; 16 U.S.C. 668-668d).

3.2.2.1 FEDERALLY AND STATE-LISTED ANIMAL SPECIES

Table 4 provides a summary of the federally and state-listed species that were identified in the USFWS IPaC (USFWS 2022), the TVA RNHD (TVA 2021), and the TDEC Rare Species Data Viewer (TDEC 2022) as potentially occurring on or within the vicinity of the Project Area. No designated critical habitat for federally listed species occurs on or in the vicinity of the Project Area.

Table 4. Federally and State-Listed Animal Species in Anderson, Cumberland, and Roane County, Tennessee

Scientific Name	Common Name	Protected Status[1]	Habitat Requirements	Suitable Habitat Observed	Species Observed
Mammals					
Corynorhinus rafinesquii	Rafinesque's Big-eared Bat	SDNM	Caves, hollow trees, abandoned buildings; often associated with forested areas	Yes – roosting, foraging	No
Myotis grisescens	Gray Bat	FE, SE	Roosts in caves or karst features year-round. Foraging habitats include wet meadows, damp woods, and uplands. No suitable roosting habitat present on-site, however, foraging habitat present	Yes – roosting, foraging	No
Myotis leibii	Eastern Small-footed Bat	SDNM	Hibernates in caves and mines; also uses abandoned buildings, bridges, and barns seasonally	Yes – roosting, foraging	No
Myotis lucifugus	Little Brown Bat	ST	Roost in caves, hollow trees, and human-made structures.	Yes – roosting, foraging	No
Myotis septentrionalis	Northern Long-eared Bat (NLEB)	FT*, ST	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures, sinkhole/karst features; statewide.	Yes – roosting, foraging	No
Myotis sodalis	Indiana Bat	FE, SE	Various habitats including wet meadows, damp woods, and uplands, including abandoned structures and sinkhole fissures/karst features; statewide.	Yes – roosting, foraging	No
Neotoma magister	Allegheny Woodrat	SDNM	Rock outcrops, cliffs, talus slopes, crevices not present	No	No
Perimyotis subflavus	Tri-colored Bat	ST	Generally associated with forested landscapes but may roost near openings	Yes – roosting, foraging	No
Sorex dispar	Long-tailed Shrew	SDNM	Mountainous, forested areas with loose talus	Yes	No
Synaptomys cooperi	Southern bog lemming	SDNM	Marshy meadows, wet balds, & rich upland forests.	Yes	No
Fish					
Chrosomus saylori	Laurel Dace	SE	Inhabits cool 1st-2nd order streams with slabrock and rubble substrate; Tennessee River watershed	Yes	No
Chrosomus tennesseensis	Tennessee Dace	SDNM	Inhabits first order spring-fed streams of woodlands in Ridge and Valley limestone region; Tennessee River watershed	Yes	No

Scientific Name	Common Name	Protected Status[1]	Habitat Requirements	Suitable Habitat Observed	Species Observed
Cycleptus elongatus	Blue Sucker	ST	Inhabits swift waters over firm substrates in big rivers.	No	No
Erimonax monachus	Spotfin Chub	FT, ST	Inhabits clear upland rivers with swift currents and boulder substrates; portions of the Tennessee River watershed	Yes	No
Erimystax cahni	Slender Chub	FT, ST	Restricted to bars and shoals of fine to medium gravel in runs and riffles of medium to large, clear, warm rivers	Yes	No
Etheostoma baileyi	Emerald Darter	SDNM	Inhabits creeks and small rivers with riffles containing gravel or rubble; upper Cumberland drainage	Yes	No
Etheostoma maydeni	Redlips Darter	ST	Inhabits slow-moving large creeks and rivers in pools along the banks strewn with boulders and woody debris	No	No
Hemitremia flammea	Flame Chub	SDNM	Inhabits springs and spring-fed streams with lush aquatic vegetation; Tennessee and middle Cumberland watersheds	Yes	No
Noturus flavipinnis	Yellowfin Madtom	FT, ST	Inhabits pools and backwaters around slab rocks, bedrock ledges, and tree roots in clear creeks and small rivers	Yes	No
Percina aurantiaca	Tangerine Darter	SDNM	Inhabits large-moderate size headwater tributaries to Tennessee River, in clear, fairly deep, rocky pools, usually below riffles	No	No
Percina squamata	Olive Darter	SDNM	Inhabits small-medium rivers; in strong flowing chutes with rubble/boulders in high=gradient streams	No	No
Mollusks					
Athearnia anthonyi	Anthony's Riversnail	FE, SE	Inhabits large-medium rivers with moderate-high gradient, or riffles of larger creeks with cobble/boulder substrate	Yes	No
Cumberlandia monodonta	Spectaclecase	FE, SE	Inhabits large rivers where they live in areas sheltered from the main force of the river current	Yes	No

Scientific Name	Common Name	Protected Status[1]	Habitat Requirements	Suitable Habitat Observed	Species Observed
Cyprogenia stegaria	Fanshell	FE, SE	Inhabits medium to large rivers in gravel riffles	Yes	No
Dromus dromas	Dromedary Pearlymussel	FE, SE	Inhabits small to medium, low turbidity, high to moderate gradient streams	Yes	No
Epioblasma turgidula	Turgid Blossom (pearlymussel)	FE, SE	Species is proposed for delisting due to extinction	No	No
Fusconaia cor	Shiny Pigtoe	FE, SE	Inhabits relatively silt-free substrates of sand, gravel, and cobble in good flows of smaller streams.	Yes	No
Fusconaia cuneolus	Fine-rayed Pigtoe	FE, SE	Inhabits Sand and gravel shoals of streams and rivers	Yes	No
Hemistena lata	Cracking Pearlymussel	FE, SE	Inhabits medium to large rivers in mud, sand, or gravel	Yes	No
Lampsilis abrupta	Pink Mucket	FE, SE	Inhabits larger tributaries in gravel or sand	Yes	No
Lampsilis virescens	Alabama Lampmussel	FE, SE	Inhabits smaller, upstream creeks or in downstream areas of large rivers	Yes	No
Lemiox rimosus	Birdwing Pearlymussel	FE, SE	Inhabits riffles with stable, sand and gravel substrates in moderate to fast currents in small to medium sized rivers	Yes	No
Obovaria retusa	Ring Pink	FE, SE	Inhabits the sandy but silt-free bottoms of large rivers.	Yes	No
Plethobasus cooperianus	Orangefoot pimpleback	FE, SE	Inhabits large rivers in gravel or mixed sand and gravel	Yes	No
Plethobasus cyphyus	Sheepnose Mussel	FE, SE	Inhabits larger rivers and streams where they are usually found in shallow areas with moderate to swift currents that flow over coarse sand and gravel.	Yes	No

Scientific Name	Common Name	Protected Status[1]	Habitat Requirements	Suitable Habitat Observed	Species Observed
Pleurobema plenum	Rough Pigtoe	FE, SE	Inhabits medium to large rivers (20 m wide or greater) in sand, gravel, and cobble substrates in shoals	Yes	No
Quadrula cylindrica strigillata	Rough Rabbitsfoot	FE, SE	Inhabits small to medium-sized streams and some larger rivers. Bottom substrates generally include a mixture of sand and gravel	Yes	No
*Venustaconcha trabalis (*formerly *Villosa perpurpurea and V. trabalis)*	Tennessee Bean	FE, SE	Inhabits small headwater streams to medium-sized rivers with moderate to fast-flowing riffles that has sand, gravel, and cobble substrates and rarely it is found in deep pools or slack water	Yes	No
Venustaconcha troostensis (formerly Villosa perpurpurea in Cumberland River Watershed)	Cumberland Bean	FE, SE	Inhabits riffle areas of small rivers and streams in sand, gravel, and cobble substrates with swift current	Yes	No
Crustaceans					
Cambarus deweesae	Valley Flame Crayfish	SE	Primary burrower; open areas with high water tables	Yes	No
Cambarus hamulatus	Prickly Cave Crayfish	SDNM	Inhabits aquatic caves; Sequatchie Valley and southern Cumberland	No	No
Cambarus obeyensis	Obey Crayfish	SE	Inhabits small-medium sized streams; headwaters of East Fork Obey River; northern Cumberland	No	No
Cambarus pristinus	Pristine Crayfish	SE	Inhabits small-large streams; headwaters of Caney Fork River and abutting Sequatchie River tributaries	No	No
Amphibians					
Cryptobranchus alleganiensis	Hellbender	SE	Inhabits clean and flowing water with plenty of oxygen in large streams and creeks. Areas with gravel bottoms and an abundance of rocks and submerged logs are necessary	Yes	No
Desmognathus abditus	Cumberland Dusky Salamander	SDNM	Inhabits streams of Cumberland Plateau; under rocks along small streams or adjacent cover	Yes	No

Scientific Name	Common Name	Protected Status[1]	Habitat Requirements	Suitable Habitat Observed	Species Observed
Desmognathus welteri	Black Mountain Salamander	SDNM	Inhabits spring runs and permanent streams in wooded mountainous terrain	Yes	No
Gyrinohilus gulolineatus	Berry Cave Salamander	FCS, ST	Inhabits aquatic cave obligate	No	No
Hemidactylium scutatum	Four-toed Salamander	SDNM	Inhabits woodland swamps, shallow depressions, and sphagnum mats on acidic soils in middle and east Tennessee	No	No
Reptiles					
Ophisaurus attenuates longicaudus	Eastern Slender Glass Lizard	SDNM	Inhabits dry upland areas including brush, cut-over woodlands and grassy fields	Yes	No
Pituophis melanoleucus	Northern Pinesnake	ST	Inhabits well-drained sandy soils in pine/pine-oak woods; dry mountain ridges	No	No
Birds					
Limnothlypis swainsonii	Swainson's Warbler	SDNM	Inhabits mature, rich, damp, deciduous floodplain and swamp forests with thick understory	Yes	No
Peucaea aestivalis	Bachman's Sparrow	SE	Inhabits dry open pine or oak woods; nests on the ground in dense cover	Yes	No
Setophaga cerulea	Cerulean Warbler	SDNM	Inhabits mature, deciduous forest, particularly in floodplains or mesic conditions	Yes	No
Thryomanes bewickii	Bewick's Wren	SDNM	Inhabits brushy areas, thickets and scrub in open country	Yes	No
Vermivora chrysoptera	Golden-winged Warbler	ST	Inhabits early successional habitats in foothills regions of Appalachians.	Yes	No
Insects					
Danaus plexippus	Monarch butterfly	FCS	Milkweeds and flowering plants	Yes	No

Source: USFWS 2022; TDEC Rare Species Data Viewer 2022; TVA 2022.
1) Federal Status: FE- federal endangered, FT – federal threatened, FCS – federal candidate species; State Status: SE – state endangered, ST – state threatened, SDNM – state deemed in need of management.
*Note: On November 29, 2022, USFWS published a final rule to reclassify the northern long-eared bat as endangered under the Endangered Species Act. The rule will take effect on January 30, 2023, and will nullify the prior 4(d) rule. Additional information is available from the USFWS site: https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis.

HDR also conducted a field pedestrian survey to identify the types of habitats present within the Project Area, including habitats that could potentially support the species listed in Table 4. The survey focused on the general characteristics of the land cover, vegetation communities, and wildlife habitats currently present within and immediately adjacent to the Project Area.

HDR's desktop database search and pedestrian survey indicated that the Project Area contains suitable habitat for three federally listed bats, three federally listed fish, and sixteen federally and state-listed mollusks as described in the sections below.

Mammals

Three species of federally listed mammals may potentially occur in the Project Area: the gray bat, the NLEB, and the Indiana Bat. In addition, four state listed bat species may potentially occur in the Project Area: eastern small-footed bat, little brown bat, Rafinesque big-eared bat, and the tricolored bat. The gray bat prefers cave habitat year-round. Winter habitat for this species includes deep vertical caves with domed halls, and summer habitat includes warm caves scattered along rivers (USFWS 1997). The Indiana bat and NLEB prefer winter habitats that include caves and mines (USFWS 2006, 2015). Although no caves were observed within the Project Area, caves utilized by bats occur elsewhere in Roane County. These caves may provide habitat to Indiana and/or gray bats.

During the summer, the Indiana bat and NLEB roost singly or in colonies underneath bark, in cavities, or crevices of both live and dead trees of varying size, age, and species (USFWS 2006, 2015). Suitable summer roost habitat for the listed bat species consisting of trees of varying ages, including dead snags, is present in the Project Area, including a total of 218.8 acres of moderately to highly suitable summer roost habitat.

Foraging habitat for all listed bat species is present in the Project Area over ponds, wetlands, streams, and open agricultural fields. Additional foraging habitat for Indiana bat and NLEB occurs within forested habitat, forest edges, and tree lines. Water resources for all bat species include ponds primarily fed by rainwater and stream channels located on the site. A more detailed description of potential habitat for listed bats in the Project Area is presented below.

Three other state listed mammals potentially occur in the Project Area: the Allegheny woodrat, the long-tailed shrew, and the southern bog lemming. The Allegheny woodrat prefers steep rocky cliffs or crevices in exposed rock (ADW 2022). The long-tailed shrew prefers mountainous, forested areas with loose talus (TN Wildlife Mammals 2022a). The southern bog lemming prefers marshy meadows, wet balds, and rich upland forests (TN Wildlife Mammals 2022b). Suitable habitat was observed for the long-tailed shrew and southern bog lemmings within the forested areas along the TVA ROW. No suitable habitat was observed for the Allegheny woodrat as no rocky cliff edges were observed within the Project Area.

Potential Summer Bat Roost Habitat Assessment

Forested areas were assessed for the presence of live trees that exhibit exfoliating bark and dead trees (snags) with cracks or crevices that could serve as suitable roost habitat for the NLEB and Indiana Bat. Buildings on the Project Area were also evaluated for their potential as suitable habitat for these two federally listed bat species. Photographs were taken to visually document the assessment areas (Appendix C). A total of 40 forest stands totaling 228.64 acres (see figures in Appendix A) were determined to provide potential summer roost and foraging habitat for the bat species listed above (Table 4). Of the 228.64 acres, 4.3 percent (9.89 acres) was assessed as providing high-quality habitat, 61.5 percent (140.7 acres) provide moderate-quality habitat, and 34.2 percent (78.09 acres) provide poor-quality habitat. The boundaries of potentially suitable habitat were mapped using a combination of aerial photography, GIS, and sub-meter GPS field mapping. Several large snags occurred in many of the larger forested stands throughout the Project Area. Refer to Appendix E for bat habitat assessment data sheets completed by HDR as part of this study.

Table 5. Potential Bat Roost Forest Stands Summary

Stand Number	Habitat Suitability	Area (acres)
Stand 1	High	2.13
Stand 2	Moderate	1.67
Stand 3	Moderate	6.11
Stand 4	Low	1.36
Stand 5	Moderate	5.17
Stand 6	Low	1.05
Stand 7	Moderate	9.34
Stand 8	Moderate	15.61
Stand 9	Moderate	8.02
Stand 10	Moderate	15.54
Stand 11	Low	2.51
Stand 12	Low	1.48
Stand 13	Low	5.05
Stand 14	Low	6.08
Stand 15	Moderate	4.92
Stand 16	Low	4.86
Stand 17	Moderate	2.09
Stand 18	Moderate	29.82
Stand 19	Low	2.02
Stand 20	Low	8.73
Stand 21	Moderate	9.45
Stand 22	Low	2.00
Stand 23	Moderate	9.25
Stand 24	Low	8.13
Stand 25	Low	9.98
Stand 26	Moderate	1.17
Stand 27	Moderate	2.83
Stand 28	Low	1.05
Stand 29	Moderate	0.50
Stand 30	Low	0.58
Stand 31	Low	0.58
Stand 32	Moderate	3.03
Stand 33	Moderate	0.81
Stand 34	Low	3.10
Stand 35	Moderate	0.95
Stand 36	Moderate	1.56
Stand 37	Low	4.72

Stand Number	Habitat Suitability	Area (acres)
Stand 38	Low	5.38
Stand 39	Low	2.56
Stand 40	Low	0.15

Forest Stand 1

Forest Stand 1 consists of an upland deciduous forest located within the western portion of the Project Area. Dominant canopy and understory trees include sweet gum, tulip poplar, southern red oak, maple species, loblolly pine, and eastern red cedar. Stand 1 was determined to have high habitat quality due to some diversity in age of trees, connection to adjacent forested area, and the Obed River and agricultural fields for foraging. The Obed River and agricultural farm ponds provide a water source for these bats. Photographs 7 and 8 are representative of Forest Stand 1 (Appendix C).

Forest Stand 2

Forest Stand 2 consists of an upland mixed deciduous forest located within the western portion of the Project Area. Dominant canopy and understory trees include sweet gum, tulip poplar, southern red oak, maple species, loblolly pine, and eastern red cedar. Stand 2 was determined to have moderate habitat quality due to having some diversity in age of trees, connection to adjacent forested areas, and having a thicker understory. Rocky Branch Creek occurs as a water resource within Forest Stand 2. Photographs 9 and 10 are representative of Forest Stand 2 (Appendix C).

Forest Stand 3

Forest Stand 3 consists of an upland mixed deciduous forest located within the western portion of the Project Area. Dominant canopy and understory trees include white oak, red oak species, sweet gum, loblolly pine, red maple, pignut hickory, common hackberry, and sugar maple. Forest Stand 3 was determined to have moderate quality habitat due to lacking snags, trees with exfoliating bark, connection to adjacent forested areas, and lack of a water source. Photograph 11 is representative of Forest Stand 3.

Forest Stand 4

Forest Stand 4 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. Dominant canopy and understory include eastern red cedar, bush honeysuckle, common hackberry, and some oak species. Forest Stand 4 was determined to have low quality habitat due to lack of snags and trees with exfoliating bark, little diversity in tree species, dense understory, lack of connection to adjacent forested areas, and lack of a water source. Photograph 12 is representative of Forest Stand 4.

Forest Stand 5

Forest Stand 5 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. Dominant canopy and understory include common hackberry, mimosa tree, white oak, southern red oak, pignut hickory, and some eastern red cedar. Forest Stand 5 was determined to have moderate quality habitat due to lack of snags, some diversity in ages of trees, connection to adjacent forested areas, and presence of a water source and agricultural fields for foraging. A freshwater pond occurs as a water source just north of the stand as well. Photographs 13 and 14 are representative of Forest Stand 5.

Forest Stand 6

Forest Stand 6 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, southern red oak, common hackberry, red cherry, and some Chinese privet. Forest Stand 6 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source. Photograph 15 is representative of Forest Stand 6.

Forest Stand 7

Forest Stand 7 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. Dominant canopy and understory include common hackberry, white oak, black walnut, pignut hickory, and some eastern red cedar. Forest Stand 7 was determined to have moderate quality habitat due to lack of snags, some diversity in ages of trees, connection to adjacent forested areas, and presence of a water source and agricultural fields for foraging. Clinch River also occurs as a water source just south of the stand. Photographs 16 and 17 are representative of Forest Stand 7.

Forest Stand 8

Forest Stand 8 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, southern red oak, common hackberry, red cherry, and some Chinese privet. Forest Stand 8 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source. Photographs 18 and 19 are representative of Forest Stand 8.

Forest Stand 9

Forest Stand 9 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, southern red oak, common hackberry, red cherry, and some Chinese privet. Forest Stand 9 was determined to have low quality habitat due to lack of snags and dense understory in some locations within the stand. The Clinch River and ephemerals act as a water source for Forest Stand 9. Photographs 19 and 20 are representative of Forest Stand 9.

Forest Stand 10

Forest Stand 10 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, southern red oak, common hackberry, red cherry, and some Chinese privet. Forest Stand 10 was determined to have moderate quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source. Photographs 21 and 22 are representative of Forest Stand 10.

Forest Stand 11

Forest Stand 11 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A gravel roadway exists within the middle of the stand. Dominant canopy and understory include eastern red cedar, bush honeysuckle, common hackberry, and some oak species. Stand 11 was determined to have low quality habitat due to lack of snags and trees with exfoliating bark, little diversity in tree species, dense understory, lack of connection to adjacent forested areas, and lack of a water source. Photograph 23 is representative of Forest Stand 11.

Forest Stand 12

Forest Stand 12 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A gravel roadway exists within the middle of the stand. Dominant canopy and understory include eastern red cedar, bush honeysuckle, common hackberry, and some oak species. Forest Stand 12 was determined to have low quality habitat due to lack of snags and trees with exfoliating bark, little diversity in tree species, dense understory, lack of connection to adjacent forested areas, and lack of a water source. Photograph 24 is representative of Forest Stand 12.

Forest Stand 13

Forest Stand 13 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A gravel roadway exists within the middle of the stand. Dominant canopy and understory include eastern red cedar, bush honeysuckle, common hackberry, and some oak species. Forest Stand 13 was determined to have low quality habitat due to lack of snags and trees with exfoliating bark, little diversity in tree species, dense understory, and lack of connection to adjacent forested areas. Poplar Creek acts as a water source for Forest Stand 13. Photographs 25 and 26 are representative of Forest Stand 13.

Forest Stand 14

Forest Stand 14 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, sweet gum, common hackberry, and red cherry. Forest Stand 14 was determined to have low quality habitat due to lack of snags and dense understory in some locations within the stand. The Clinch River and Poplar Creek act as a water source for Forest Stand 14. Photographs 26 and 27 are representative of Forest Stand 14.

Forest Stand 15

Forest Stand 15 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. An unpaved trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, southern red oak, common hackberry, Virginia pine, red cherry, and some Chinese privet.

Forest Stand 15 was determined to have moderate quality habitat due to lack of snags, diversity among trees within stand, and multiple water sources nearby. Photographs 26 and 28 are representative of Forest Stand 15.

Forest Stand 16

Forest Stand 16 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, sweet gum, common hackberry, Virginia pine, basswood, and red cherry. Forest Stand 16 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photograph 29 is representative of Forest Stand 16.

Forest Stand 17

Forest Stand 17 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. This stand lies south of TVA open ROW. Dominant canopy and understory include pignut hickory, white oak, sweet gum, common hackberry, Virginia pine, basswood, and red cherry. Forest Stand 17 was determined to have moderate quality habitat due to lack of snags, access to a larger forested stand, diversity in trees within stand, and having a water source near the stand. Poplar Creek acts as a water source for this stand. Photograph 30 is representative of Forest Stand 17.

Forest Stand 18

Forest Stand 18 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. An unpaved trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include shagbark hickory, white oak, ironwood-muscle wood, tulip poplar, sugar maple, common hackberry, Virginia pine, and black cherry. Forest Stand 18 was determined to have moderate quality habitat due to lack of snags, diversity among trees within stand, and having a water source within the stand. East Fork Poplar Creek acts as a water source within this stand. A bat box was observed within this stand. Photographs 31 and 32 are representative of Forest Stand 18.

Forest Stand 19

Forest Stand 19 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. Dominant canopy and understory include pignut hickory, white oak, Virginia pine, common hackberry, and black cherry. Forest Stand 19 was determined to have low quality habitat due to lack of snags and dense understory in some locations within the stand. Poplar Creek act as a nearby water source for Stand 19. Photographs 33 and 34 are representative of Forest Stand 19.

Forest Stand 20

Forest Stand 20 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include white oak, sweet gum, eastern red cedar, common hackberry, Virginia pine, and black cherry. A box culvert was observed within the stand; however, no evidence of bat use was observed. Forest Stand 20 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photographs 35 and 36 are representative of Forest Stand 20.

Forest Stand 21

Forest Stand 21 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. An unpaved trail leads through the middle of the forested stand that occurs within the Project Area. Dominant canopy and understory include pignut hickory, white oak, common hackberry, Virginia pine, red cherry, and sugar maple. Forest Stand 21 was determined to have moderate quality habitat due to lack of snags, diversity among trees within stand, access to larger forested stands, and lack of a water source. Photograph 37 is representative of Forest Stand 21.

Forest Stand 22

Forest Stand 22 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A road occurs northwest of the stand. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, and eastern red cedar. Forest Stand 22 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photographs 38 is representative of Forest Stand 22.

Forest Stand 23

Forest Stand 23 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A graveled trail runs through a small section of this stand along with the TVA ROW. Dominant canopy and understory include ironwood-muscle wood, box elder, American sycamore, black walnut, common hackberry, and black cherry. Forest Stand 23 was determined to have moderate quality habitat due to lack of snags, access to a larger forested stand, diversity in trees within stand, and having a water source near the stand. Unnamed tributaries and wetlands act as a water source within this stand. Photographs 39 and 40 are representative of Forest Stand 23.

Forest Stand 24

Forest Stand 24 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A road occurs southwest of the stand. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, and eastern red cedar. Forest Stand 24 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photograph 41 is representative of Forest Stand 24.

Forest Stand 25

Forest Stand 25 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. A road occurs southwest of the stand. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, and eastern red cedar. Forest Stand 25 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photograph 42 is representative of Forest Stand 25.

Forest Stand 26

Forest Stand 26 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area and near residential neighborhoods. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, red maple, and eastern red cedar. Forest Stand 26 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photograph 43 is representative of Forest Stand 26.

Forest Stand 27

Forest Stand 27 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. Dominant canopy and understory include ironwood- muscle wood, box elder, white oak, black walnut, common hackberry, and black cherry. Forest Stand 27 was determined to have moderate quality habitat due to lack of snags, access to a larger forested stand, diversity in trees within stand, and having a water source nearby the stand. Unnamed tributaries act as a water source within this stand. Photographs 44 and 45 are representative of Forest Stand 27.

Forest Stand 28

Forest Stand 28 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area and near residential neighborhoods. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, red maple, and eastern red cedar. Forest Stand 28 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photograph 46 is representative of Forest Stand 28.

Forest Stand 29

Forest Stand 29 consists of an upland mixed deciduous forest located within the eastern portion of the Project Area. Dominant canopy and understory include ironwood- muscle wood, oak species, sugar maple, black walnut, common hackberry, and black cherry. Forest Stand 29 was determined to have moderate quality habitat due containing one snag, access to a larger forested stand, diversity in trees within stand, and an intermittent stream acting as a water source within the stand. Photographs 47 and 48 are representative of Forest Stand 29.

Forest Stand 30

Forest Stand 30 consists of an upland mixed deciduous forest located within the Eastern Project Area and near residential neighborhoods. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, red maple, and eastern red cedar. Forest Stand 30 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photographs 49 is representative of Forest Stand 30.

Forest Stand 31

Forest Stand 31 consists of an upland mixed deciduous forest located within the Eastern Project Area and near residential neighborhoods. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, red maple, and eastern red cedar. Forest Stand 31 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photographs 49 is representative of Forest Stand 31.

Forest Stand 32

Forest Stand 32 consists of an upland mixed deciduous forest located within the Eastern Project Area. Dominant canopy and understory include ironwood- muscle wood, oak species, sugar maple, black walnut, common hackberry, and shagbark hickory. Forest Stand 32 was determined to have moderate quality habitat due containing several snags, access to a larger forested stand, diversity in trees within stand, and no water source within the stand. Photographs 50 and 51 are representative of Forest Stand 32.

Forest Stand 33

Forest Stand 33 consists of an upland mixed deciduous forest located within the Eastern Project Area. Dominant canopy and understory include ironwood- muscle wood, oak species, sugar maple, black walnut, common hackberry, and shagbark hickory. Forest Stand 33 was determined to have moderate quality habitat due containing several snags, access to a larger forested stand, diversity in trees within stand, and no water source within the stand. Photograph 50 is representative of Forest Stand 33.

Forest Stand 34

Forest Stand 34 consists of an upland mixed deciduous forest located within the Eastern Project Area and near residential neighborhoods. Dominant canopy and understory include white oak, sweet gum, common hackberry, Virginia pine, sugar maple, and some eastern red cedar. Forest Stand 34 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of a water source within the stand. Photograph 52 is representative of Forest Stand 34.

Forest Stand 35

Forest Stand 35 consists of an upland mixed deciduous forest located within the Eastern Project Area. This stand surrounds a large stream system and open maintained lawn/ agricultural fields. Dominant canopy and understory include ironwood- muscle wood, oak species, sugar maple, black walnut, common hackberry, and shagbark hickory. Forest Stand 35 was determined to have moderate quality habitat due to lack of snags, access to a larger forested stand, diversity in trees within stand, and having a water source within the stand. Photograph 53 is representative of Forest Stand 35.

Forest Stand 36

Forest Stand 36 consists of an upland mixed deciduous forest located within the Eastern Project. The top half of this stand near the stream system is surrounded by kudzu. Dominant canopy and understory include pignut hickory, oak species, sugar maple, common hackberry, and shagbark hickory. Forest Stand 36 was determined to have moderate quality habitat due to lack of snags, access to a larger forested stand, diversity in trees within stand, and having a water source within the stand. Photographs 54 and 55 are representative of Forest Stand 36.

Forest Stand 37

Forest Stand 37 consists of an upland mixed deciduous forest located within the Eastern Project Area. Dominant canopy and understory include white oak, common hackberry, Virginia pine, sugar maple, and some eastern red cedar. Forest Stand 37 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, lack of diversity in ages of trees within the stand and lack of a water source within the stand. Photograph 56 is representative of Forest Stand 37.

Forest Stand 38

Forest Stand 38 consists of an upland mixed deciduous forest located within the Eastern Project Area. Dominant canopy and understory include white oak, common hackberry, Virginia pine, sugar maple, and some eastern red cedar. Forest Stand 38 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, and lack of diversity in ages of trees within the stand Project Area. An intermittent stream acts as a water source within Stand 38. Photographs 57 and 58 are representative of Forest Stand 38.

Forest Stand 39

Forest Stand 39 consists of an upland mixed deciduous forest located within the Eastern Project Area. Dominant canopy and understory include white oak, common hackberry, Virginia pine, sugar maple, and some eastern red cedar. Forest Stand 39 was determined to have low quality habitat due to lack of snags, dense understory in some locations within the stand, lack of diversity in ages of trees within the stand and no water source available within the stand. Photograph 59 is representative of Forest Stand 39.

Forest Stand 40

Forest Stand 40 consists of an upland mixed deciduous forest located within the Eastern Project Area. Dominant canopy and understory include chestnut oak, white oak, common hackberry, Virginia pine, sugar maple, and some eastern red cedar. Forest Stand 40 was determined to have low quality habitat due to dense understory in some locations within the stand, lack of diversity in ages of trees within the stand and no water source available within the stand. Photograph 60 is representative of Forest Stand 40.

Fish

Based on the review of the species databases, eleven state listed or protected fish species potentially occur in the Project Area: yellowfin madtom, blue sucker, emerald darter, flame chub, olive darter, redlips darter, slender chub, spotfin chub, tangerine darter, and Tennessee dace.

The yellowfin madtom prefers small-to-medium size streams with a moderate current, warm water, good water quality, and little siltation (Biological Diversity 2022). The blue sucker inhabits the mainstem of major rivers and lower sections of main tributaries where they can be found in strong currents, riffles or rapidly flowing chutes, and over gravel and rock substrates (ADW 2022). The slender chub prefers bars and shoals in runs and riffles of medium to large rivers with clear, warm water (NatureServe 2022). The spotfin chub prefers clear, large creeks or medium sized rivers of moderate gradient, in upland and montane areas with moderate and swift currents over bedrock (NatureServe 2022). The flame chub prefers habitat with springs, shallow seepage waters, and spring-fed streams usually with mud, gravel, or bedrock substrates (NatureServe 2022). The emerald darter inhabits creeks and small rivers with riffles containing gravel or rubble in the upper Cumberland drainage. The laurel dace inhabits cool streams with slabrock and rubble substrates. The olive darter prefers small-medium sized rivers with strong flowing chutes with rubble/boulders in high gradient streams. The redlips darter inhabits slow-moving large creeks and rivers in pools along the banks strewn with boulders and woody debris (NatureServe 2022). The tangerine darter inhabits large-moderate sized headwater tributaries to Tennessee River in clear, fairly deep, rocky pools. The Tennessee dace inhabits first order spring-fed streams of woodlands. Potentially suitable habitat was observed in streams located within the Project Area for the yellowfin madtom, slender chub, spotfin chub, flame chub, emerald darter, and the Tennessee dace, but no individuals were observed during the field surveys.

Mollusks and Crustaceans

There are nineteen federally and/or state-listed mollusk species that may occur in the Project Area. The federally listed turgid blossom is not expected to be present within the Project Area as they are believed extinct and are currently proposed to be delisted due to extinction.

The federally listed shiny pigtoe, Tennessee bean (formerly the purple bean), Cumberland bean, and the Alabama lampmussel require relatively silt free substrates of sand, gravel, and cobble in good flows of smaller streams (NatureServe 2022). Habitat exists for these species within the Project Area; however, no individuals were observed during the field surveys.

The federally listed rough rabbitsfoot, dromedary pearlymussel, and birdwing pearlymussel inhabit small to medium sized streams with sand and gravel substrates (NatureServe 2022). Potentially suitable habitat was identified on-site for these species, but no individuals were observed during the field surveys.

The federally listed rough pigtoe, fine-rayed pigtoe, fanshell, cracking pearlymussel, and Anthony's riversnail inhabit medium to large rivers in sand, gravel, and cobble substrates. Potentially suitable habitat was documented on-site for these species, but no individuals were observed during the field surveys.

The federally listed spectaclecase, sheepnose mussel, ring pink, pink mucket, and the orangefoot pimpleback inhabit large rivers with sand and gravel substrates (NatureServe 2022). Potentially suitable habitat exists within the Project Area for these species, but no individuals were observed during the field surveys.

There are four state listed crustacean species that may occur in the Project Area; Obey crayfish, prickly cave crayfish, pristine crayfish, and valley flame crayfish. The Obey crayfish and the pristine crayfish inhabit headwaters of East Fork Obey River and headwaters of the Caney Fork River, respectively. No suitable habitat exits onsite for these crayfish because these rivers do not flow within the Project Area. No suitable habitat was found for the prickly cave crayfish since no caves were observed within the Project Area. The valley flame crayfish prefers open areas with high water tables in order to burrow. Suitable habitat exits onsite for this species, but no individuals were observed during the field survey.

Amphibians

There are five state listed amphibian species that may occur within the Project Area: berry cave salamander, black mountain salamander, Cumberland dusky salamander, four-toed salamander, and the hellbender.

The berry cave salamander inhabits caves year-round; no suitable habitat exists onsite for this species. The four-toed salamander inhabits woodland swamps, shallow depressions, and sphagnum mats on acidic soils. No suitable habitat exists onsite for this species.

The black mountain salamander inhabits spring runs and permanent streams in wooded mountainous terrain (NatureServe 2022). The Cumberland dusky salamander inhabits streams of the Cumberland Plateau under rocks along small streams or adjacent cover. The Hellbender inhabits clean and flowing water with plenty of oxygen in large streams and creeks with areas with an abundance of rocks (NatureServe 2022). Suitable habitat exits onsite for these species; however, no individuals were observed at the time of the field survey.

Reptiles

There are two state listed reptile species that may occur in the Project Area: the eastern slender glass lizard and the northern pine snake. The northern pine snake inhabits well-drained sandy soils in pine/pine-oak woods and dry mountain ridges. No suitable habitat exits onsite for this species. The slender glass lizard inhabits dry upland areas including brush, cut-over woodlands, and grassy fields. Potentially suitable habitat exists for this species; however, no individuals were observed in the habitat at the time of the field survey.

Insects

The monarch butterfly is the only federally listed candidate insect species that may occur in the Project Area. The monarch butterfly prefers habitats that provide milkweed and flowering plants such as roadside areas, open areas, wet areas, or urban gardens (NatureServe 2022). No monarch butterflies were observed during the field survey; however, milkweed was observed in multiple areas throughout the Project Area; therefore, potentially suitable habitat for the monarch butterfly exists in the Project Area.

Birds

There are five state listed bird species that may potentially occur in the Project Area: Bachman’s sparrow, Bewick’s wren, cerulean warbler, golden-winged warbler, and Swainson’s warbler.

Bachman's sparrow inhabits dry open pine or oak woods (NatureServe 2022). Bewick's wren prefers brushy areas, thickets, and scrub in open country, open and riparian woodland, and chaparral. Cerulean warblers inhabit deciduous forests (Audubon 2022). The golden-winged warbler inhabits upland sites on abandoned farmland in early successional habitats, powerline ROWs, dry and shrubby fields, woodland clearings, and wet areas covered by felled trees (NatureServe 2022). Swainson's warbler inhabits swamps and river floodplain forests, with dense understory and sparse ground cover (Audubon 2022). Potentially suitable habitat exists onsite for these species; however, no individuals were observed at the time of the field survey.

3.2.2.2 MIGRATORY BIRDS AND EAGLES

E.O. 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) directs federal agencies to take certain actions to further implement the MBTA. The MBTA prohibits the "take" of migratory birds. The regulatory definition of "take" as defined by 50 CFR § 10.12, "means to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue hunt, shoot, wound, kill, trap, capture, or collect." The following prohibitions apply to migratory bird nests: "possession, sale, purchase, barter, transport, import and export, take, and collect." The MBTA is executed and enforced by USFWS.

Approximately 276 species of migratory birds have been identified in Roane, Anderson, and Cumberland counties (eBird 2022), and additional species likely occur regularly. The USFWS maintains a list of migratory birds of conservation concern (USFWS 2021c). These species are not listed under the ESA but are a high conservation priority of the USFWS and without additional conservation action are likely to become candidates for listing under the ESA. Twenty-three species of birds of conservation concern are listed for Bird Conservation Region 28 (BCR 28), Appalachian Mountains, which contains the Project Area. Of these 20 species, at least 15 potentially occur with some regularity on or in the immediate vicinity of the Project Area (Table 6).

Table 6. Migratory Bird Species of Conservation Concern Potentially Occurring in the Project Area.

Scientific Name	Common name	Season of Occurrence	Likelihood of Presence/Habitat
Coccyzus americanus	Yellow-billed Cuckoo (Eastern)	Spring through fall	**Possible**, occurs in wooded habitat with dense cover and water nearby, including woodlands with low, scrubby, vegetation, overgrown orchards, abandoned farmland and dense thickets along streams and marshes;
Coccyzus erythropthalmus	Black-billed Cuckoo	Spring through fall	**Possible,** occurs along wood edges, groves, thickets. Breeds mostly in deciduous thickets and shrubby places, often on the edges of woodland or around marshes.
Caprimulgus carolinensis	Chuck-will's Widow	Spring and fall	**Likely**, open dry woodlands
Caprimulgus vociferus	Eastern Whip-poor-will	Year-round	**Likely**; deciduous and or mixed woods
Chaetura pelagica	Chimney Swift	Spring through fall	**Likely**, nests in chimneys and less frequently large, open-topped hollow trees; reported from vicinity and likely forages over TL Upgrade Area

Scientific Name	Common name	Season of Occurrence	Likelihood of Presence/Habitat
Aegolius acadicus	Northern Saw-whet Owl	Year-round	**Possible,** occurs in forest with an open understory for foraging, deciduous trees for nesting, dense conifers for roosting, and riverside habitat nearby. But they nest in a wide range of wooded habitats, including coniferous swamps, disturbed deciduous woods, savannahs, riverside forest, and shrub-steppe habitat
Melanerpes erythrocephalus	Red-headed Woodpecker	Year-round	**Likely**; inhabits open forests and pine savannahs, reported from vicinity
Poecile atricapillus	Black-capped Chickadee (Appalachian)	Spring through fall	**Likely**, occurs in deciduous and mixed forests, open woods, parks, willow thickets, cottonwood groves, and disturbed areas.
Hylocichla mustelina	Wood Thrush	Spring through fall	**Likely**, deciduous and mixed forests with shrubs in understory; reported from vicinity
Dolichonyx oryzivorus	Bobolink	Spring through fall	**Likely**, open country with a preference for large hayfields, moist meadows and weedy fields dominated by a mixture of tall grasses
Euphagus carolinus	Rusty Blackbird	Winter	**Possible,** occurs in forested wetlands
Protonotaria citrea	Prothonotary Warbler	Spring through fall	**Possible**, forested wetlands with areas of standing water
Oporornis formosus	Kentucky Warbler	Spring through fall	**Likely**, moist deciduous forest with shrubby understory
Dendroica cerulea	Cerulean Warbler	Spring through fall	**Possible,** mature deciduous forest with scattered canopy gaps
Dendroica discolor	Prairie Warbler	Spring through fall	**Likely**, brushy fields and recently harvested, regenerating woodlands

1) BCC: Bird of Conservation Concern

A large portion of the currently forested portions of the Project Area, as well as the recently clear-cut areas, provide suitable habitat for one or more of the birds listed in Table 6. Many additional species of migratory birds not listed as a conservation concern in USFWS (2021c) likely also occur on the Project Area. Table 3 lists a few of these species whose presence was confirmed. The other species likely present include wood ducks and other waterfowl, additional species of hawks and owls, woodpeckers, flycatchers, vireos, thrushes, and warblers. The deciduous forests and regenerating clear-cut areas also provide habitat for migratory birds with declining populations that are not currently protected under the Endangered Species Act (USFWS 2021c).

Both bald and golden eagles are protected by the MBTA and the BGEPA. Under the BGEPA it is illegal to kill, harass, possess (without a permit), or sell bald and golden eagles and their parts.

Bald eagles typically utilize forested areas adjacent to large bodies of water for nesting habitat. Tall, mature coniferous or deciduous trees that afford a wide view of the surroundings are used as nest trees and roost trees. Bald eagles typically avoid heavily developed areas. Suitable summer nesting habitat for bald eagles generally consists of prominent trees along riparian corridors on large bodies of water. Winter habitat in Tennessee includes reservoirs and large rivers. Bald eagles are known to nest in Tennessee, with 175 nesting pairs as of 2012 (TWRA 2021). The suitability of the Project Area as habitat for the bald eagle is generally low due to the absence of large water bodies throughout much of the Project Area; however, potentially suitable habitat does occur on the eastern TLs where they cross the Emory River, near the Kingston reservation..

The golden eagle is a rare winter resident in Tennessee and most reports of it have been in the vicinity of reservoirs. Wintering habitat includes a mix of forest and open habitats for foraging. The Project Area encompasses suitable winter roosting and foraging habitat, and the golden eagle has been reported from adjacent counties; therefore, the golden eagle could potentially occur in the Project Area, although none were observed during the field survey.

4 Summary

A large portion of the Project Area is dry herbaceous powerline ROW, with some agricultural lands and mixed deciduous forests intermixed. Potential suitable habitat was identified and evaluated during field surveys for the presence of the federal and state protected plant species listed in Table 4; no federal or state protected plant species were observed within the Project Area during the time of the field survey.

Forested areas within the Project Area provide potential bat roosting and foraging habitat for federally listed bat species, as well as several other bat species. Several migratory birds considered to be of conservation concern, as well as many other bird species, some with declining populations, likely occur in the Project Area.

5 References

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Appendix A

Figures

Appendix B

USFWS IPaC, TVA RHND, TDEC Rare Species Data Viewer Results

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

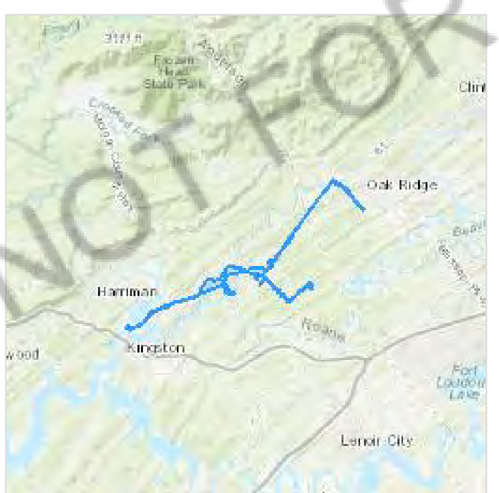
Project information

NAME

Kingston_TransLine_East

LOCATION

Anderson and Roane counties, Tennessee



DESCRIPTION

None

Local office

Tennessee Ecological Services Field Office

(931) 528-6481

(931) 528-7075

446 Neal Street
Cookeville, TN 38501-4027

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Log in to IPaC.
2. Go to your My Projects list.
3. Click PROJECT HOME for this project.
4. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Gray Bat Myotis grisescens — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6329

Indiana Bat Myotis sodalis — Endangered
Wherever found
There is **final** critical habitat for this species. The location of the critical habitat is not available.
https://ecos.fws.gov/ecp/species/5949

Northern Long-eared Bat Myotis septentrionalis — Threatened
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/9045

Fishes

NAME	STATUS
Slender Chub Erimystax cahni Wherever found There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/6637	Threatened
Spotfin Chub Erimonax monachus There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/1521	Threatened
Yellowfin Madtom Noturus flavipinnis There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/8565	Threatened

Clams

NAME	STATUS
Alabama Lampmussel Lampsilis virescens No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/916	Endangered
Birdwing Pearlymussel Lemiox rimosus No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6636	EXPN

Cracking Pearlymussel Hemistena lata — Endangered

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4130

Cumberland Bean (pearlymussel) Villosa trabalis — Endangered

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6061

Dromedary Pearlymussel Dromus dromas — Endangered

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6377

Fanshell Cyprogenia stegaria — Endangered

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4822

Finerayed Pigtoe Fusconaia cuneolus — Endangered

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/3038

Orangefoot Pimpleback (pearlymussel) Plethobasus cooperianus — Endangered

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/1132

Pink Mucket (pearlymussel) Lampsilis abrupta — Endangered

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7829

Purple Bean Villosa perpurpurea — Endangered

Wherever found

There is **final** critical habitat for this species. The location of the critical habitat is not available.
https://ecos.fws.gov/ecp/species/4125

Ring Pink (mussel) Obovaria retusa — Endangered

Wherever found

No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/4128

Rough Pigtoe Pleurobema plenum — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6894

Rough Rabbitsfoot Quadrula cylindrica strigillata — Endangered
Wherever found
There is **final** critical habitat for this species. The location of the critical habitat is not available.
https://ecos.fws.gov/ecp/species/5629

Sheepnose Mussel Plethobasus cyphyus — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/6903

Shiny Pigtoe Fusconaia cor — Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/2573

Spectaclecase (mussel) Cumberlandia monodonta — Endangered
Wherever found
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7867

Turgid Blossom (pearlymussel) Epioblasma turgidula — Endangered
No critical habitat has been designated for this species.
https://ecos.fws.gov/ecp/species/7659

Snails

NAME	STATUS
Anthony's Riversnail Athearnia anthonyi No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4827	EXPN
Anthony's Riversnail Athearnia anthonyi No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/4827	Endangered

Insects

NAME	STATUS

Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Flowering Plants

NAME	STATUS
Virginia Spiraea Spiraea virginiana Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1728	Threatened
White Fringeless Orchid Platanthera integrilabia No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1889	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

THERE ARE NO CRITICAL HABITATS AT THIS LOCATION.

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php

- Nationwide conservation measures for birds
  http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Aug 31
Bobolink Dolichonyx oryzivorus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31
Canada Warbler Cardellina canadensis This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Aug 10

Cerulean Warbler Dendroica cerulea — Breeds Apr 27 to Jul 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.
https://ecos.fws.gov/ecp/species/2974

Eastern Whip-poor-will Antrostomus vociferus — Breeds May 1 to Aug 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Kentucky Warbler Oporornis formosus — Breeds Apr 20 to Aug 20

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Prairie Warbler Dendroica discolor — Breeds May 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Prothonotary Warbler Protonotaria citrea — Breeds Apr 1 to Jul 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Red-headed Woodpecker Melanerpes erythrocephalus — Breeds May 10 to Sep 10

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Rusty Blackbird Euphagus carolinus — Breeds elsewhere

This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA

Wood Thrush Hylocichla mustelina — Breeds May 10 to Aug 31

This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

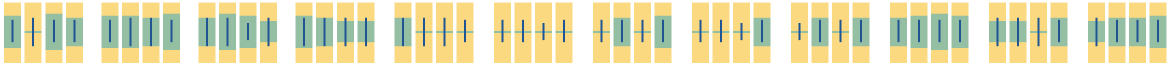
No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

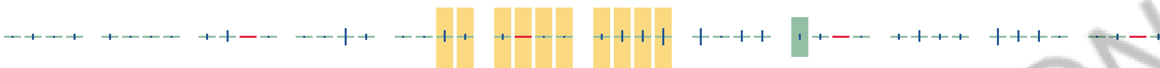
■ probability of presence ■ breeding season | survey effort – no data

SPECIES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC

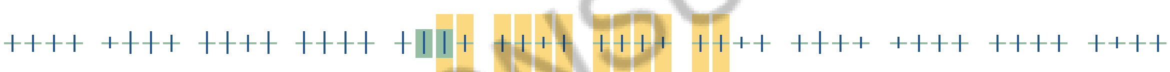
Bald Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)



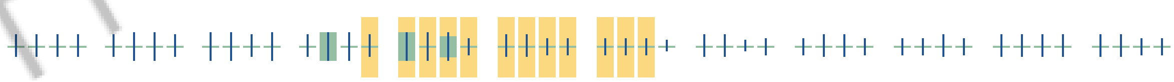
Bobolink
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



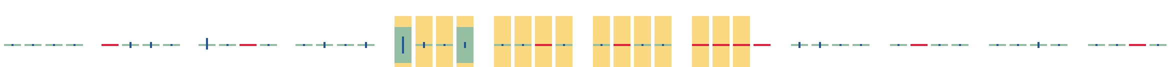
Canada Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



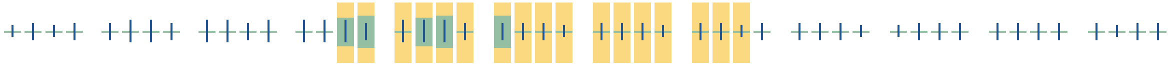
Cerulean Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



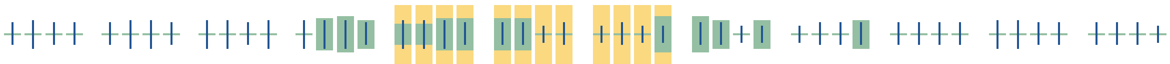
Eastern Whip-poor-will
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



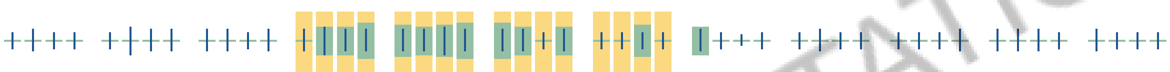
Kentucky Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



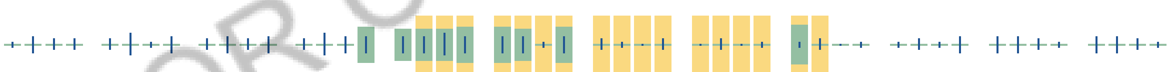
Prairie Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Prothonotary Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

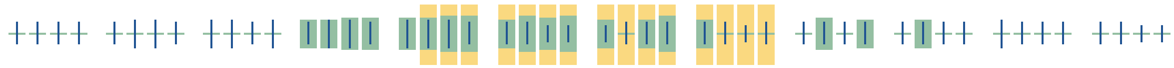


Red-headed Woodpecker
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Rusty Blackbird
BCC - BCR (This is a Bird of Conservation Concern (BCC) only in particular Bird Conservation Regions (BCRs) in the continental USA)

Wood Thrush
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

WETLAND INFORMATION IS NOT AVAILABLE AT THIS TIME
This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

IPaC **U.S. Fish & Wildlife Service**

IPaC resource list

This report is an automatically generated list of species and other resources such as critical habitat (collectively referred to as *trust resources*) under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction that are known or expected to be on or near the project area referenced below. The list may also include trust resources that occur outside of the project area, but that could potentially be directly or indirectly affected by activities in the project area. However, determining the likelihood and extent of effects a project may have on trust resources typically requires gathering additional site-specific (e.g., vegetation/species surveys) and project-specific (e.g., magnitude and timing of proposed activities) information.

Below is a summary of the project information you provided and contact information for the USFWS office(s) with jurisdiction in the defined project area. Please read the introduction to each section that follows (Endangered Species, Migratory Birds, USFWS Facilities, and NWI Wetlands) for additional information applicable to the trust resources addressed in that section.

Project information

NAME

Kingston_TransLine_West

LOCATION

Cumberland County, Tennessee

DESCRIPTION

None

Local office

Tennessee Ecological Services Field Office

(931) 528-6481

(931) 528-7075

446 Neal Street
Cookeville, TN 38501-4027

Endangered species

This resource list is for informational purposes only and does not constitute an analysis of project level impacts.

The primary information used to generate this list is the known or expected range of each species. Additional areas of influence (AOI) for species are also considered. An AOI includes areas outside of the species range if the species could be indirectly affected by activities in that area (e.g., placing a dam upstream of a fish population even if that fish does not occur at the dam site, may indirectly impact the species by reducing or eliminating water flow downstream). Because species can move, and site conditions can change, the species on this list are not guaranteed to be found on or near the project area. To fully determine any potential effects to species, additional site-specific and project-specific information is often required.

Section 7 of the Endangered Species Act **requires** Federal agencies to "request of the Secretary information whether any species which is listed or proposed to be listed may be present in the area of such proposed action" for any project that is conducted, permitted, funded, or licensed by any Federal agency. A letter from the local office and a species list which fulfills this requirement can **only** be obtained by requesting an official species list from either the Regulatory Review section in IPaC (see directions below) or from the local field office directly.

For project evaluations that require USFWS concurrence/review, please return to the IPaC website and request an official species list by doing the following:

1. Log in to IPaC.
2. Go to your My Projects list.
3. Click PROJECT HOME for this project.
4. Click REQUEST SPECIES LIST.

Listed species[1] and their critical habitats are managed by the Ecological Services Program of the U.S. Fish and Wildlife Service (USFWS) and the fisheries division of the National Oceanic and Atmospheric Administration (NOAA Fisheries[2]).

Species and critical habitats under the sole responsibility of NOAA Fisheries are **not** shown on this list. Please contact NOAA Fisheries for species under their jurisdiction.

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1. Species listed under the Endangered Species Act are threatened or endangered; IPaC also shows species that are candidates, or proposed, for listing. See the listing status page for more information. IPaC only shows species that are regulated by USFWS (see FAQ).
2. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

The following species are potentially affected by activities in this location:

Mammals

NAME	STATUS

Gray Bat Myotis grisescens Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6329	Endangered
Indiana Bat Myotis sodalis Wherever found There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/5949	Endangered
Northern Long-eared Bat Myotis septentrionalis Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9045	Threatened

Fishes

NAME	STATUS
Spotfin Chub Erimonax monachus There is **final** critical habitat for this species. Your location overlaps the critical habitat. https://ecos.fws.gov/ecp/species/1521	Threatened

Clams

NAME	STATUS
Cumberland Bean (pearlymussel) Villosa trabalis No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/6061	Endangered
Purple Bean Villosa perpurpurea Wherever found There is **final** critical habitat for this species. The location of the critical habitat is not available. https://ecos.fws.gov/ecp/species/4125	Endangered

Insects

NAME	STATUS
Monarch Butterfly Danaus plexippus Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/9743	Candidate

Flowering Plants

NAME	STATUS
Cumberland Rosemary Conradina verticillata Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/3677	Threatened
Virginia Spiraea Spiraea virginiana Wherever found No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1728	Threatened
White Fringeless Orchid Platanthera integrilabia No critical habitat has been designated for this species. https://ecos.fws.gov/ecp/species/1889	Threatened

Critical habitats

Potential effects to critical habitat(s) in this location must be analyzed along with the endangered species themselves.

This location overlaps the critical habitat for the following species:

NAME	TYPE
Spotfin Chub Erimonax monachus https://ecos.fws.gov/ecp/species/1521#crithab	Final

Migratory birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.

Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php

- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

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For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON (IF A BREEDING SEASON IS INDICATED FOR A BIRD ON YOUR LIST, THE BIRD MAY BREED IN YOUR PROJECT AREA SOMETIME WITHIN THE TIMEFRAME SPECIFIED, WHICH IS A VERY LIBERAL ESTIMATE OF THE DATES INSIDE WHICH THE BIRD BREEDS ACROSS ITS ENTIRE RANGE. "BREEDS ELSEWHERE" INDICATES THAT THE BIRD DOES NOT LIKELY BREED IN YOUR PROJECT AREA.)
Bald Eagle Haliaeetus leucocephalus This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Aug 31
Bobolink Dolichonyx oryzivorus This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 20 to Jul 31

Eastern Whip-poor-will *Antrostomus vociferus* — Breeds May 1 to Aug 20
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Prairie Warbler *Dendroica discolor* — Breeds May 1 to Jul 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Red-headed Woodpecker *Melanerpes erythrocephalus* — Breeds May 10 to Sep 10
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Wood Thrush *Hylocichla mustelina* — Breeds May 10 to Aug 31
This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.

Probability of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

To see a bar's probability of presence score, simply hover your mouse cursor over the bar.

Breeding Season ( )

Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)

Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

To see a bar's survey effort range, simply hover your mouse cursor over the bar.

No Data (–)

A week is marked as having no data if there were no survey events for that week.

Survey Timeframe

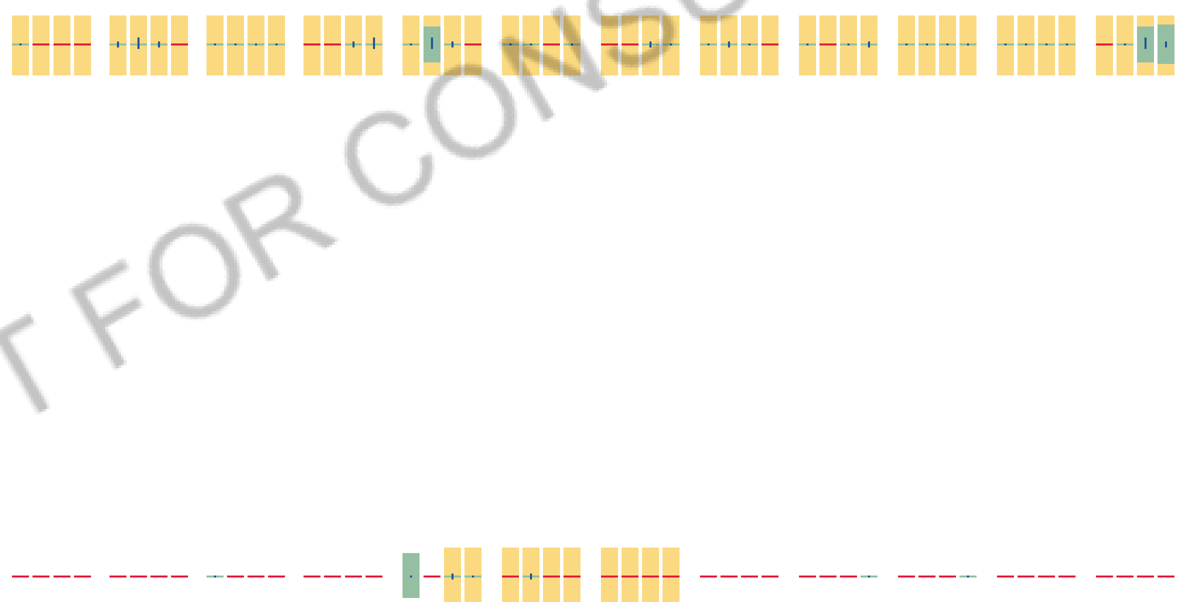
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.

probability of presence | breeding season | survey effort | – no data

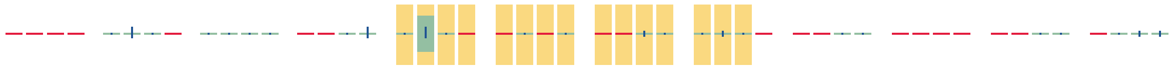
SPECIES JAN FEB MAR APR MAY JUN JUL AUG SEP OCT NOV DEC

Bald Eagle
Non-BCC Vulnerable (This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities.)

Bobolink
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

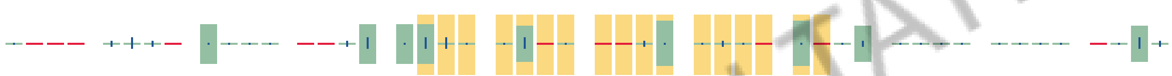


Eastern Whip-poor-will
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

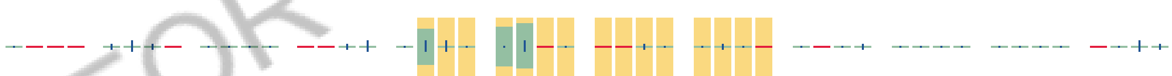


Prairie Warbler
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)

Red-headed Woodpecker
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Wood Thrush
BCC Rangewide (CON) (This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.)



Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.

Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?

The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?

The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?

To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?

Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and
3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects

For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?

If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report

The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Facilities

National Wildlife Refuge lands

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS AT THIS LOCATION.

Fish hatcheries

THERE ARE NO FISH HATCHERIES AT THIS LOCATION.

Wetlands in the National Wetlands Inventory

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

WETLAND INFORMATION IS NOT AVAILABLE AT THIS TIME

This can happen when the National Wetlands Inventory (NWI) map service is unavailable, or for very large projects that intersect many wetland areas. Try again, or visit the NWI map to view wetlands at this location.

Data limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

The accuracy of image interpretation depends on the quality of the imagery, the experience of the image analysts, the amount and quality of the collateral data and the amount of ground truth verification work conducted. Metadata should be consulted to determine the date of the source imagery used and any mapping problems.

Wetlands or other mapped features may have changed since the date of the imagery or field work. There may be occasional differences in polygon boundaries or classifications between the information depicted on the map and the actual conditions on site.

Data exclusions

Certain wetland habitats are excluded from the National mapping program because of the limitations of aerial imagery as the primary data source used to detect wetlands. These habitats include seagrasses or submerged aquatic vegetation that are found in the intertidal and subtidal zones of estuaries and nearshore coastal waters. Some deepwater reef communities (coral or tuberficid worm reefs) have also been excluded from the inventory. These habitats, because of their depth, go undetected by aerial imagery.

Data precautions

Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.

TN Department of Environment & Conservation

Rare Species by Watershed | Rare Species by County | Rare Species by Quadrangle | Stormwater Programs

- Download Status and Ranks

Help

Key to Status and Ranks

Rare Species by County

Data is refreshed on or around January and July each year.

Go Rows All Actions

County = 'Roane'

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County	Type	Category	Scientific Name	Common Name	Global Rank	State Rank	Fed. Status	State Status	Habitat	Wet Habitat Flag
Roane	Vertebrate Animal	Mammal	Spilogale putorius	Eastern Spotted Skunk	G4	S3	--	Rare, Not State Listed	Rocky outcrops, open prairies, brushy areas, cultivated fields, and barnyards; more common in east Tennessee; reclusive.	Upland
Roane	Invertebrate Animal	Crustacean	Caecidotea incurva	Incurved Cave Isopod	G2G4	S1	--	Rare, Not State Listed	Aquatic cave obligate; known from two wet caves in east Tennessee.	Aquatic
Roane	Animal Assemblage	No Data	Rookery	Heron Rookery	G5	SNR	--	Rare, Not State Listed	No Data	No Data
Roane	Vertebrate Animal	Fish	Percina aurantiaca	Tangerine Darter	G4	S3	--	D	Large-moderate size headwater tribs to Tennessee River, in clear, fairly deep, rocky pools, usually below riffles.	Aquatic
Roane	Vascular Plant	Flowering Plant	Helianthus occidentalis	Naked-stem Sunflower	G5	S2	--	S	Limestone Glades And Barrens	Upland
Roane	Vascular Plant	Flowering Plant	Diervilla sessilifolia var. rivularis	Mountain Bush-honeysuckle	G3	S2	--	T	Dry Cliffs And Bluffs	Upland
Roane	Vascular Plant	Flowering Plant	Elodea nuttallii	Nuttall's Waterweed	G5	S2	--	S	Aquatic; Streams And Ponds	Aquatic
Roane	Vertebrate Animal	Fish	Erimonax monachus	Spotfin Chub	G2	S2	LT,XN	T	Clear upland rivers with swift currents & boulder substrates; portions of the Tennessee River watershed.	Aquatic
Roane	Vertebrate Animal	Fish	Cycleptus elongatus	Blue Sucker	G3G4	S2	--	T	Swift waters over firm substrates in big rivers.	Aquatic
Roane	Vertebrate Animal	Bird	Peucaea aestivalis	Bachman's Sparrow	G3	S1B	--	E	Dry open pine or oak woods; nests on the ground in dense cover.	Upland
Roane	Vascular Plant	Flowering Plant	Platanthera integrilabia	White Fringeless Orchid	G2G3	S2S3	LT	E	Acidic Seeps And Stream Heads	Possible
Roane	Vascular Plant	Flowering Plant	Platanthera flava var. herbiola	Tubercled Rein-orchid	G4?T4Q	S2	--	T	Swamps And Floodplains	Possible
Roane	Vascular Plant	Flowering Plant	Agalinis auriculata	Earleaved False-foxglove	G3	S2	--	E	Barrens	Upland
Roane	Vascular Plant	Flowering Plant	Delphinium exaltatum	Tall Larkspur	G3	S2	--	E	Glades And Barrens	Upland
Roane	Vascular Plant	Flowering Plant	Bolboschoenus fluviatilis	River Bulrush	G5	S1	--	S	Marshes	Possible
Roane	Vascular Plant	Fern and Fern Ally	Asplenium scolopendrium var. americanum	Hart's-tongue Fern	G4T3	S1	LT	E	Sinks	Possible
Roane	Vascular Plant	Flowering Plant	Juncus brachycephalus	Small-headed Rush	G5	S2	--	S	Seeps And Wet Bluffs	Possible
Roane	Invertebrate Animal	Mollusc	Lampsilis abrupta	Pink Mucket	G1G2	S2	LE	E	Generally a large river species, preferring sand-gravel or rocky substrates with mod-strong currents; Tennessee & Cumberland river systems.	Aquatic

Roane	Vertebrate Animal	Mammal	Myotis grisescens	Gray Myotis	G4	S2	LE	E	Cave obligate year-round; frequents forested areas; migratory.	Upland
Roane	Invertebrate Animal	Mollusc	Plethobasus cyphyus	Sheepnose	G3	S2S3	LE	E	Large to medium-sized rivers, in riffles and coarse sand/gravel subst; TN & Cumb river systems incl KY Reservoir; W Uplands & Rim.	Aquatic
Roane	Invertebrate Animal	Mollusc	Cumberlandia monodonta	Spectaclecase	G3	S2S3	LE	E	Medium to large rivers; in substrates from mud and sand to gravel, cobble, and boulders; Cumberland and Tennessee river systems.	Aquatic
Roane	Vascular Plant	Flowering Plant	Draba ramosissima	Branching Whitlow-grass	G4	S2	--	S	Calcareous Bluffs	Upland
Roane	Vascular Plant	Flowering Plant	Erysimum capitatum	Western Wallflower	G5	S1S2	--	E	Rocky Bluffs	Upland
Roane	Vascular Plant	Flowering Plant	Pseudognaphalium helleri	Heller's Catfoot	G4G5	S2	--	S	Dry Sandy Woods	Upland
Roane	Vascular Plant	Flowering Plant	Ribes missouriense	Missouri Gooseberry	G5	S2	--	S	Rocky Woods	Upland
Roane	Nonvascular Plant	Non-Vascular Plant	Preissia quadrata	A Liverwort	G5	S1	--	T	Seepy Limestone Cliffs And Bluffs	Possible
Roane	Vascular Plant	Flowering Plant	Juglans cinerea	Butternut	G3	S3	--	T	Rich Woods And Hollows	Possible
Roane	Vertebrate Animal	Amphibian	Hemidactylium scutatum	Four-toed Salamander	G5	S3	--	D	Woodland swamps, shallow depressions, & sphagnum mats on acidic soils; middle & east Tennessee.	Possible
Roane	Vascular Plant	Flowering Plant	Marshallia grandiflora	Large-fl. Barbara's-buttons	GNR	S2	--	E	Rocky River Bars	Possible
Roane	Vascular Plant	Flowering Plant	Liatris cylindracea	Slender Blazing-star	G5	S2	--	T	Barrens	Upland
Roane	Vertebrate Animal	Fish	Chrosomus tennesseensis	Tennessee Dace	G3	S3	--	D	First order spring-fed streams of woodlands in Ridge and Valley limestone region; Tennessee River watershed.	Aquatic
Roane	Vascular Plant	Flowering Plant	Diervilla lonicera	Northern Bush-honeysuckle	G5	S2	--	T	Rocky Woodlands And Bluffs	Upland
Roane	Vertebrate Animal	Reptile	Pituophis melanoleucus melanoleucus	Northern Pinesnake	G4T4	S3	--	T	Well-drained sandy soils in pine/pine-oak woods; dry mountain ridges; E portions of west TN, E to lower elev of the Appalachians.	Upland
Roane	Vascular Plant	Flowering Plant	Leucothoe racemosa	Fetter-bush	G5	S2	--	T	Acidic Wetlands And Swamps	Possible
Roane	Vertebrate Animal	Amphibian	Aneides aeneus	Green Salamander	G3G4	S3S4	--	Rare, Not State Listed	Damp crevices in shaded rock outcrops and ledges; beneath loose bark and cracks of trees and sometimes in/or under logs.	Upland
Roane	Invertebrate Animal	Mollusc	Obovaria retusa	Ring Pink	G1	S1	LE,XN	E	Large rivers in gravel and sand bars; Tennessee & Cumberland river watersheds; many historic locations currently inundated.	Aquatic
Roane	Invertebrate Animal	Mollusc	Venustaconcha trabalis	Tennessee Bean	G1	S1	LE, XN	E	Riffle areas of small rivers & streams in sand, gravel, & cobble substrates with swift current; upper Cumb. & upper Tenn. river systems.	Aquatic
Roane	Invertebrate Animal	Mollusc	Plethobasus cooperianus	Orangefoot Pimpleback	G1	S1	LE, XN	E	Large rivers in sand-gravel-cobble substrates in riffles and shoals in deep flowing water; Cumberland & Tennessee river systems.	Aquatic
Roane	Vertebrate Animal	Amphibian	Gyrinophilus gulolineatus	Berry Cave Salamander	G1Q	S1	C	T	Aquatic cave obligate; Ridge & Valley; formerly	Aquatic

									included with G. palleucus.	
Roane	Vertebrate Animal	Mammal	Perimyotis subflavus	Tri-colored bat	G2G3	S2S3	--	T	Generally associated with forested landscapes but may roost near openings.	No Data
Roane	Vascular Plant	Flowering Plant	Spiranthes lucida	Shining Ladies'-tresses	G4	S1S2	--	T	Alluvial Woods And Moist Slopes	Possible
Roane	Vascular Plant	Flowering Plant	Panax quinquefolius	American Ginseng	G3G4	S3S4	--	S-CE	Rich Woods	Possible
Roane	Invertebrate Animal	Mollusc	Fusconaia cuneolus	Finerayed Pigtoe	G1	S1	LE, XN	E	Riffles of fords and shoals of mod gradient streams in firm cobble and gravel substrates; middle & upper Tennessee River watershed.	Aquatic
Roane	Vascular Plant	Flowering Plant	Aureolaria patula	Spreading False-foxglove	G3	S3	--	S	Oak Woods And Edges	Upland
Roane	Vascular Plant	Flowering Plant	Oligoneuron album	Prairie Goldenrod	G5	S1S2	--	E	Barrens	Upland
Roane	Invertebrate Animal	Mollusc	Lampsilis virescens	Alabama Lampmussel	G1	S1	LE	E	Found in sand and gravel substrates in shoal areas of small-medium size rivers; middle and upper TN R system; recently rediscovered in Emory River.	Aquatic
Roane	Invertebrate Animal	Crustacean	Cambarus deweesae	Valley Flame Crayfish	G4	S1	--	E	Primary burrower; open areas with high water tables; northern Ridge & Valley.	Aquatic
Roane	Invertebrate Animal	Mollusc	Fusconaia cor	Shiny Pigtoe	G1	S1	LE, XN	E	Shoals and riffles of small-medium sized rivers with mod-fast current over sand-cobble substrates; upper Tennessee River watershed.	Aquatic
Roane	Invertebrate Animal	Mollusc	Theliderma cylindrica strigillata	Rough Rabbitsfoot	G3G4T2	S2	LE	E	Small-medium sized rivers, in clear, shallow riffles with sand-gravel substrates; Tenn. & Cumb. river systems; upland form.	Aquatic
Roane	Vascular Plant	Flowering Plant	Liparis loeselii	Fen Orchis	G5	S1	--	T	Calcareous Seeps	Possible
Roane	Vascular Plant	Flowering Plant	Pedicularis lanceolata	Swamp Lousewort	G5	S1S2	--	S	Wet Acidic Barrens And Seeps	Possible
Roane	Vertebrate Animal	Mammal	Sorex dispar	Long-tailed Shrew	G4	S2	--	D	Mountainous, forested areas with loose talus; east Tennessee.	Upland
Roane	Vascular Plant	Flowering Plant	Symphyotrichum pratense	Barrens Silky Aster	G4?	S1	--	E	Barrens	Upland
Roane	Nonvascular Plant	Non-Vascular Plant	Myurella julacea	A Moss	G5	SH	--	S-P	Shale Bluffs	Possible
Roane	Vertebrate Animal	Fish	Hemitremia flammea	Flame Chub	G3	S3	--	D	Springs and spring-fed streams with lush aquatic vegetation; Tennessee & middle Cumberland river watersheds.	Aquatic
Roane	Vertebrate Animal	Amphibian	Cryptobranchus alleganiensis	Hellbender	G3	S3	No Status	E	Rocky, clear creeks and rivers with large shelter rocks.	Aquatic
Roane	Vascular Plant	Flowering Plant	Spiraea virginiana	Virginia Spiraea	G2	S2	LT	E	Stream Bars And Ledges	Possible
Roane	Invertebrate Animal	Mollusc	Io fluvialis	Spiny Riversnail	G1G2	S2	--	Rare, Not State Listed	Shallow waters of shoals that are rapid to moderate and well-oxygenated; Tennessee River & main tributaries; E Tennessee.	Aquatic
Roane	Vascular Plant	Flowering Plant	Lonicera dioica	Mountain Honeysuckle	G5	S2	--	S	Mountain Woods And Thickets	Possible
Roane	Vertebrate Animal	Mammal	Synaptomys cooperi	Southern Bog Lemming	G5	S4	--	D	Marshy meadows, wet balds, & rich upland forests.	Possible
Roane	Invertebrate Animal	Mollusc	Pleurobema rubrum	Pyramid Pigtoe	G2G3	S1S2	--	Rare, Not State Listed	Rivers with strong current and firm sand/gravel substrates; TN & Cumb river systems incl KY Reservoir; W Uplands & W Highland Rim.	Aquatic

Roane	Vertebrate Animal	Mammal	Myotis septentrionalis	Northern Myotis	G1G2	S1S2	LT	T	A forest bat whose summer roosts may include caves, mines, live trees and snags; hibernates in caves and mines, often using small cracks and fissures. Notably susceptible to White-Nose Syndrome.	No Data
Roane	Vascular Plant	Flowering Plant	Eurybia schreberi	Schreber's Aster	G4	S1	--	S	Mesic Woods & Seepage Slopes	Upland
Roane	Vertebrate Animal	Reptile	Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	G5T5	S3	--	D	Dry upland areas including brushy, cut-over woodlands and grassy fields; nearly statewide but obscure; fossorial.	Upland
Roane	Vertebrate Animal	Bird	Limnothlypis swainsonii	Swainson's Warbler	G4	S3	--	D	Mature, rich, damp, deciduous floodplain and swamp forests.	Possible
Roane	Invertebrate Animal	Mollusc	Cyprogenia stegaria	Fanshell	G1	S1	LE, XN	E	Medium to large streams and rivers with coarse sand and gravel substrates; Cumberland and Tennessee river systems.	Aquatic

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TN Department of Environment & Conservation

Help

Key to Status and Ranks

- Download Status and Ranks

Rare Species by County

Data is refreshed on or around January and July each year.

Go Rows All Actions

Row text contains 'Anderson'

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County	Type	Category	Scientific Name	Common Name	Global Rank	State Rank	Fed. Status	State Status	Habitat	Wet Habitat Flag
Anderson	Vertebrate Animal	Mammal	Neotoma magister	Allegheny Woodrat	G3G4	S3	--	D	Outcrops, cliffs, talus slopes, crevices, sinkholes, caves & karst.	Upland
Anderson	Vertebrate Animal	Reptile	Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	G5T5	S3	--	D	Dry upland areas including brushy, cut-over woodlands and grassy fields; nearly statewide but obscure; fossorial.	Upland
Anderson	Invertebrate Animal	Mollusc	Pleurobema plenum	Rough Pigtoe	G1	S1	LE, XN	E	Medium to large rivers in sand, gravel, and cobble substrates of shoals; Tennessee & Cumberland river systems.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Lampsilis abrupta	Pink Mucket	G1G2	S2	LE	E	Generally a large river species, preferring sand-gravel or rocky substrates with mod-strong currents; Tennessee & Cumberland river systems.	Aquatic
Anderson	Nonvascular Plant	Non-Vascular Plant	Lejeunea sharpii	Sharp's Lejeunea	G2G3	S1S2	--	E	Calcareous Bluffs, Rock & Logs Of Wet Sinks	Possible
Anderson	Invertebrate Animal	Crustacean	Caecidotea recurvata	Southwestern Virginia Cave Isopod	G5	S2	--	Rare, Not State Listed	Aquatic cave obligate; northernmost Ridge & Valley; reported from Campbell, Claiborne, & Hancock counties.	Aquatic
Anderson	Invertebrate Animal	Crustacean	Cambarus deweesae	Valley Flame Crayfish	G4	S1	--	E	Primary burrower; open areas with high water tables; northern Ridge & Valley.	Aquatic
Anderson	Vertebrate Animal	Amphibian	Cryptobranchus alleganiensis	Hellbender	G3	S3	--	E	Rocky, clear creeks and rivers with large shelter rocks.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Margaritifera monodonta	Spectaclecase	G3	S2S3	LE	E	Medium to large rivers; in substrates from mud and sand to gravel, cobble, and boulders; Cumberland and Tennessee river systems.	Aquatic
Anderson	Invertebrate Animal	Crustacean	Amerigoniscus nicholasi	A Cave Obligate Isopod	G1G2	S1S2	--	Rare, Not State Listed	Terrestrial cave obligate; known from two caves; Western Highland Rim and Ridge & Valley.	Upland
Anderson	Vertebrate Animal	Mammal	Myotis lucifugus	Little Brown Myotis	G3G4	S3	--	T	Often uses human-made structures for resting and maternity sites; they also use caves and hollow trees. Typically feed over water.	No Data

Anderson	Invertebrate Animal	Mollusc	Plethobasus cooperianus	Orangefoot Pimpleback	G1	S1	LE, XN	E	Large rivers in sand-gravel-cobble substrates in riffles and shoals in deep flowing water; Cumberland & Tennessee river systems.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Lampsilis virescens	Alabama Lampmussel	G1	S1	LE	E	Found in sand and gravel substrates in shoal areas of small-medium size rivers; middle and upper TN R system; recently rediscovered in Emory River.	Aquatic
Anderson	Vertebrate Animal	Fish	Erimonax monachus	Spotfin Chub	G2	S2	LT,XN	T	Clear upland rivers with swift currents & boulder substrates; portions of the Tennessee River watershed.	Aquatic
Anderson	Invertebrate Animal	Insect	Pseudanophthalmus wallacei	Wallace's Cave Beetle	G1	S1	--	Rare, Not State Listed	Terrestrial cave obligate; Ridge & Valley; Anderson County.	Upland
Anderson	Vascular Plant	Flowering Plant	Pycnanthemum torrei	Torrey's Mountain-mint	G2	S1	--	E	Barrens	Upland
Anderson	Vertebrate Animal	Fish	Erimystax cahni	Slender Chub	G1	S1	LT, XN	T	Major headwater tribs to TN River with small gravel substrates & swift-moderate currents.	Aquatic
Anderson	Vascular Plant	Flowering Plant	Aureolaria patula	Spreading False-foxglove	G3	S3	--	S	Oak Woods And Edges	Upland
Anderson	Vertebrate Animal	Fish	Cycleptus elongatus	Blue Sucker	G3G4	S2	--	T	Swift waters over firm substrates in big rivers.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Cyprogenia stegaria	Fanshell	G1	S1	LE, XN	E	Medium to large streams and rivers with coarse sand and gravel substrates; Cumberland and Tennessee river systems.	Aquatic
Anderson	Vascular Plant	Flowering Plant	Platanthera flava var. herbiola	Tubercled Rein-orchid	G4?T4Q	S2	--	T	Swamps And Floodplains	Possible
Anderson	Invertebrate Animal	Insect	Pseudanophthalmus pusillus	Tiny Cave Beetle	G1	S1	--	Rare, Not State Listed	Terrestrial cave obligate; northern Ridge & Valley.	Upland
Anderson	Vascular Plant	Flowering Plant	Helianthus occidentalis	Naked-stem Sunflower	G5	S2	--	S	Limestone Glades And Barrens	Upland
Anderson	Invertebrate Animal	Arachnid	Hesperochernes mirabilis	Southeastern Cave Pseudoscorpion	G5	S3	--	Rare, Not State Listed	Terrestrial cave obligate; woodrat debris in caves; middle Tennessee.	Upland
Anderson	Vascular Plant	Flowering Plant	Juglans cinerea	Butternut	G3	S3	--	T	Rich Woods And Hollows	Possible
Anderson	Vascular Plant	Flowering Plant	Parnassia grandifolia	Large-leaved Grass-of-parnassus	G3	S3	--	S	Calcareous Seeps	Possible
Anderson	Vertebrate Animal	Reptile	Pituophis melanoleucus melanoleucus	Northern Pinesnake	G4T4	S3	--	T	Well-drained sandy soils in pine/pine-oak woods; dry mountain ridges; E portions of west TN, E to lower elev of the Appalachians.	Upland
Anderson	Vascular Plant	Flowering Plant	Meehania cordata	Heartleaf Meehania	G5	S2	--	T	Wooded Mountain Slopes	Upland
Anderson	Vertebrate Animal	Fish	Etheostoma baileyi	Emerald Darter	G4G5	S2	--	D	Creeks and small rivers with riffles containing gravel or rubble; upper Cumberland drainage.	Aquatic
Anderson	Vascular Plant	Flowering Plant	Sullivantia sullivantii	Sullivantia	G4	S1	--	E	Moist Shaded Cliffs	Upland
Anderson	Vertebrate Animal	Mammal	Synaptomys cooperi	Southern Bog Lemming	G5	S4	--	D	Marshy meadows, wet balds, & rich upland forests.	Possible
Anderson	Vascular Plant	Flowering Plant	Draba ramosissima	Branching Whitlow-grass	G4	S2	--	S	Calcareous Bluffs	Upland
Anderson	Invertebrate Animal	Mollusc	Athearnia anthonyi	Anthony's Riversnail	G1	S1	LE,XN	E	Larger rivers and downstream stretches	Aquatic

									of lg creeks, on cobble/boulder substrates adj. riffles; portions of upper TN River basin.	
Anderson	Invertebrate Animal	Mollusc	Fusconaia cor	Shiny Pigtoe	G1	S1	LE, XN	E	Shoals and riffles of small-medium sized rivers with mod-fast current over sand-cobble substrates; upper Tennessee River watershed.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Io fluvialis	Spiny Riversnail	G1G2	S2	--	Rare, Not State Listed	Shallow waters of shoals that are rapid to moderate and well-oxygenated; Tennessee River & main tributaries; E Tennessee.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Lemiox rimosus	Birdwing Pearlymussel	G1	S1	LE, XN	E	Small-medium size rivers in riffle areas with sand and gravel substrates in mod-fast currents; Tennessee River system.	Aquatic
Anderson	Vertebrate Animal	Bird	Limnothlypis swainsonii	Swainson's Warbler	G4	S3	--	D	Mature, rich, damp, deciduous floodplain and swamp forests.	Possible
Anderson	Invertebrate Animal	Mollusc	Carychium stygium	Cave Thorn	G3	S2	--	Rare, Not State Listed	Cave obligate; feeds on cricket guano; Highland Rim & escarpment of Cumberland Plateau.	Upland
Anderson	Vertebrate Animal	Amphibian	Aneides aeneus	Green Salamander	G3G4	S3S4	--	Rare, Not State Listed	Damp crevices in shaded rock outcrops and ledges; beneath loose bark and cracks of trees and sometimes in/or under logs.	Upland
Anderson	Nonvascular Plant	Non-Vascular Plant	Palamocladium leskeoides	A Moss	G3G5	S1	--	T	Seepy Limestone Cliffs And Bluffs	Possible
Anderson	Vertebrate Animal	Mammal	Perimyotis subflavus	Tri-colored bat	G3G4	S2S3	--	T	Generally associated with forested landscapes but may roost near openings.	No Data
Anderson	Invertebrate Animal	Mollusc	Plethobasus cicatricosus	White Wartyback	G1	S1	LE, XN	E	Presumed to inhabit shoals and riffles in large rivers; Tennessee & Cumberland river systems. Very rare & poss extirpated in TN.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Hemistena lata	Cracking Pearlymussel	G1	S1	LE, XN	E	Medium-sized rivers of mod current, deeply buried in mud, sand, gravel, and cobble substrates; Tennessee & Cumb. river systems.	Aquatic
Anderson	Vascular Plant	Flowering Plant	Elodea nuttallii	Nuttall's Waterweed	G5	S2	--	S	Aquatic; Streams And Ponds	Aquatic
Anderson	Invertebrate Animal	Insect	Pseudanophthalmus paynei	Payne's Cave Beetle	G1	S1	--	Rare, Not State Listed	Terrestrial cave obligate; northern Ridge & Valley; reported from Anderson County.	Upland
Anderson	Vertebrate Animal	Amphibian	Hemidactylium scutatum	Four-toed Salamander	G5	S3	--	D	Woodland swamps, shallow depressions, & sphagnum mats on acidic soils; middle & east Tennessee.	Possible
Anderson	Nonvascular Plant	Non-Vascular Plant	Homaliadelphus sharpii	Sharp's Homaliadelphus	G3?	S1	--	E	Calcareous Or Dolomite Bluffs	Upland
Anderson	Vertebrate Animal	Bird	Vermivora chrysoptera	Golden-winged Warbler	G4	S3B	--	T	Early successional habitats in foothill regions of Appalachians.	Upland
Anderson	Vascular Plant	Flowering Plant	Oligoneuron album	Prairie Goldenrod	G5	S1S2	--	E	Barrens	Upland
Anderson	Vertebrate Animal	Fish	Etheostoma maydeni	Redlips Darter	GNR	S2	--	T	Found in slow-moving large creeks and rivers in pools along the banks strewn with	No Data

									boulders and woody debris.	
Anderson	Animal Assemblage	No Data	Rookery	Heron Rookery	G5	SNR	--	Rare, Not State Listed	No Data	No Data
Anderson	Vertebrate Animal	Fish	Chrosomus tennesseensis	Tennessee Dace	G3	S3	--	D	First order spring-fed streams of woodlands in Ridge and Valley limestone region; Tennessee River watershed.	Aquatic
Anderson	Vascular Plant	Flowering Plant	Diervilla lonicera	Northern Bush-honeysuckle	G5	S2	--	T	Rocky Woodlands And Bluffs	Upland
Anderson	Vascular Plant	Flowering Plant	Fothergilla major	Mountain Witch-alder	G3	S2	--	T	Rocky Slopes And River Banks	Possible
Anderson	Invertebrate Animal	Mollusc	Fusconaia cuneolus	Finerayed Pigtoe	G1	S1	LE, XN	E	Riffles of fords and shoals of mod gradient streams in firm cobble and gravel substrates; middle & upper Tennessee River watershed.	Aquatic
Anderson	Vertebrate Animal	Mammal	Myotis grisescens	Gray Myotis	G3G4	S2	LE	E	Cave obligate year-round; frequents forested areas; migratory.	Upland
Anderson	Vertebrate Animal	Fish	Noturus flavipinnis	Yellowfin Madtom	G1	S1	LT,XN	T	Medium size to large creeks and small rivers that are unpolluted & relatively unsilted; upper Tennessee River watershed.	Aquatic
Anderson	Vertebrate Animal	Fish	Percina aurantiaca	Tangerine Darter	G4	S3	--	D	Large-moderate size headwater tribs to Tennessee River, in clear, fairly deep, rocky pools, usually below riffles.	Aquatic
Anderson	Vascular Plant	Flowering Plant	Delphinium exaltatum	Tall Larkspur	G3	S2	--	E	Glades And Barrens	Upland
Anderson	Vertebrate Animal	Amphibian	Desmognathus welteri	Black Mountain Salamander	G4	S3	--	D	Spring runs and permanent streams in wooded mountainous terrain; northern Cumberlands.	Aquatic
Anderson	Invertebrate Animal	Mollusc	Dromus dromas	Dromedary Pearlymussel	G1	S1	LE, XN	E	Medium-large rivers with riffles and shoals w/ relatively firm rubble, gravel, and stable substrates; Tennessee & Cumberland systems.	Aquatic
Anderson	Invertebrate Animal	Arachnid	Nesticus paynei	A Cave Spider	G3G4	S3	--	Rare, Not State Listed	Terrestrial cave associate; also may be found on surface; northern Ridge & Valley.	Upland
Anderson	Vascular Plant	Flowering Plant	Iris fulva	Copper Iris	G5	S2	--	T	Bottomlands	Possible
Anderson	Vascular Plant	Flowering Plant	Epilobium ciliatum	Hairy Willow-herb	G5	S1	--	T	Mountain Balds	Possible
Anderson	Vertebrate Animal	Bird	Setophaga cerulea	Cerulean Warbler	G4	S3B	--	D	Mature deciduous forest, particularly in floodplains or mesic conditions.	Upland
Anderson	Vertebrate Animal	Bird	Thryomanes bewickii	Bewick's Wren	G5	S1	--	D	Brushy areas, thickets and scrub in open country, open and riparian woodland.	Upland

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TN Department of Environment & Conservation

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Rare Species by Watershed | Rare Species by County | Rare Species by Quadrangle | Stormwater Programs

Help

Key to Status and Ranks

- Download Status and Ranks

Rare Species by County

Data is refreshed on or around January and July each year.

Go Rows 25 Actions

County = 'Cumberland'

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County	Type	Category	Scientific Name	Common Name	Global Rank	State Rank	Fed. Status	State Status	Habitat	Wet Habitat Flag
Cumberland	Vertebrate Animal	Mammal	Myotis leibii	Eastern Small-footed Myotis	G4	S2S3	--	D	Hibernates in caves & mines; also uses abandoned buildings, bridges, and barns seasonally.	Upland
Cumberland	Vertebrate Animal	Mammal	Neotoma magister	Allegheny Woodrat	G3G4	S3	--	D	Outcrops, cliffs, talus slopes, crevices, sinkholes, caves & karst.	Upland
Cumberland	Vertebrate Animal	Reptile	Ophisaurus attenuatus longicaudus	Eastern Slender Glass Lizard	G5T5	S3	--	D	Dry upland areas including brushy, cut-over woodlands and grassy fields; nearly statewide but obscure; fossorial.	Upland
Cumberland	Vascular Plant	Flowering Plant	Lilium philadelphicum	Wood Lily	G5	S1	--	E	Dry Openings, Powerlines	Possible
Cumberland	Invertebrate Animal	Crustacean	Cambarus hamulatus	Prickly Cave Crayfish	G3G4	S3	--	D	Aquatic cave obligate; Sequatchie Valley & southern Cumberlands.	Aquatic
Cumberland	Vascular Plant	Flowering Plant	Conradina verticillata	Cumberland Rosemary	G3	S3	LT	T	Sandy, Rocky River Banks And Bars	Possible
Cumberland	Vertebrate Animal	Amphibian	Cryptobranchus alleganiensis	Hellbender	G3	S3	--	E	Rocky, clear creeks and rivers with large shelter rocks.	Aquatic
Cumberland	Vertebrate Animal	Fish	Erimonax monachus	Spotfin Chub	G2	S2	LT,XN	T	Clear upland rivers with swift currents & boulder substrates; portions of the Tennessee River watershed.	Aquatic
Cumberland	Vascular Plant	Flowering Plant	Ribes curvatum	Granite Gooseberry	G4	S1	--	T	Rocky Woods	Upland
Cumberland	Vascular Plant	Flowering Plant	Sagittaria platyphylla	Ovate-leaved Arrowhead	G5	S2S3	--	S	Swamps, Emergent	Possible
Cumberland	Vascular Plant	Flowering Plant	Spiranthes ochroleuca	Yellow Nodding Ladies'-tresses	G4	S1	--	E	Moist Mountain Woods	Possible
Cumberland	International Terrestrial Ecological System Classification	Plant Community	Cumberland Sandstone Glade and Barrens	Cumberland Sandstone Glade and Barrens	GNR	S2S3	--	Rare, Not State Listed	No Data	No Data
Cumberland	Invertebrate Animal	Mollusc	Venustaconcha trabalis	Tennessee Bean	G1	S1	LE, XN	E	Riffle areas of small rivers & streams in sand, gravel, & cobble substrates with swift current; upper Cumb. & upper Tenn. river systems.	Aquatic
Cumberland	Vascular Plant	Flowering Plant	Rhynchospora chalarocephala	Loose-headed Beakrush	G5	S1	--	T	Wet Barrens	Possible
Cumberland	Vascular Plant	Flowering	Gratiola	Sticky Hedge-	G4	S1	--	S	Wet Barrens And	Possible

		Plant	brevifolia	hyssop					Marshes	
Cumberland	Vascular Plant	Flowering Plant	Diamorpha smallii	Small's Stonecrop	G4	S1S2	--	E	Sandstone Outcrops	Upland
Cumberland	Vascular Plant	Flowering Plant	Marshallia grandiflora	Large-fl. Barbara's-buttons	GNR	S2	--	E	Rocky River Bars	Possible
Cumberland	Invertebrate Animal	Insect	Ophiogomphus alleghaniensis	Allegheny Snaketail	G3T2T3Q	S1	--	Rare, Not State Listed	Riffle areas of spring-fed streams; Cumberland Plateau, Ridge & Valley, & Blue Ridge; not watershed specific.	Aquatic
Cumberland	Vascular Plant	Flowering Plant	Pogonia ophioglossoides	Rose Pogonia	G5	S2	--	E	Wet Acidic Barrens	Possible
Cumberland	Vascular Plant	Flowering Plant	Potamogeton amplifolius	Large-leaf Pondweed	G5	S1	--	T	Lakes And Streams	Aquatic
Cumberland	Vascular Plant	Flowering Plant	Helianthus occidentalis	Naked-stem Sunflower	G5	S2	--	S	Limestone Glades And Barrens	Upland
Cumberland	Vascular Plant	Flowering Plant	Utricularia subulata	Zigzag Bladderwort	G5	S1	--	T	Wet Barrens, Ecotones	Possible
Cumberland	Vascular Plant	Flowering Plant	Spiraea virginiana	Virginia Spiraea	G2?	S2	LT	E	Stream Bars And Ledges	Possible
Cumberland	Vertebrate Animal	Amphibian	Desmognathus abditus	Cumberland Dusky Salamander	G2G3	S2S3	--	D	Assoc. with streams of Cumberland Plateau; under rocks along small streams or adj. cover; Morgan & Grundy counties.	Aquatic
Cumberland	Vascular Plant	Flowering Plant	Amelanchier sanguinea	Roundleaf Shadbush	G5	S2	--	T	Rocky Slopes And River Banks	Upland

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TN Department of Environment & Conservation

Appendix C

Photographs

Photograph 1- Representative of pasture/hay field within the Project Area, facing west.

Photograph 2- Representative of dry deciduous forest within the Project Area, facing east.

Photograph 3- Representative of wet deciduous forest within the Project Area, facing northeast.

Photograph 4- Representative of dry herbaceous within the Project Area, facing northwest.

Photograph 5- Representative of wet herbaceous within the Project Area, facing northwest.

Photograph 6- Representative of Kudzu infestation within the Project Area, facing east.

Photograph 7- Forest Stand 1 high quality bat habitat, facing south.

Photograph 8- Forest Stand 1 high quality bat foraging habitat, facing north.

Photograph 9- Forest Stand 2 moderate quality foraging bat habitat, facing north.

Photograph 10- Forest stand 2 moderate bat habitat, facing west.

Photograph 11- Forest Stand 3 low quality bat habitat, facing north.

Photograph 12- Forest stand 4 low quality bat habitat, facing northeast.

Photograph 13- Forest Stand 5 moderate bat habitat, facing northeast.

Photograph 14- Forest Stand 5 moderate quality foraging habitat, facing north.

Photograph 15- Forest Stand 6 low quality bat habitat, facing west.

Photograph 16- Forest Stand 7 moderate foraging bat habitat, facing south.

Photograph 17- Forest Stand 7 moderate quality bat habitat, facing north.

Photograph 18- Forest Stand 8 moderate quality bat habitat, facing north.

Photograph 19- Forest Stand 8 and 9 foraging bat habitat, facing southeast.

Photograph 20- Forest Stand 9 low quality bat habitat, facing south.

Photograph 21- Forest Stand 10 moderate quality bat habitat, facing south.

Photograph 22- Forest Stand 10 moderate quality bat habitat, facing southeast.

Photograph 23- Forest Stand 11 low quality bat habitat, facing west.

Photograph 24- Forest Stand 12 low quality habitat for bats, facing southwest.

Photograph 25- Forest Stand 13 low quality bat habitat, facing northeast.

Photograph 26- Forest Stand 13, 14, and 15 foraging habitat, facing northeast.

Photograph 27- Forest Stand 14 low quality bat habitat, facing south.

Photograph 28- Forest Stand 15 moderate quality bat habitat, facing southwest.

Photograph 29- Forest Stand 16 low quality bat habitat, facing northeast.

Photograph 30- Forest Stand 17 foraging habitat, facing west.

Photograph 31- Forest Stand 18 moderate quality bat habitat, facing northeast.

Photograph 32- Forest Stand 18 foraging habitat, facing east.

Photograph 33- Forest Stand 19 low quality bat habitat, facing west.

Photograph 34- Forest Stand 19 foraging habitat, facing east.

Photograph 35- Forest Stand 20 low quality bat habitat, facing south.

Photograph 36- Forest Stand 20 box culvert and water resource within stand, facing west.

Photograph 37- Forest Stand 21 moderate quality bat habitat, facing southeast.

Photograph 38- Forest Stand 22 low quality bat habitat, facing northeast

Photograph 39- Forest Stand 23 moderate quality bat habitat, facing north.

Photograph 40- Forest Stand 23 foraging bat habitat, facing north

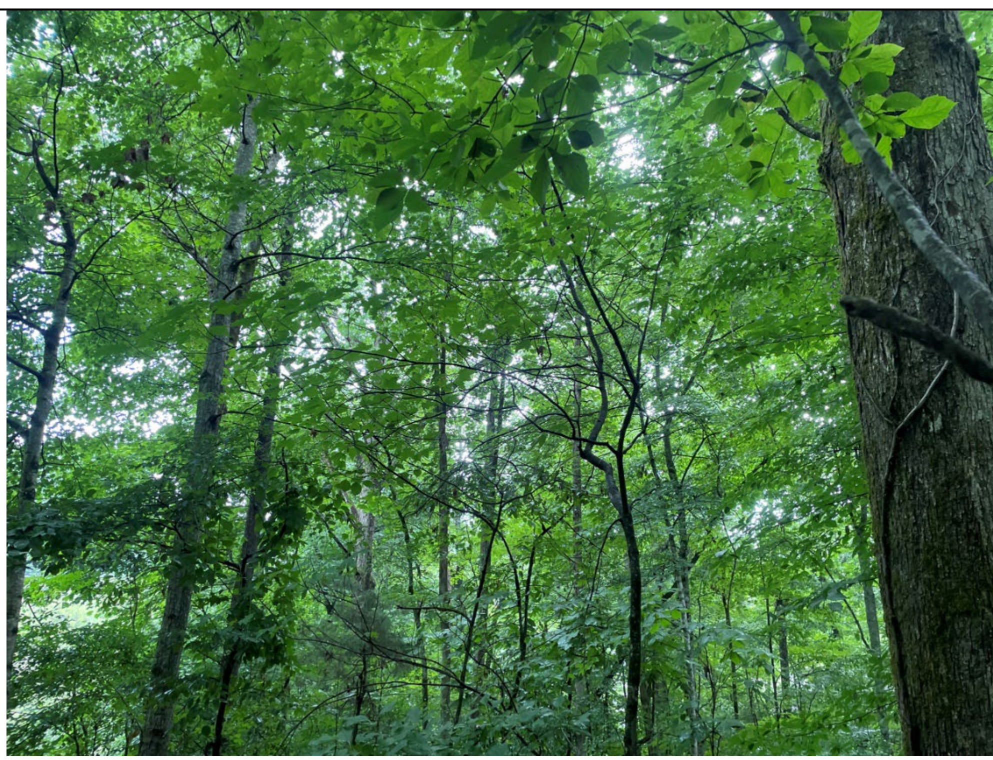
Photograph 41- Forest Stand 24 low quality bat habitat, facing southeast.

Photograph 42- Forest Stand 25 low quality bat habitat, facing northeast

Photograph 43- Forest Stand 26 low quality bat habitat, facing southeast.

Photograph 44- Forest Stand 27 moderate quality bat habitat, facing south

Photograph 45- Forest Stand 27 Intermittent Stream, facing northwest.



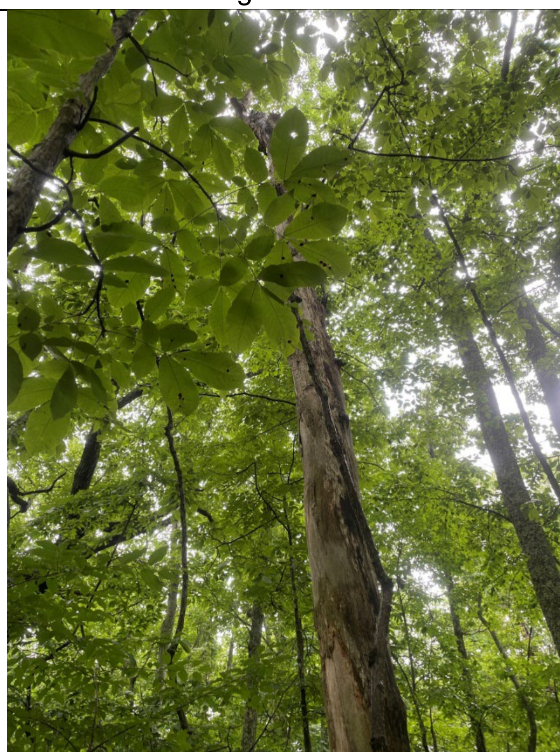
Photograph 46- Forest Stand 28 low quality bat habitat, facing northeast.

Photograph 47- Forest Stand 29 moderate quality bat habitat (snag), facing north

Photograph 48- Forest Stand 29 Intermittent stream, facing north.

Photograph 49- Forest Stand 30 and 31 low quality bat habitat, facing northeast

Photograph 50- Forest Stand 32 and Forest Stand 33 moderate quality bat habitat, facing northeast.



Photograph 51- Forest Stand 32 representative snag, facing northeast

Photograph 52- Forest Stand 34 low quality bat habitat, facing southwest.

Photograph 53- Forest Stand 35 moderate quality bat habitat, facing west.

Photograph 54- Forest Stand 36 moderate quality bat habitat, facing southwest.

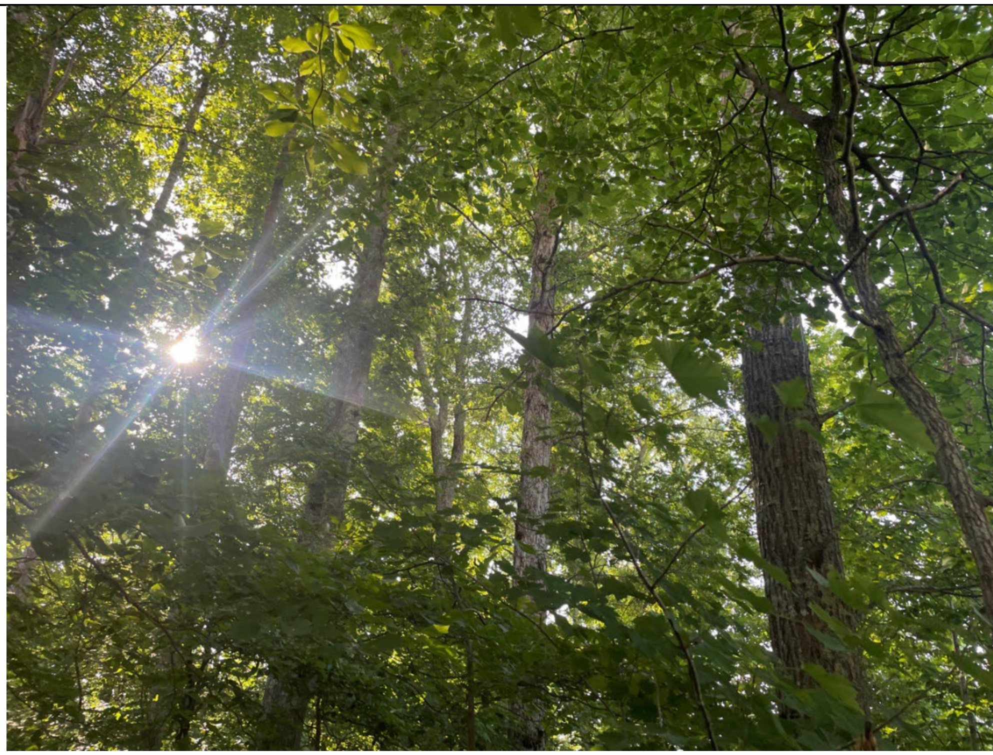
Photograph 55- Forest Stand 36 Perennial Stream, facing southwest.

Photograph 56- Forest Stand 37 low quality bat habitat, facing northeast.

Photograph 57- Forest Stand 38 low quality bat habitat, facing east.

Photograph 58- Forest Stand 38 Intermittent Stream within Stand 38, facing northwest.

Photograph 59- Forest Stand 39 low quality bat habitat, facing south.



Photograph 60- Forest Stand 40, low quality bat habitat, facing east.

Appendix D

Botany Report

Kingston Fossil Plant (KIF) Botanical Survey Memo

Roane, Cumberland, and Anderson Counties, TN
November 30, 2022

Table of Contents

Attachments

Attachment A- List of Botanical Species Observed during Kingston TL Botanical Field Survey

Attachment B- Photographs of Botanical Survey

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Project Background

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units, and construction and operation of approximately 1,500 megawatts (MW) of replacement generation requiring extensive regional transmission system upgrades to be completed and operational prior to coal unit retirement. Upgrades may include uprating, reconductoring, or rebuilding transmission lines (TLs) as well as replacing terminal equipment, bus work, or jumpers.

HDR Engineering, Inc (HDR) conducted an environmental site assessment of the Project Area which consisted of three TLs: (1) the Eastern Segment TLs (L5108 and L5302) located north of the city of Kingston and west of the city of Oak Ridge, in Anderson and Roane Counties, Tennessee; and (2) the Western Segment TL (L5383) located north of the city of Crossville, in Cumberland County, Tennessee, and associated access roads (Project Area) proposed for upgrades under Alternative A of the KIF Retirement EIS Project. Under Alternative A, TVA would make improvements to existing transmission lines within the Kingston Reservation, including new TL connections to the proposed combined cycle gas facilities and switch station. As part of the environmental site assessment, HDR was tasked with surveying the Project for threatened and endangered plant species. From August 15 to 18, 2022, the Project Area was surveyed for the presence of federally and state-listed threatened or endangered plant species throughout the various habitat types within the Project limits.

Habitat Overview

The Project Area lies within the Central Plateau (CU) – Cumberland Co. and Ridge and Valley (RV), in Roane, Cumberland, and Anderson Counties, Tennessee. A variety of vegetative communities are known to exist within these physiographic regions and were divided into 10 habitat type categories through a desktop review for the purposes of this study.

Category 1. Wetlands (i.e., swamps and floodplains, acidic wetlands and swamps, acidic seeps wet meadows, marshes, emergent herbaceous wetlands, bogs, acidic open wetlands)

Category 2. Acidic and calcareous seeps

Category 3. Wet and dry barrens (i.e., limestone glades and barrens, wet acidic barrens)

Category 4. Outcrops (i.e., dry sandstone, granite outcrops, sandstone outcrops)

Category 5. Stream, ponds, and lakes (i.e., lakes (margins), streams (margins), ponds (margins), slow acidic streams, stream bars and ledges, stream heads, sandy/rocky river bars, Rocky sand stream sides)

Category 6. Rocky woods, rock slopes, riverbanks, and river bars

Category 7. Bluffs, cliffs, and mountain balds (i.e., calcareous bluffs/seepy limestone cliffs/bluffs/shale bluffs, dolomite bluffs, wet bluffs, moist shaded cliffs, rocky bluffs)

Category 8. Wooded areas (i.e., rich woods/hollows, rich oak woods, dry woods, wooded mt. slopes and mt. thickets, dry sandy woods, Mesic woods and seepage slopes, mesic woods and seepage slopes, oak woods and edges [maintained row], alluvial/moist ravines in dry ridges, bottomland hardwoods [*could include wetlands])

Category 9. Sinks

Category 10. Dry openings, powerlines

The species on the targeted threatened and endangered list can all be categorized as being found in one (or more) of these ten generalized habitat types. A list of state and federal protected species with potential to exist within the various broad habitat types in the Project Area is provided in the Kingston Wetlands and Streams Survey Report and is based on resources provided in Appendix B of that report.

Methodology

A desktop review was performed to identify general vegetation communities and habitat types with potential to occur within the Project survey area. In June 2022, HDR field biologists then performed a field verification of the information compiled during the desktop assessment. Based on the results of desktop review and field habitat and vegetation characterizations, approximately 30 botanical survey locations were identified for follow-up with a focused field assessment. The objective of the survey was to determine the suitability of the Project Area habitat for any threatened or endangered species and document the presence/absence of federal and state listed species during the field assessment. At the time of the survey, there were 70 state-listed protected species, three of which were also listed as federally threatened: white fringeless orchid (*Platanthera integrilabia*), Cumberland rosemary (*Conradina verticillata*), and Virginia spirea (*Spirea virginiana*). HDR staff, including a botanist, surveyed for federal and state listed species at approximately 30 locations along the TL alignment and associated access roads in the Project Area that were previously identified as having habitat conditions potentially supportive of the listed species.

Observational Data

Areas surveyed along the western Project alignment near Crossville, Tennessee (L5383), contained higher diversity than the more urbanized eastern Project TLs (L5108 and L5302). Land use along the western alignment was primarily agricultural land with some scattered pond/open water wetlands, where most of the increased biodiversity was observed during the botanical survey. Invasive and opportunistic species were more abundant along the eastern alignment near Oak Ridge, Tennessee, which can be correlated to the high density of urbanization.

The federally listed white fringeless orchid flowers from June to September in Tennessee and generally prefers wet, flat, boggy areas in acidic muck or sand, and partially shaded areas at the head of streams or seepage slopes. Although several locations with potentially suitable habitat were identified along the Project alignment during the June 2022 field botany survey, no individuals of white fringeless orchid were found to be present at the time of the survey.

The federally listed Virginia spirea and Cumberland Rosemary prefer stream bars and stream ledges, as well as gravel bars, sandy riverbanks, and riparian areas with seasonal flooding. Riverbank and river bar habitat were present along the Obed River, Clinch River, Poplar Creek, East Fork Poplar Creek, and several unnamed tributaries; however, no state or federally listed species were observed to be present. Boat surveys were not implemented at these locations due to time and budget constraints and on the premise that the Project would not be associated with any riverbank or stream bar activity.

Remnants of sandstone, shallow bedrock, glade and barren like habitat, and chert rock habitat were observed throughout the Project Area. These rocky habitat types have the potential to support state listed species including (but not limited to) branching whitlow-grass (*Draba ramosissima*), mountain bush-honeysuckle (*Diervilla sessilifolia var. rivularis*), myurella moss (*Myurella julacea*), naked-stem sunflower (*Helianthus occidentalis*), prairie goldenrod (*Oligoneuron album*), roundleaf shadbush (*Amelanchier sanguinea*), Sharp's homaliadelphus (*Homaliadelphus sharpi*), Sharp's lejeunea (*Lejeunea sharpii*), silverling (P*aronychia agryrocoma*), slender blazing-star (*Liatris cylindracea*), Small's stonecrop (*Diamorphia smallii*), tall larkspur (*Delphinium exaltatum*), Torrey's mountain-mint (*Pycanthemum torrei*), western wallflower (*Erysimum capitatum*), and zigzag bladderwort (*Utricularia subulate*); however, none of these species were observed during the field botanical survey.

Dry powerline openings, bog and wet meadows, and disturbed prairie habitat were found throughout the Project alignment. State listed species with the potential to occur in these habitats include (but are not limited to) early St. John's wort (*Hypericum nudiflorum*), Muhlenberg's nutrush (*Scleria muehlenbergii*), ovate-leaved arrowhead (*Sagittaria platyphylla*), spoonleaf sundew (*Drosera intermedia*), sticky hedge-hyssop (*Gratiola brevifolia*), swamp lousewort (*Pedicularis lanceolata*), tawny cotton-grass (*Eriophorum virginicum*), tubercled rein-orchid (*Platanthera flava var. herbioloa*), and wood lily (*Lilium philadelphicum*). Several forested areas associated with planned access roads were also surveyed and included both younger successional woodlands of old fencerows and abandoned agricultural lots, and mature, upland, oak-hardwood communities. These forested areas were comprised largely of common and abundant woody species and no state or federally listed species were observed during the time of the field botanical survey.

Agricultural fields and ponds, and urbanized locations where invasives were plentiful were surveyed but deemed as areas of low ecological value with no suitable habitat for any of the state or federally listed species identified during the desktop review. Invasive species such as kudzu (*Pueraria montana*) and Johnson grass (*Sorghum halepense*) were plentiful in the Project area near Oak Ridge, and herbicide use was evident at many of the locations in the western alignment. A list of notable, but unlisted/protected plants observed during the survey can be found in Attachment A. Photos taken during the botanical survey are provided in Attachment B.

Survey Results

In June 2022 a field botanical survey of 30 areas identified as having potentially suitable habitat for federal and state listed species was evaluated by HDR biologists and botanist. Although potentially suitable habitat was identified within the Kingston TL Project area, no federal or state listed botanical species were observed occupying those habitats at the time of the survey.

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A

Attachment A- List of Botanical Species Observed during Kingston TL Botanical Field Survey

Scientific Name	Common Name
Agave virginica	false aloe
Agrimonia parviflora	harvestlice
Alisma plantago-aquatica	common water plantain
Apocynum cannabinum	Indian hemp
Arisaema dracontium	green dragon
Aronia arbutifolia	red chokeberry
Asclepias tuberosa	butterfly milkweed
Asclepias verticillata	whorled milkweed
Bidens aristosa	bearded beggarticks
Bignonia capreolata	crossvine
Boehmeria cylindrica	false nettle
Carex crinita	fringed sedge
Cichorium intybus	chicory
Cirsium discolo	field thistle
Clinopodium vulgare	wild basil
Conocephallum conicum	great scented liverwort
Conoclinium coelestinum	blue mistlfower
Coreopsis major	greater Tickseed
Cryptotaenia canadensis	honewort
Dichanthelium clandestinum	deertongue
Dichanthelium oligosanthes	Heller's rosette grass
Diodia teres	rough buttonweed
Dulichium arundinaceum	threeway sedge
Elymus virginicus	Virginia wild-rye
Erigeron strigosus	prairie fleabane
Euonymus fortunei	winter creeper euonymus
Eupatorium altissimum	tall boneset
Frangula caroliniana	Carolina buckthorn
Gaylussacia baccata	black huckleberry
Lactuca floridana	woodland lettuce
Lespedez hirta	hairy lespedeza
Lindernia dubia	yellowseed false pimpernel
Lobelia spicata	pale spiked lobelia
Lonicera maackii	Amur honeysuckle
Ludwigia alternifolia	seedbox
Lycopus americanus	American bugleweed

Scientific Name	Common Name
Mimulus alatus	sharpwing moonkeyflower
Mimulus ringens	Allegheny monkeyflower
Monarda fistulosa	wild bergamot
Nabalus albus	white lettuce
Nabalus albus	white rattlesnakeroot
Oenothera biennis	evening-primrose
Oenothera guara	biennial gaura
Panicum oligosanthes	Fewanther obscuregrass
Parthenium integrifolium	wild quinine
Penthorum sedoides	ditch stonecrop
Phlox maculata	wild sweetwilliam
Phlox paniculata	garden phlox
Phyla lanceolata	fogfruit
Pinus virginiana	Virginia pine
Platanther ciliaris	orange-fringed orchid
Polygala curtissii	Curtis's milkwort
Polygala sanguinea	purple milkwort
Potamogeton natans	floating pondweed
Prunella vulgaris	common selfheal
Pycnanthemum albescens	whiteleaf mountainmint
Pycnanthemum muticum	blunt mountainmint
Pycnanthemum tenuifolium	narrow-leaf mountainmint
Ranunculus hispidus	bristly buttercup
Ratibida pinnata	praria coneflower
Rudbeckia laciniata	cutleaf coneflower
Rudbeckia trilobia	brown-eyed susan
Sabata stellans	marsh pink
Sagittaria latifolia	broadleaf arrowhead
Salvia lyrata	lyreleaf sage
Scutellaria incana	hoary skullcap
Scutellaria integrifolia	helmet skullcap
Sedum ternatum	woodland stonecrop
Senna marylandica	Maryland sena
Silphium integrifolium	wholeleaf rosinweed
Silphium perfoliatum	cup plant
Sparganium americanum	American bur-reed

Scientific Name	Common Name
Spiraea tomentosa	steeplebush
Tripsacum dactyloides	Eastern gamagrass
Verbesena alternifolia	common wingstem
Verbesena virginica	frostweed
Vernonia noveboracencis	ironweed
Vitis labrusca	fox grape

B

Attachment B- Photographs of Botanical Survey

	
Photo 1. Wet opening with *Boehmeria cylindrica.*	Photo 2. Sprayed portion along Clinch River with Solidago spp. and Rubus spp.
	
Photo 3. Hypericum spp. determined not to be state listed.	Photo 4. Upland transitional edge with Solidago spp.

Photo 5. Orange crested orchid, a non-listed species.

Photo 6. Nabulus spp, a non-listed species.

Photo 7. Dry powerline opening with Solidago spp.

Photo 8. Lillium spp. determined not to be state-listed.

Photo 9. River bar surveyed and had no listed species.

Photo 10. Rocky cliff surveyed and had no state-listed species.

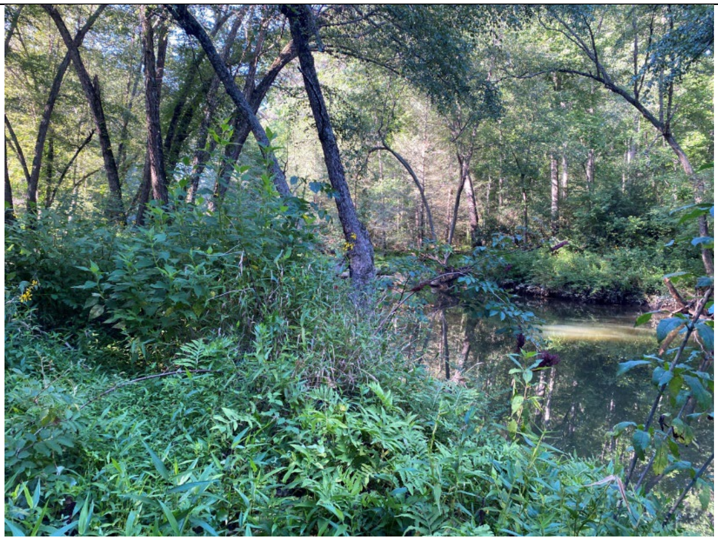

Photo 11. Riparian area with wingstem and other non-listed species.

Photo 12. Small mudflat lacking vegetation.

	
Photo 13. Survey site with submerged aquatic vegetation (SAV).	Photo 14. SAVs present but no listed species observed.
	
Photo 15. Dry ridge with small seep containing woolgrass.	Photo 16. Pond on Oak ridge property with mostly Rubus spp. on banks.

<table>
<tr><td></td><td></td></tr>
<tr><td>Photo 17. Pond on Oak Ridge property. No visual observance of any listed species.</td><td>Photo 18. A dry opening containing Rubus spp., Solidago spp., and other non-listed species.</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Photo 19. Pond with emergent edge containing woolgrass and Boehmeria cylindrica.</td><td>Photo 20. Mature forested area along access road with oaks and other non-listed hardwoods</td></tr>
</table>

Photo 21. An agricultural pond containing Wolffia spp. Emergent fringe containing Ludwigia spp.

Photo 22. An abandoned agricultural field containing an assortment of non-listed grasses and weedy species.

Photo 23. Regularly mowed section of the transmission line.

Photo 24. A Dry opening containing Solidago spp. and other non-listed species.

	
Photo 25. Stream draining off-site pond with emergent wetland edge. No observance of listed species.	Photo 26. Large patch of Rubus spp. and Smilax spp.
	
Photo 27. Close-up of SAV, determined not to be state listed species.	Photo 28. Johnsongrass and pokeweed growing along powerline.

Appendix E

Bat Habitat Assessment Data Sheets

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/14/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 34.768784/ -90.267322

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and o peration of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 1

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: Obed River: 260 ft	Describe existing condition of water sources: A large freshwater river (obed river) exists within the middle of the stand and a freshwater agricultural pond exists just outside the stand. They both act a good water source for bats
Pools/Ponds (# and size)	1- 0.75 acres	Open and accessible to bats? Yes		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	1	
Dominant Species of Mature Trees	Eastern red cedar, red oak, white oak, sweetgum, tulip poplar			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	30	60	10	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Stand 1 had several trees with exfoliating bark, moderate diverity in portions of the stand (Right Bank of the Obed River) and had connection to a larger forestest stand. No snags were observed within the stand at the time of the survey. Quality of the stand is considered high for the NLEB and Indiana Bat.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/16/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 34.768784/ -90.267322

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and o peration of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 2

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 2- 1,003 feet	Describe existing condition of water sources:
Pools/Ponds (# and size)	1- 0.84 acres	Open and accessible to bats? Yes		An agricultural field with a large open water and Rocky Branch and its associated tribuatires provide year round water. Rocky Branch ranges from 10-20 feet wide and is flows into two forested areas and a non forested area
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	1	
Dominant Species of Mature Trees	Eastern red cedar, red oak, white oak, sweetgum, tulip poplar			
% Trees w/ Exfoliating Bark	0	5	4	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	10	45	45	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Stand 2 had some trees with exfoliating bark, moderate diverity in portions of the stand and had connection to a larger forestest stand. No snags were observed within the stand at the time of the survey. Quality of the stand is considered moderate for the NLEB and Indiana Bat.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/16/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.990926/-84.988344

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and o peration of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 3

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: NA
Pools/Ponds (# and size)	1- 0.84 acres	Open and accessible to bats? Yes		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	
	4	3	1	
Dominant Species of Mature Trees	White oak, red oak, sweet gum, virginia pine, red maple, mockernut hickory, sugar maple			
% Trees w/ Exfoliating Bark	0	5	4	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	10	40	50	
No. of Suitable Snags		0		

1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Stand 3 had some trees with exfoliating bark, moderate diverity in portions of the stand and had connection to a larger forestest stand. No snags were observed within the stand at the time of the survey. Quality of the stand is considered moderate for the NLEB and Indiana Bat.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/20/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 34.768784/ -90.267322

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 4

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 1-775 feet	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: Only one small ephemeral acts as a water source for this stand. It only flows during rain events
Pools/Ponds (# and size)	0	Open and accessible to bats?		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	1	2	5	
Dominant Species of Mature Trees	Eastern red cedar, red oak, white oak, and bush honeysuck;e			
% Trees w/ Exfoliating Bark	0	1	0	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	60	30	10	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Stand 4 contained very dense understory with little to no trees with exfoliating bark . No snags were observed in the stand. One ephemeral acts as a water source but does not provide water year round.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/20/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.915765/-84.475226

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

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Project	1421.92	408.35	781.11

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Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 5

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: One small fresh water pond near a maintained lawn with an abutting freshwater emergent wetland
Pools/Ponds (# and size)	1-0.02 acres	Open and accessible to bats? Yes		
Wetlands (approx. ac.)	Permanent: 1-0.02 acres	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	3	5	3	
Dominant Species of Mature Trees	Eastern red cedar, red oak, white oak, pignut hickory, bush honeysuckle, mimosa tree			
% Trees w/ Exfoliating Bark	0	4	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	30	30	40	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Stand 5 at first had a thick, dense understory but opened up more towards the north and south of the forested stand. Stand 5 was considered to have moderate habitat quality due to presense of a water source and open field for foraging, lack of sngags, and was connected to a larger forested stand.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/21/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.916648/ -84.478334

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 6

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	N/A- no water source exists within this stand that occurs within the TL Upgrade Area
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	1	
Dominant Species of Mature Trees	Pignut hickory, white oak, southern red oak, common hackberry, red cherry, and chinese privet.			
% Trees w/ Exfoliating Bark	0	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	60	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 6 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water is within this stand.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/21/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.922630/ -84.449057

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

Project	Total Acres	Forest Acres		Open Acres
	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 7

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	1-354 feet	One large perennial stream with open canopy and a Scrub-shrub wetland is located within the middle of the stand and acts as a water source.
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	1-0.38 acres	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	2	4	3	
Dominant Species of Mature Trees	Common hackberry, white oak, black walnut, pignut hickory, and eastern red cedar			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	60	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:
Forest stand 7 is part of a larger forested stand. No snags were observed within the forested stand that occured within the TL Upgrade Area. One large perennial stream with open canopy and a Scrub-shrub wetland is located within the middle of the stand

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/21/2022

Township/Range/Section: ______

Lat Long/UTM/ Zone: 35.934956/-84.422271

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 8

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	Clinch River and triburies off of the Clinch River. The Clinch River is just south of the stand
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	1	
Dominant Species of Mature Trees	Pignut hickory, white oak, southern red oak, common hackberry, red cherry, and chinese privet.			
% Trees w/ Exfoliating Bark	0	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	60	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 9 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water is within this stand.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/21/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.934956/-84.422271

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 9

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: Clinch River and triburies off of the Clinch River. The Clinch River is just south of the stand
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	1	
Dominant Species of Mature Trees	Pignut hickory, white oak, southern red oak, common hackberry, red cherry, and chinese privet.			
% Trees w/ Exfoliating Bark	0	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	60	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 9 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water is within this stand.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/21/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.950314/ -84.405378

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 10

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: N/A however the Clinch River is nearby
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	1	
Dominant Species of Mature Trees	Pignut hickory, white oak, southern red oak, common hackberry, red cherry, and chinese privet.			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	40	40	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 10 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water is within this stand but the Clinch River is located nearby.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/21/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.940508/ -84.414154

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 11

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	N/A
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site			
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')
	2	3	4
Dominant Species of Mature Trees	eastern red cedar, bush honeysuckle, common hackberry, and white oak		
% Trees w/ Exfoliating Bark	0	2	0
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)
	50	30	20
No. of Suitable Snags	0		

1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 11 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water is within this stand

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/21/2022

Township/Range/Section: ____________

Lat Long/UTM/ Zone: 35.937187/ -84.415078

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 12

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: N/A
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	2	3	4	
Dominant Species of Mature Trees	eastern red cedar, bush honeysuckle, common hackberry, and white oak			
% Trees w/ Exfoliating Bark	0	2	0	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	50	30	20	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 12 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water is within this stand

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.932594/-84.407687

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 13

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 1- 433 feet	Describe existing condition of water sources: Poplar Creek (20-40 feet width) acts as a good water source within the project area
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	eastern red cedar, bush honeysuckle, common hackberry, and white oak			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 13 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water is within this stand

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.927665/ -84.407214

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 14

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 1- 433 feet	Describe existing condition of water sources: Poplar Creek (20-40 feet width) acts as a good water source within the project area. The Clinch River is also nearby
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	eastern red cedar, bush honeysuckle, common hackberry, and white oak			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 14 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. Two large water bodies exist nearby this stand.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone 35.924796/ -84.401315

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and o peration of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 15

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	1- 433 feet	Poplar Creek (20-40 feet width) acts as a good water source within the project area. The Clinch River is also nearby
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	eastern red cedar, bush honeysuckle, red oak, virginia pine common hackberry, and white oak			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 15 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. Two large water bodies exist nearby this stand.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.949170/ -84.395105

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and o peration of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 16

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: N/A
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	eastern red cedar, bush honeysuckle, red oak, virginia pine common hackberry, and white oak			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 16 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. No water source was observed within the stand.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area   Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.949183/ -84.378707   Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 17

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 1- 709 feet	Describe existing condition of water sources: East Fork Poplar Creek (15-20 feet width) acts as a good water source
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 4- 2.79	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	shagbark hickory, white oak, ironwood-musclewood, tulip poplar, sugar maple, common hackberry, Virginia pine			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 17 is apart of a larger forested stand. No snags were observed within the area within the TL Upgrade area. East Fork Poplar Creek acts as a water source

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section: __________

Lat Long/UTM/ Zone: 35.949183/ -84.378707

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 18

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 1- 709 feet	Describe existing condition of water sources: East Fork Poplar Creek (15-20 feet width) acts as a good water source
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 4- 2.79	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	shagbark hickory, white oak, ironwood-musclewood, tulip poplar, sugar maple, common hackberry, Virginia pine			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 18 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area. East Fork Poplar Creek acts as a water source

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.944966/-84.382177

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 19

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 1- 709 feet	Describe existing condition of water sources: East Fork Poplar Creek (15-20 feet width) acts as a good water source
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site			
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')
	4	3	2
Dominant Species of Mature Trees	white oak, tulip poplar, sugar maple, common hackberry, Virginia pine		
% Trees w/ Exfoliating Bark	0	5	5
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)
	20	50	30
No. of Suitable Snags	0		

1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 19 is apart of a larger forested stand. No snags were observed within the area within the TL Upgrade area. No water source was observed within the stand

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.942018/ -84.376232

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 20

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: N/A
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	white oak, tulip poplar, sugar maple, common hackberry, Virginia pine			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 20 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.956628 /-84.356102

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 21

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 1-229 feet	Describe existing condition of water sources: One Perennial Stream occurs near the end of this forested stand
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	white oak, tulip poplar, sugar maple, common hackberry, Virginia pine			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 21 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.948882/-84.362221

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 22

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	N/A
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	white oak, tulip poplar, sugar maple, common hackberry, Virginia pine			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 22 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.947141/-84.365307

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 23

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	1-287 feet	One Perennial Stream occurs near the end of this forested stand and a permanent wetland surrounds the stream
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	1- 2.64	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 23 is apart of a larger forested start. No snags were observed within the stand

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.938436/ -84.363627

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 24

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	NA
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 24 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.937729/-84.368646

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 25

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: NA
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 25 is apart of a larger forested stand, however the section that occurs within the TL Upgrade Area contains a gravel path that is utilized by vehicles. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.983584/ -84.332082 Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 26

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources: NA
	0	0	0	
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest Stand 26 lies northwest of Old Ridge TKPE and residential neighborhoods

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.987148/ -84.329146

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and o peration of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 27

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	2-460 feet	0	Several intermittent streams cross the forested stand
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:
Forest stand 27 lies northwest of Oak Ridge TKPE and residential neighborhoods

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.987148/ -84.329146

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 28

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: NA
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:
Forest Stand 28 is surrounded by residential neighborhoods

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area Date: 6/22/2022

Township/Range/Section: ____________

Lat Long/UTM/ Zone: 35.986649/-84.329538 Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 29

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	2- 330 feet	0	0	Two ephemeral channels occur within this channel
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	1			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest Stand 29 contains one small snag (10 dbh) with no holes and approximately 12 feet tall. The stand is also surrounded by residential neighborhoods

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 36.009954/-84.308059 Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 30

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	NA
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 30 is surrounded by residnetial neighborhoods

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 36.000274/ -84.317089

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 31

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	NA
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:
Forest Stand 31 is surrounded by residential neighborhoods

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 36.008213/ -84.309671

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 32

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 2- 330 feet	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: Two very week ephemeral streams act as a water source
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	5	10	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	1			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest Stand 32 is surrounded by residential neighborhoods and near the edge of the TVA ROW

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 36.009814/ -84.308119

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 33

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	NA
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	ironwood- muscle wood, common hackberry, black walnut, and black cherry			
% Trees w/ Exfoliating Bark	2	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	2			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:
Forest Stand 33 is surrounded by residenital neighborhoods

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/22/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 36.015743/ -84.302719

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 34

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	NA
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	4	3	2	
Dominant Species of Mature Trees	sugar maple, common hackberry, sweet gum, Virginia pine, and eastern red cedar			
% Trees w/ Exfoliating Bark	2	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 34 is apart of a larger forested stand, however the section that occurs just out side the TVA ROW Powerline areas. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/8/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 36.022019/ -84.287523

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 35

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 1-212 feet	Describe existing condition of water sources: A perennial stream acts as a water source for this stand Kudzu infestations makes the stream not as accessable
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	3	4	2	
Dominant Species of Mature Trees	pignut hickory, oak species, sugar maple, common hackberry, and shagbark hickory			
% Trees w/ Exfoliating Bark	5	10	10	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 36 is apart of a larger forested stand that exists outside of the TVA ROW. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/20/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.935442/-84.317449

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
Proposed Tree Removal (ac)	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	**Post-Project**
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 36

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	1-212 feet	A perennial stream acts as a water source for this stand Kudzu infestations makes the stream not as accessable
Pools/Ponds (# and size)	0	Open and accessible to bats?		
		0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	3	4	2	
Dominant Species of Mature Trees	pignut hickory, oak species, sugar maple, common hackberry, and shagbark hickory			
% Trees w/ Exfoliating Bark	5	10	10	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	30	50	
No. of Suitable Snags	1			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 36 is apart of a larger forested stand that exists outside of the TVA ROW. No snags were observed within the area within the TL Upgrade area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

APPENDIX A: PHASE 1 HABITAT ASSESSMENTS

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/20/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.923122/ -84.344308

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 37

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: NA
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	2	4	3	
Dominant Species of Mature Trees	white oak, common hackberry, Virginia pine, sugar maple, and eastern red cedar			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 37 is alongside the edge of the TVA ROW. Stand 37 is apart of a larger forested stand that is not within the TL Upgrade Area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/20/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.928570/ -84.328124

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a r elated action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description

Sample Site No.(s): 38

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 1-185 feet	Intermittent: 2-456 feet	Perennial: 0	Describe existing condition of water sources: Two intermittent streams and one ephemeral provide a seasonal water source
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	2	4	3	
Dominant Species of Mature Trees	white oak, common hackberry, Virginia pine, sugar maple, and eastern red cedar			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 38 is alongside the edge of the TVA ROW. Stand 39 is apart of a larger forested stand that is not within the TL Upgrade Area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/20/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.933044/-84.322086

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres		Open Acres
Project	1421.92	408.35		781.11
	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing	
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed	

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 39

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral: 0	Intermittent: 0	Perennial: 0	Describe existing condition of water sources: NA
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent: 0	Seasonal: 0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	2	4	3	
Dominant Species of Mature Trees	white oak, common hackberry, Virginia pine, sugar maple, and eastern red cedar			
% Trees w/ Exfoliating Bark	0	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	50	30	
No. of Suitable Snags	0			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:
Forest stand 39 is alongside the edge of the TVA ROW. Stand 39 is apart of a larger forested stand that is not within the TL Upgrade Area.

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

INDIANA BAT HABITAT ASSESSMENT DATASHEET

Project Name: Kingston TL Upgrade Area

Date: 6/20/2022

Township/Range/Section:

Lat Long/UTM/ Zone: 35.935442/-84.317449

Surveyor: Lyranda Thiem

Brief Project Description

Tennessee Valley Authority (TVA) has proposed the retirement of the Kingston Fossil Plant (KIF), demolition of the coal units and construction and operation of a CC Gas Plant paired with a dual-fuel Aero CT Gas Plant on the KIF reservation. This alternative also includes construction and operation of a natural gas pipeline, a related action to be constructed, owned and operated by ETNG pending FERC approval.

Project Area

	Total Acres	Forest Acres	Open Acres
Project	1421.92	408.35	781.11

	Completely cleared	Partially cleared (will leave trees)	Preserve acres- no clearing
Proposed Tree Removal (ac)	Plans not developed	Plans not developed	Plans not developed

Vegetation Cover Types

Pre-Project	Post-Project
Mixed Decidous pasture/hay Wet Herbecous Dry Herbecous Maintained lawns	Plans are not set yet

Landscape within 5 mile radius

Flight corridors to other forested areas?

Describe Adjacent Properties (e.g. forested, grassland, commercial or residencial development, water sources)

Adjacent properties to the TL upgrade areas include mixed decidous forest, industrail and commercial properties, residential neighborhoods, maintained areas, and streams/ freshwater ponds.

Proximity to Public Land

What is the distance (mi.) from the project area to forested public lands (e.g., national or state forests, national or state parks, conservation areas, wildlife management areas)?

The TL upgrade area goes through the Black Oak Ridge Wildlife management area

Use additional sheets to assess discrete habitat types at multiple sites in a project area

Include a map depicting locations of sample sites if assessing discrete habitats at multiple sites in a project area

A single sheet can be used for multiple sample sites if habitat is the same

Sample Site Description
Sample Site No.(s): 40

Water Resources at Sample Site				
Stream Type (# and length)	Ephemeral	Intermittent	Perennial	Describe existing condition of water sources:
	0	0	0	NA
Pools/Ponds (# and size)	0	Open and accessible to bats? 0		
Wetlands (approx. ac.)	Permanent	Seasonal		
	0	0		

Forest Resources at Sample Site				
Closure/Density	Canopy (> 50 ')	Midstory (20-50')	Understory (<20')	1=1-10%, 2=11-20%, 3=21-40%, 4=41-60%, 5=61-80%, 6=81=100%
	2	4	3	
Dominant Species of Mature Trees	Chestnut oak, white oak, common hackberry, Virginia pine, sugar maple, eastern red cedar			
% Trees w/ Exfoliating Bark	5	5	5	
Size Composition of Live Trees (%)	Small (3-8 in)	Med (9-15 in)	Large (>15 in)	
	20	40	40	
No. of Suitable Snags	1			

Standing dead trees with exfoliating bark, cracks, crevices, or hollows. Snags without these characteristics are not considered suitable.

IS THE HABITAT SUITABLE FOR INDIANA BATS? Yes and NLEB

Additional Comments:

Forest stand 40 is apart of a larger forested stand that exists outside of the TVA ROW. The stand is adjacent to a paved road and is not connected to adjacent stands. One medium sized snag was observed within this stand

Attach aerial photo of project site with all forested areas labeled and a general description of the habitat

Photographic Documentation: habitat shots at edge and interior from multiple locations; understory/midstory/canopy; examples of potential suitable snags and live trees; water sources

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Appendix M – Fish Impingement at Kingston Fossil Plant During 2004 through 2006

TENNESSEE VALLEY AUTHORITY

KINGSTON FOSSIL PLANT
NPDES PERMIT NO. TN0005452
316(b) MONITORING PROGRAM

FISH IMPINGEMENT AT KINGSTON FOSSIL PLANT DURING 2004 THROUGH 2006

ENVIRONMENTAL STEWARDSHIP AND POLICY

2007

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LIST OF ACRONYMS

BIP	Balanced Indigenous Population
CCW	Condenser Cooling Water
CWA	Clean Water Act
EA	Equivalent Adult
EPA	Environmental Protection Agency
EPRI	Formerly known as the Electric Power Research Institute
KIF	Kingston Fossil Plant
PF	Production Foregone
RFAI	Reservoir Fish Assemblage Index
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority

Introduction

Kingston Fossil Plant (KIF), placed into operation in 1955, withdraws condenser cooling water (CCW) from Watts Bar Reservoir and is subject to compliance with the Tennessee Water Quality Act and the federal Clean Water Act (CWA). Section 316(b) of the CWA requires the location, design, construction, and capacity of cooling water intake structures to reflect the best technology available for minimizing adverse environmental impact. Impingement mortality is a component of 316(b) and is defined as an impact in which fish and/or shelfish are trapped or impinged against an intake screen and often killed in the process. In response to the Environmental Protection Agency (EPA) issuance of a 2004 rule for implementing Section 316(b) (a rule subsequently suspended in 2007) and in accordance with the Proposal for Information Collection submitted to the Tennessee Department of Environment and Conservation (TDEC) in 2005, Tennessee Valley Authority (TVA) conducted impingement monitoring at KIF from November 2004 through November 2006 to assess the effects of impingement on the aquatic community of Watts Bar Reservoir. This report presents impingement data collected from the CCW intake screens during 2004-2006 with comparisons to historical data collected during 1974-1978.

Per an agreement reached in September 2001 with TDEC, Division of Water Pollution Control, TVA performs Reservoir Fish Assemblage Index (RFAI) (Hickman and Brown 2002) sampling once every two years to demonstrate that KIF operation is not impacting the balanced indigenous population (BIP). TVA conducted these RFAI studies to evaluate fish communities in areas immediately upstream and downstream of KIF during the 2001, 2003, and 2005 (Scott 2006). The primary reason for gathering these data is to support the continuation of Section 316(a) thermal variance for KIF. However, the RFAI monitoring also gives an indication of the overall impact of plant operations on the reservoir fish assemblage and benthic community, including potential impacts from the plant's cooling water intake.

Plant Description

KIF is located on a peninsula formed by the Clinch and Emory River embayments of Watts Bar Reservoir approximately 4.4 km (2.7 miles) above the confluence of the Clinch and Tennessee Rivers (Figure 1). The final unit of the nine-unit plant was placed in commercial operation December 2, 1955, bringing the total capacity to 1,700 megawatts. With an average summer water temperature of 23.9°C (75.02°F), Units 1-4 each require 6.6 m^3/s (241 cfs) CCW and Units 5-9 each require 9.2 m^3/sec (324.8 cfs) for an approximate plant total flow of 73.3 m^3/s (2,587 cfs) for condenser cooling purposes.

The 18 condenser circulating water pumps each withdraw from separate suction pits. Water enters the intake structure through trashracks constructed of vertical 1.59 cm (5/8 in) steel bars with 9.21 cm (3-5/8 in) openings. The racks are periodically cleaned by a rake operated by the intake gantry crane. Following the trashracks, the CCW passes through the vertical traveling screens. These are constructed of 0.6 X 3 m (2 X 10 ft) screen panels of 12-gauge galvanized wire with 9.5 mm (3/8 in) square openings. The panels are fastened top to bottom to form an endless belt and attached to chains operating between sprockets at the bottom and drive sprockets supported on the intake deck. Debris and fish collected on the traveling screens are washed off into a sluice trench that extends the length of the pumping station deck and empties into a 68.6 cm (27 in) concrete pipe which conveys the screen backwash discharge underground in a southerly direction for 440 m (1,442 ft) to empty into the CCW discharge basin.

Intake Channel and Skimmer Wall

An intake channel extends 1,372 m (4,500 ft) from the pumping station to the original streambed of the Emory River in the Swan Pond Embayment of Watts Bar Reservoir (Figure 1). A 126 m (413 ft) long skimmer wall is positioned across the intake channel and extends 7.5 m (24 ft) below the water surface. The maximum depth of the intake channel is 12.5 m (40 ft).

The skimmer wall provides water at a substantially lower temperature to the plant's condensers during the summer months. A still further significant temperature reduction was obtained by the construction of a submerged dam or barrier on the Clinch River near kilometer 6.3 (mile 3.9), downstream from the mouth of the Emory River. The computed reduction in intake temperatures has been as much as 2.5°C (4.5°F), resulting in a substantial saving in fuel consumption at KIF. The dam is built of quarry-run limestone dumped into position from barges. The 1.8 m (6 ft) wide submerged dam crest is at an approximate elevation of 220 m (722 ft), which ensures an adequate navigation depth at all times.

Methods

Weekly impingement monitoring began on November 16, 2004, and continued through November 6, 2006. To simplify comparisons in this report, data from November 16, 2004, through November 8, 2005, will be referred to as <u>Year-One</u>, and from November 16, 2005, through November 6, 2006, as <u>Year-Two</u>.

To collect each sample, the plant intake screens were rotated and washed on a prearranged schedule by the plant Assistant Unit Operator to remove all fish and debris. After 24 hours, screens were again rotated and washed with an Aquatic Monitoring and Management crew on site. Fish and debris were collected in a catch basket constructed of 9.5 mm (3/8 in) mesh at the end of the sluice pipe where the monitoring crew removed and processed the sample. Fish were sorted from debris, identified, separated into 25 mm (1 in) length classes, enumerated, and weighed. Data were recorded by one member of the crew and checked and verified (signed) by the other for quality control. Quality Assurance/Quality Control procedures for impingement sampling (TVA 2004) were followed to ensure samples were comparable with historical impingement mortality data.

Historical impingement sampling was conducted by TVA from August 1974 through April 1975 (TVA 1976). Additional sampling was conducted three days per week by Oak Ridge National Laboratory personnel during the periods November 1976 through April 1977 and September 1977 through April 1978 (TVA 1981).

Moribund/Dead Fish

The majority of fish collected from a 24-hr screen wash were dead when processed. Incidental numbers of fish which appeared to have been dead for more than 24 hours (i.e., exhibiting pale gills, cloudy eyes, fungus, or partial decomposition) were not included in the sample. Also, during winter, threadfin shad occasionally suffer die-offs and are often impinged after death or in a moribund state (Griffith and Tomljanovich 1975, Griffith 1978). If these die-off incidents were observed, they were documented to specify that either all, or a portion of impinged threadfin shad during the sample period were due to cold-shock and would not have been impinged otherwise. Any fish collected alive were returned to the reservoir after processing.

Data Analysis

Impingement data from weekly 24-hour samples were extrapolated for each week to provide estimates of total fish impinged by week and an estimate for each year of the study. In rare situations when less than a 24-hr sample occurred, data were normalized to 24 hrs.

Historical data collected during 1976-1978 (TVA 1981) were collected during three days per week and weekly estimates were extrapolated accordingly. For annual estimates, data collected from September or November through April were extrapolated to annual totals impinged. These annual estimates, even though based on less than full-year samples, should be relatively comparable to current data presented here (2004-2006) since sampling covered the period of peak impingement.

To facilitate the implementation of and compliance with the EPA regulations for Section 316(b) of the CWA prior to its suspension by EPA, impingement losses of fish were evaluated by extrapolating the losses to equivalent reductions of adult fish, or of biomass production available to predators. In conformance with methods utilized by EPA in its Technical Development Documents in support of the Phase II Rule (EPA 2004), EPRI (formerly known as the Electric Power Research Institute) has identified two models (Barnthouse 2004) for extrapolating losses of fish eggs, larvae, and juveniles at intake structures to numbers or production of older fish. The Equivalent Adult (EA) model quantifies entrainment and impingement losses in terms of the number of fish that would have survived to a given future age. The Production Foregone (PF) model applies to forage fish species to quantify the loss from entrainment and impingement in terms of potential available forage for consumption by predators. Required inputs to the models are site-specific data on the distribution and abundance of fish populations vulnerable to entrainment and impingement. TVA in turn also used these models to determine the "biological liability" of the CCW intake structure.

Results and Discussion

Numbers of fish collected by year and species are presented in Table 1. During Year-One and Year-Two of recent impingement monitoring, 26,511 and 32,171 fish were collected, respectively (Table 1). The total number of species collected each year was similar with 30 species in Year-One and 33 in Year-Two (Table 1).

Total numbers estimated impinged by extrapolation by species and year for Year-One and Year-Two are presented in Table 2. Threadfin shad comprised 95% of the two-year total followed by gizzard shad, freshwater drum, and channel catfish at 1% each (Table 2).

In Table 3, the estimated total fish impinged and percent of the annual total by month for both years are presented. The estimated annual impingement extrapolated from weekly samples was 185,577 during Year-One and 225,197 during Year-Two (Table 4). Peak impingement occurred during October through December at KIF (Table 3 and Figure 2). The proportion of total fish impinged during October through December each year was 86% in Year-One and 69% in Year-Two.

A plot of daily (24-hour average) ambient intake water temperatures for KIF during each of the two years sampled is presented in Figure 3. Lower temperatures appear to be generally correlated with peak impingement as previously reported in numerous studies

(EPRI 2005, Griffith and Tomljanovich 1975, Griffith 1978, McLean et al., 1980). A recent study by Fost (2006) also indicated that cold-stressed threadfin and gizzard shad can be classified as either impaired or moribund. Impaired shad could recover if environmental conditions improved and would therefore not die if not impinged. Moribund fish, on the other hand, are assumed to not be able to recover and die regardless of impingement. Fost's data indicated that threadfin shad began to exhibit reduced or impaired swimming performance at 7.5°C (45.5°F). Figure 3 also presents average KIF intake temperatures from 1986-2006 for comparison. While winter temperatures during both Year-One and Year-Two dropped below the Fost threshold, these temperatures did not appear to coincide with specific impingement peaks in this study period (Figure 2).

Threadfin and/or gizzard shad typically comprise over 90% of fish impinged on cooling-water intake screens of thermal power stations in the Southeastern U. S. (EPRI 2005). They also comprise an average of 35%-56% of total fish biomass where they occur (Jenkins 1967). No state or federal protected fish species were collected or are known to occur in the vicinity of KIF.

Application of the EA and PF models to the estimated total numbers of impinged fish indicated that 7,893 and 8,216 in Year-One and Year-Two, respectively (Table 4), would have been expected to survive to either harvestable (EA) size/age or to provide forage (PF). This reduced number is considered the "biological liability" resulting from plant CCW impingement mortality based on the guidance developed for the now suspended 316(b) regulations.

As part of TVA's Vital Signs Monitoring Program (Scott 2006), resident fish communities were sampled in Watts Bar Reservoir upstream and downstream of KIF in 2001, 2003, and 2005. Results indicated "Good" fish communities at both sites and TVA concluded that operations at KIF are not impacting the fish community of Watts Bar Reservoir.

Comparison with Historical Data

Estimated impingement from historical sampling conducted during 1974-1978 (including the extrapolated annual totals for number of fish impinged) and the numbers estimated after EA and PF reduction are presented in Table 4. The extrapolated total for 1974-1975 was 335,076; for 1976 was 1,163,232; and for 1977-1978 was 2,881,039. Table 5 presents the percent composition by number of major species impinged during 1974-1978 and 2004-2006. Threadfin shad dominance was consistent at between 95% and 98% except during 1977-1978 when threadfin shad comprised only 48% of the total. Peak impingement during October through January for the historical data (Figure 4) agrees with that observed during 2004-2006 (Figure 3). For the historical study it was concluded that based on data collected during 1974-1975, impingement of fish at KIF resulted in no adverse environmental impact (TVA 1976).

The Watts Bar Reservoir area experienced an unusually cold winter during 1976-1977 which caused a significant die-off of threadfin shad from cold shock. McLean, et al. (1979, 1980) conducted studies at KIF to determine (1) the physical and biological causes of impingement of threadfin shad and (2) the effects of impingement on the threadfin shad population and on the threadfin shad-predator population of Watts Bar Reservoir. Impingement samples taken three times per week from mid-November 1976 through April 1977 produced an estimate of 240,000 threadfin shad impinged during this 5-1/2 month period. The impingement rate for threadfin shad was strongly associated with temperature. Approximately 3,000 threadfin shad were impinged per day during November. On December 7, water temperature decreased from 7°C (44.6°F) to 4°C (39.2°F) and the following day 42,000 threadfin were impinged. Water temperature later decreased to 2.7°C (36.86°F) which is below the lower lethal limit for threadfin shad (Griffith and Tomljanovich 1975) and stressed shad were observed in large numbers in the KIF intake channel. Dead and moribund threadfin shad were observed in shallow embayments and along the reservoir shoreline during this period. The heated CCW discharge channel at KIF was the only place that healthy threadfin shad were observed throughout the winter (Schneider and Tuberville 1981).

Despite the obvious significant mortality in the threadfin shad population that was estimated at 95% in Watts Bar Reservoir, more than twice as many threadfin shad were impinged the following winter (1977-1978). From late September 1977 through the end of April 1978, an estimated 560,000 threadfin shad were impinged at KIF (McLean et al., 1980). As observed during the previous year, almost all threadfin shad were impinged before January 25.

Total numbers of all fish estimated impinged during the winter of 1977-1978 (2,881,039) were also higher (Table 4). While the percent composition of threadfin shad was lower (48%) during this period, skipjack herring composition (28%) as well as gizzard shad at 22% was significantly higher during 1977-1978 (Table 5). The fact that threadfin shad demonstrated the ability to rebound from a reservoir-wide, non-plant induced mortality (cold stress) indicates that impingement mortality at KIF does not represent an adverse impact to the threadfin shad population of Watts Bar Reservoir.

Summary and Conclusions

Impingement of fish by the KIF CCW was monitored during 2004-2006 and compared with historical data collected during 1974-1978. Total numbers of fish estimated to be impinged annually were lower during 2004-2006 than during 1974-1978. The average number estimated to be impinged during 2004-2006 (two years) was 205,387, compared to 1,459,782 per year during 1974-1978. Annual fish impingement totals were noticeably lower during 2005-2006 than during historical monitoring periods (1974-1978). RFAI scores in 2003 and 2005 of 43 and 44 for downstream and upstream samples, respectively, indicated good fish communities at both sites. Resident fish communities at these locations reached 71.1% and 73.3% of their potential scores for downstream and upstream sites, respectively. All the score averages for the Tennessee River stations in the vicinity of KIF indicate “Good” fish communities, and the nearest downstream Watts Bar Reservoir average met the adjusted 70% screening criteria for designation as BIP.

These factors as described above provide evidence of a balanced and healthy fish community and indicate that the KIF CCW intake has not adversely impacted the Watts Bar Reservoir biota.

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Table 1. List of Fish Species by Family, Scientific, and Common Name Including Numbers Collected in Impingement Samples During 2004-2006 at TVA's Kingston Fossil Plant.

Family	Scientific Name	Common Name	Total Number Impinged	
			Year-One	Year-Two
Petromyzontidae	*Ichthyomyzon castaneus*	Chestnut lamprey	2	0
Clupeidae	*Alosa pseudoharengus*	Alewife	65	36
	Dorosoma cepedianum	Gizzard shad	514	308
	Alosa chrysochloris	Skipjack herring	2	68
	Dorosoma petenense	Threadfin shad	25,320	30,491
	D. petenense x *D. cepedianum*	Hybrid shad	1	0
Cyprinidae	*Pimephales notatus*	Bluntnose minnow	1	6
	Pimephales vigilax	Bullhead minnow	0	3
	Pimephales promelas	Fathead minnow	1	0
	Cyprinella spiloptera	Spotfin shiner	0	1
	Campostoma oligolepis	Largescale stoneroller	1	0
	Notropis atherinoides	Emerald shiner	0	3
	Notropis photogenis	Silver shiner	1	0
Catostomidae	*Hypentelium nigricans*	Northern hogsucker	5	3
	Minytrema melanops	Spotted sucker	1	0
Ictaluridae	*Ictalurus furcatus*	Blue catfish	13	38
	Ictalurus punctatus	Channel catfish	210	137
	Pylodictis olivaris	Flathead catfish	26	5
	Ameiurus natalis	Yellow bullhead	3	0
Atherinidae	*Labidesthes sicculus*	Brook silverside	0	1
Moronidae	*Morone saxatilis*	Striped bass	18	29
	Morone chrysops	White bass	0	3
	Morone mississippiensis	Yellow bass	58	129
Centrarchidae	*Lepomis cyanellus*	Green sunfish	4	0
	Lepomis macrochirus	Bluegill	61	211
	Lepomis gulosus	Warmouth	0	3
	Lepomis megalotis	Longear sunfish	0	5
	Lepomis auritus	Redbreast sunfish	2	7
	Lepomis microlophus	Redear sunfish	0	1

Table 1. (continued)

Family	Scientific Name	Common Name	Total Number Impinged	
			Year-One	Year-Two
Centrarchidae	*Ambloplites rupestris*	Rock bass	9	2
	Micropterus dolomieu	Smallmouth bass	1	2
	Micropterus punctulatus	Spotted bass	14	13
	Micropterus salmoides	Largemouth bass	1	4
	Pomoxis annularis	White crappie	2	8
	Pomoxis nigromaculatus	Black crappie	0	6
Percidae	*Percina sciera*	Dusky darter	0	2
	Etheostoma blennioides	Greenside darter	0	1
	Percina caprodes	Logperch	22	20
	Perca flavescens	Yellow perch	0	1
	Sander canadense	Sauger	2	4
	Sander vitreus	Walleye	1	0
Sciaenidae	*Aplodinotus grunniens*	Freshwater drum	150	620
	Total number of fish		**26,511**	**32,171**
	Total number of species		**30**	**33**

Table 2. Estimated Annual Numbers, Biomass, and Percent Composition of Fish Impinged by Species at Kingston Fossil Plant During 2004-2006.

Species	Estimated Number			Estimated Biomass (g)			Percent Composition by Number
	Year-One	Year-Two	Average	Year-One	Year-Two	Total	
Threadfin shad	177,240	213,451	**195,346**	525,959	511,644	**1,037,603**	95
Freshwater drum	1,050	4,361	**2,706**	39,326	204,736	**244,062**	1
Gizzard shad	3,598	2,149	**2,874**	40,656	26,922	**67,578**	1
Channel catfish	1,470	959	**1,215**	7,112	9,751	**16,863**	1
Bluegill	427	1,477	**952**	5,061	9,345	**14,406**	**T**
Yellow bass	406	854	**630**	8,610	14,924	**23,534**	**T**
Alewife	455	231	**343**	9,261	1,652	**10,913**	**T**
Skipjack herring	14	476	**245**	8,260	5,110	**13,370**	**T**
Striped bass	126	217	**343**	1,050	1,400	**2,450**	**T**
Blue catfish	91	217	**308**	1,001	6,818	**7,819**	**T**
Logperch	154	140	**294**	2,030	1,652	**3,682**	**T**
Spotted bass	238	0	**238**	1,162	0	**1,162**	**T**
Flathead catfish	182	35	**217**	2,674	224	**2,898**	**T**
Rock bass	63	14	**77**	1,435	322	**1,757**	**T**
White crappie	14	56	**70**	56	4,165	**4,221**	**T**
Redbreast sunfish	14	49	**63**	42	105	**147**	**T**
Northern hogsucker	35	21	**56**	245	147	**392**	**T**
Bluntnose minnow	7	42	**49**	7	168	**175**	**T**
Sauger	14	28	**42**	11,375	21,119	**32,494**	**T**
Black crappie	0	42	**42**	0	854	**854**	**T**
Largemouth bass	7	28	**35**	35	483	**518**	**T**
Longear sunfish	0	35	**35**	0	1,939	**1,939**	**T**
White bass	0	35	**35**	0	3,773	**3,773**	**T**
Green sunfish	28	0	**28**	91	0	**91**	**T**
Smallmouth bass	7	21	**28**	35	147	**182**	**T**
Yellow bullhead	21	0	**21**	315	0	**315**	**T**
Emerald shiner	0	21	**21**	0	63	**63**	**T**
Warmouth	0	21	**21**	0	1,218	**1,218**	**T**
Chestnut lamprey	14	0	**14**	875	0	**875**	**T**
Bullhead minnow	0	14	**14**	0	70	**70**	**T**
Dusky darter	0	14	**14**	0	420	**420**	**T**
Fathead minnow	7	0	**7**	35	0	**35**	**T**
Hybrid shad	7	0	**7**	35	0	**35**	**T**

Table 2. (continued)

Species	Estimated Number			Estimated Biomass (g)			Percent Composition by Number
	Year-One	Year-Two	Average	Year-One	Year-Two	Total	
Largescale stoneroller	7	0	**7**	35	0	**35**	**T**
Silver shiner	7	0	**7**	70	0	**70**	**T**
Spotted sucker	7	0	**7**	4,410	0	**4,410**	**T**
Walleye	7	0	**7**	4,305	0	**4,305**	**T**
Brook silverside	0	7	**7**	0	56	**56**	**T**
Greenside darter	0	7	**7**	0	56	**56**	**T**
Redear sunfish	0	7	**7**	0	70	**70**	**T**
Spotfin shiner	0	7	**7**	0	7	**7**	**T**
Yellow perch	0	7	**7**	0	315	**315**	**T**
Total	**185,577**	**225,197**		**675,563**	**829,675**		

T = Trace < one percent

Table 3. Numbers of Fish Impinged at Kingston Fossil Plant by Month and Percent of Annual Total During Year-One and Year-Two and for Both Years Combined.

Month	Total Number of Fish Impinged Year-One	Percent of Annual Total	Total Number of Fish Impinged Year-Two	Percent of Annual Total	Years One and Two Combined	Percent of Two-Year Total
Nov	9,009	34	4,291	14	13,300	23
Dec	10,623	40	12,980	42	23,603	41
Jan	322	1	1,023	3	1,345	2
Feb	128	0	1,729	6	1,857	3
Mar	148	1	6,132	20	6,280	11
Apr	88	0	252	1	340	1
May	51	0	62	0	113	0
Jun	25	0	94	0	119	0
Jul	630	2	242	1	872	2
Aug	1,989	8	1,702	5	3,691	6
Sep	563	2	534	2	1,097	2
Oct	2,935	11	3,130	10	6,065	11
Total	**26,511**		**32,171**		**58,682**	

Table 4. Total Numbers of Fish Estimated Impinged by Year at Kingston Fossil Plant and Numbers Following Application of Equivalent Adult and Production Foregone Models.

	1974-1975	1976*	1977-1978	2004-2005	2005-2006
Extrapolated Annual Number Impinged	**335,076**	**1,163,232**	**2,881,039**	**185,577**	**225,197**
Number after EA and PF Reduction	**5,862**	**7,077**	**20,622**	**7,893**	**8,216**

***1976 data extrapolated from seven samples between 11/19/76–12/01/76**

Table 5. Percent Composition (By Number and After EA and PF Models Applied) of Major Species of Fish Impinged at TVA's Kingston Fossil Plant During 1974-1978 and 2004-2006.

	1974-1975		1976*		1977-1978		2004-2005		2005-2006	
Species Composition	**% by Number**	**% after PA and EF**	**% by Number**	**% after PA and EF**	**% by Number**	**% after PA and EF**	**% by Number**	**% after PA and EF**	**% by Number**	**% after PA and EF**
Threadfin shad	95	89	98	94	48	45	96	89	95	86
Skipjack herring	2	2	-	-	28	26	-	-	-	-
Gizzard shad	-	-	-	-	22	20	-	-	1	1
Freshwater drum	1	2	2	3	1	3	1	1	2	5
Channel catfish	-	-	-	-	-	-	1	1	-	1
Bluegill	1	2	-	-	-	-	-	1	1	2
Logperch	-	2	-	-	-	-	-	1	-	-
White bass	-	1	-	-	-	2	-	-	-	-
Yellow bass	-	-	-	-	-	1	-	2	-	2
White crappie	-	-	-	-	-	1	-	-	-	-
Striped bass	-	-	-	-	-	-	-	1	-	1
Alewife	-	-	-	-	-	-	-	1	-	-
Sauger	-	-	-	1	-	-	-	1	-	1
Total	**99**	**99**	**100**	**98**	**99**	**98**	**100**	**100**	**99**	**99**

***1976 data from seven samples between 11/19/76–12/01/76**

Dash denotes not a major species during that year.

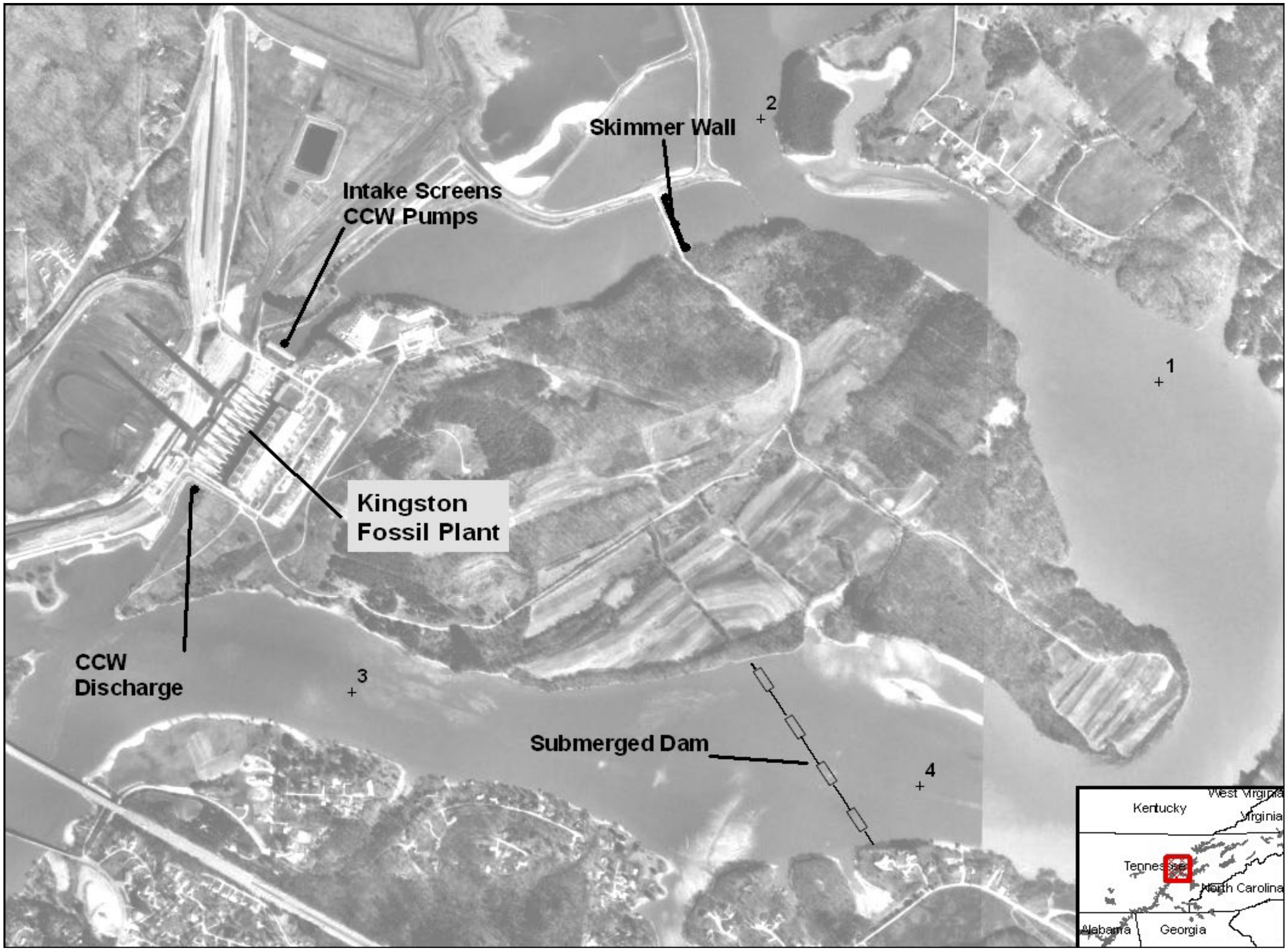

Figure 1. Aerial photograph of Kingston Fossil Plant including CCW intake structure, skimmer wall, intake basin, and discharge channel.

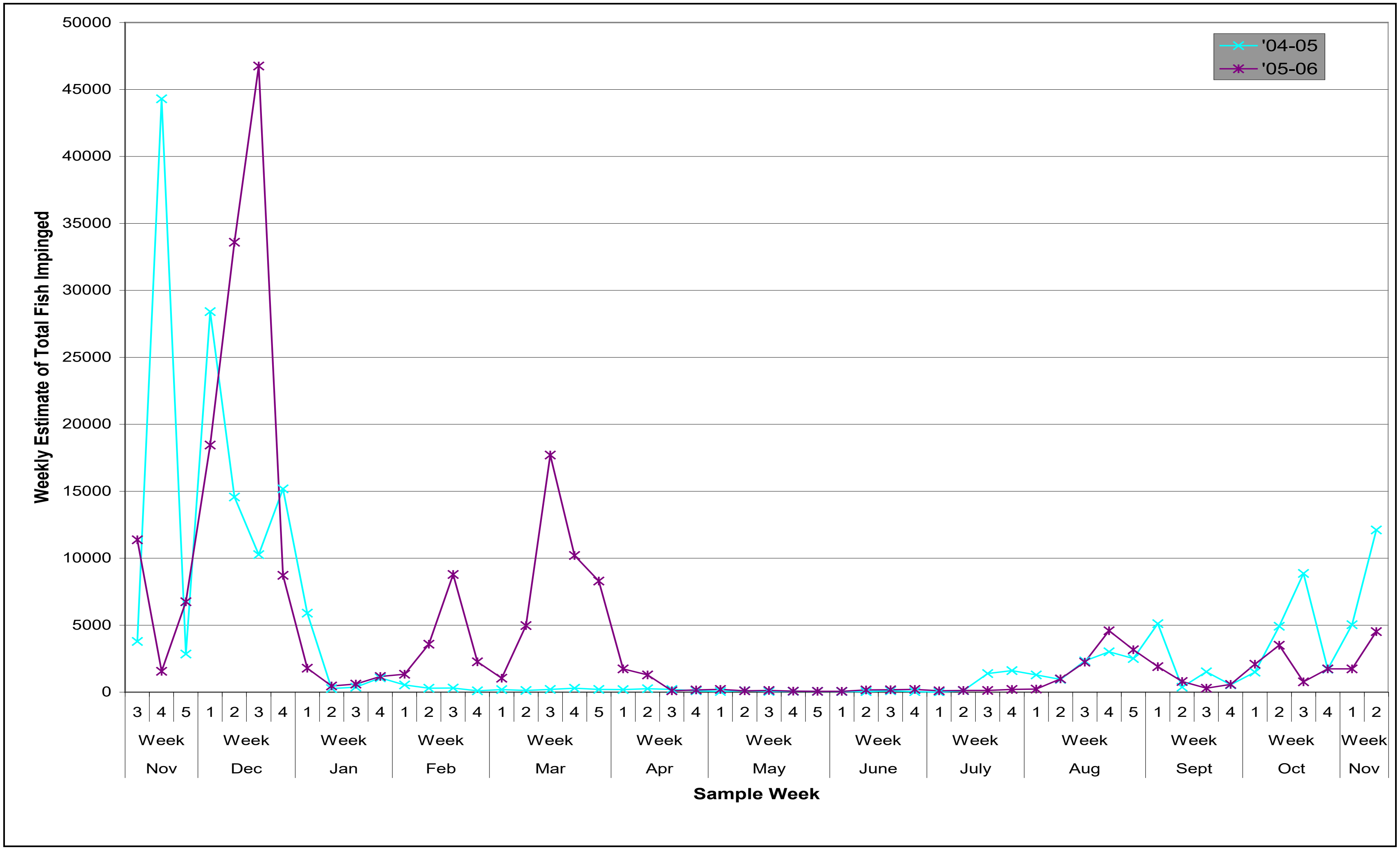

Figure 2. Estimated weekly fish impingement at TVA's Kingston Fossil Plant during 2004-2006.

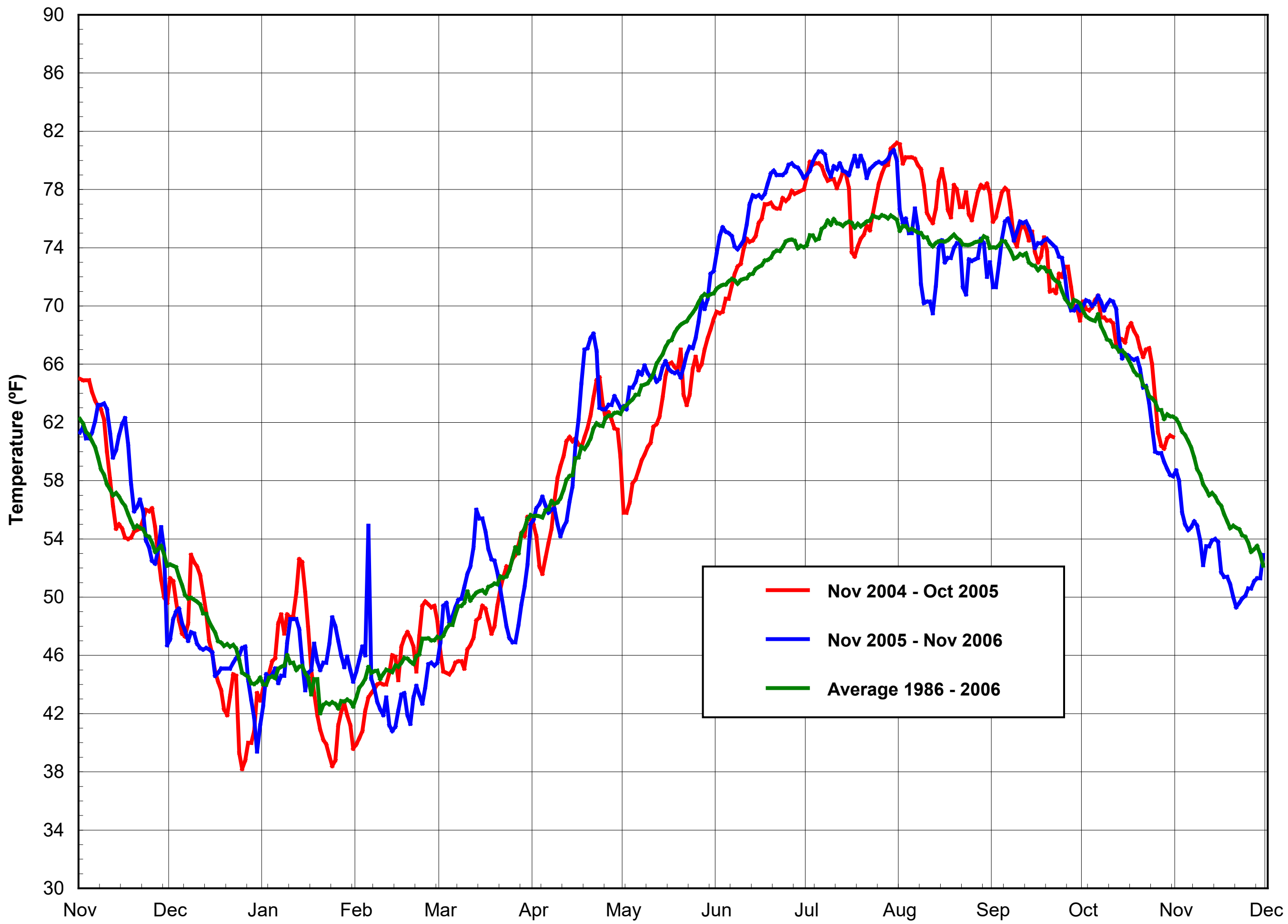

Figure 3. Ambient daily (24-hr avg) water temperature at Kingston Fossil Plant intake during historical (1986-2006) and recent (2004-2006) impingement monitoring.

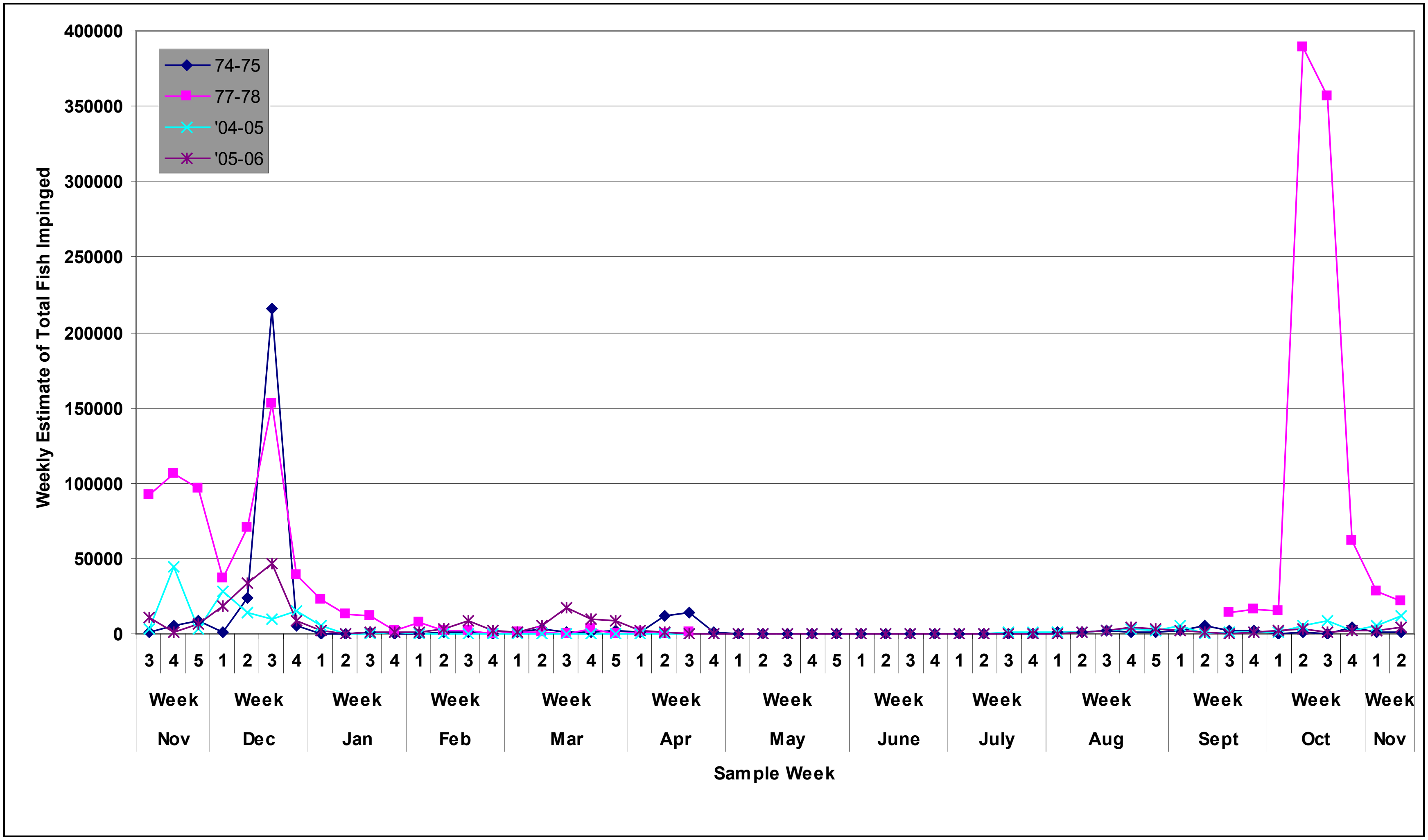

Figure 4. Comparison of estimated weekly fish impingement at TVA's Kingston Fossil Plant during historical and recent monitoring periods.

Appendix N – Kingston Cultural Report and TN SHPO Correspondence

Subject: FW: Retirement of Kingston Fossil Plant and Construction of Replacement Generation, (35.8980, -84.5200), CID 81491 - Project # SHPO0001212

TENNESSEE HISTORICAL COMMISSION
STATE HISTORIC PRESERVATION OFFICE
2941 LEBANON PIKE
NASHVILLE, TENNESSEE 37243-0442
OFFICE: (615) 532-1550
www.tnhistoricalcommission.org

2023-05-04 10:17:50 CDT

James Osborne
Tennessee Valley Authority
jwosborn@tva.gov

RE: Tennessee Valley Authority (TVA), Retirement of Kingston Fossil Plant and Construction of Replacement Generation, (35.8980, -84.5200), CID 81491, Project#: SHPO0001212, Kingston, Roane, Anderson, Cumberland, Sumner, and Wilson County, TN

Dear Mr. Osborne:

Pursuant to your request, this office has reviewed documentation concerning the above-referenced undertaking. Our review of and comment on your proposed undertaking are among the requirements of Section 106 of the National Historic Preservation Act. This Act requires federal agencies or applicants for federal assistance to consult with the appropriate State Historic Preservation Office before they carry out their proposed undertakings. The Advisory Council on Historic Preservation has codified procedures for carrying out Section 106 review in 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739).

Based on the architectural survey results, we could not determine National Register eligibility for the Green Cemetery but due to the planned avoidance of the site described in your letter we concur that if it were to be determined eligible the proposed undertaking would be unlikely to adversely affect it. We would require additional information to determine whether Fredonia Baptist Church and Cemetery is eligible for listing in the National Register but based on the changed scope of the project, this property appears to be outside of the area of potential affect. The remaining properties in the architectural survey report did not appear to be eligible.

See the comments below regarding archaeological resources:

1. Concur with eligibility determinations for archaeology. No adverse effect to site 40RE45.
2. The 40RE45 testing report includes digital editorial notes from TVA to the author. The revised report should address these comments and delete them from the text.
3. The consultation letter erroneously lists site 40CU691 in two places. The correct site number is 40CU91.
4. Remove all references to sites 40RE44A, 40RE44C, and 40RE44D in both consultation letters and reports. The official site number for each of these areas is 40RE44. Additionally, the area designated as 40RE44A is not recorded as a site or within the boundary of 40RE44.
5. The testing report and your letter state that the boundary of 40RE45 was reduced. The recorded site boundary has not been reduced. The results of the testing simply defined the portions of the site that retain integrity. The letter and reports should be revised accordingly. As a portion of 40RE45 lies within the area of potential effects, our office finds that the site will be affected, but the affect will not be adverse.
6. Site record updates for previously recorded sites 40RE224, 40RE228, 40RE572, and 40RE620 must be filed with, and accepted by, the Tennessee Division of Archaeology.

This office has no objection to the implementation of this project as currently planned. If project plans are changed or previously unevaluated archaeological resources are discovered during project construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act. Include the Project # if you need to submit any additional information regarding this undertaking. Questions and comments may be directed to Kelley Reid, who drafted this response, at Kelley.Reid@tn.gov, +16157701099. We appreciate your cooperation.

Sincerely,

E. Patrick McIntyre, Jr.

E. Patrick McIntyre, Jr.
Executive Director and
State Historic Preservation Officer

Ref:MSG8192430_KHcXCZJBxAfna1AFT0NM

Appendix O – Concentric Report

ASSESSMENT OF THE DRAFT ENVIRONMENTAL IMPACT STUDY AND RESPONSE TO CERTAIN REPORTS

PREPARED FOR:
TENNESEE VALLEY AUTHORITY

OCTOBER 3, 2022

WWW.CEADVISORS.COM

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ATTACHMENTS

REPORT SCOPE AND SUMMARY OF FINDINGS

Background

The Tennessee Valley Authority (TVA) is proposing to retire two coal-fired units at the Cumberland Fossil Plant (CUF). As part of an assessment of the environmental impacts of retiring the two coal-fired units and replacing the generation provided by one of the retired CUF units, TVA is preparing an Environmental Impact Statement (EIS) in which TVA is assessing various alternatives for replacement generation, including: Alternative A - Retirement of CUF and construction and operation of a combined cycle combustion turbine (CC) Gas Plant at the same site; Alternative B - Retirement of CUF and construction and operation of simple cycle combustion turbine (CT) Gas Plants at alternate locations; and Alternative C - Retirement of CUF and construction and operation of Solar and Storage Facilities, primarily at alternate locations.

The scope of this report is to assess the reasonableness of TVA's identification of Alternative A as the preferred alternative in its Draft EIS. Alternative A involves the retirement of the two CUF coal-fired units and the replacement of the generation of one unit with a 1450 MW CC plant. In addition, this report responds to Attachment 2 submitted by the Southern Environmental Law Center titled "Critique of TVA's Alternatives Analysis in the Utility's Cumberland Fossil Plant Retirement, Draft Environmental Impact Statement"' authored by Grid Strategies, LLC and dated June 13, 2022 (Grid Strategies report) as well as Attachment 1 submitted by the Sierra Club titled "Clean Portfolio Replacement at Tennessee Valley Authority" authored by Synapse Energy Economics, Inc. and dated May 2022 (Synapse report).

Summary of Findings

Observation #1: The Board Approved 2019 IRP provides a solid basis and analytic framework for future resource decisions. TVA's 2019 Integrated Resource Plan (IRP) serves as the backdrop for near-term and long-term resource additions that will build on TVA's existing diverse asset portfolio to ensure low-cost, reliable, and clean electricity for TVA customers into the future. The 2019 IRP included an analysis of a broad set of resources, portfolios, inputs, future worlds, and sensitivities to provide a robust view of possible future outcomes. The resulting long-term strategy involves the pursuit of up to 14 gigawatts (GW) of solar, up to 5 GW of storage, and 2 to 17 GW of natural gas generation by 2038.

Observation #2: The Cumberland retirement and resulting replacement resources represent an early step of a broader strategic plan. The evaluation of the near-term implementation measures to implement the strategy outlined in the IRP should be more about testing the consistency of the measures with the strategy as opposed to attempting to reset TVA's broad direction or decisions. There is general alignment about the retirement of the Cumberland facility as well as the need for future solar and storage; however, an important component of TVA's long-term plan to meet reliability and environmental mandates is the inclusion of both combined cycle and simple cycle natural gas generators. Concurrent with the steps outlined in Alternative A and consistent with its 2019 IRP, TVA is completing a demand side management (DSM) market potential study, installing up to 8 GW of solar resources by 2028, deploying up to 2,400 megawatts (MW) of battery storage by 2028, and investing in transmission infrastructure, while working closely with its local distributors, to support higher penetration of renewable energy.

Observation #3: Long-term resource plans that exclude natural gas rely on overly optimistic assumptions. Focusing on narrow and optimistic long-term future assumptions about the cost and operation of still nascent technologies can have significant financial and reliability impacts. For example, lowering the assumed cost of renewable technologies results in an understatement of the cost of alternative "clean replacement" portfolios by more than $10 billion. Instead, as TVA did, resource portfolio strategies should be evaluated against a range of scenarios and critical input sensitivities to choose a target supply mix that achieves the desired objectives while mitigating risk.

Observation #4: Near-term deployment of combined cycle generation provides a solid foundation for aggressive renewable energy deployment. A diverse energy mix offers reliability and resilience and has proven to be particularly valuable during difficult operating conditions, like peak power demand during high summer temperatures or bitter cold during deep freezes. Recognizing industry studies have shown that the complexity of renewable integration escalates with the growing penetration of renewable energy, flexible and dispatchable natural gas resources will be a valuable part of TVA's resource portfolio to achieve its reliability requirements.

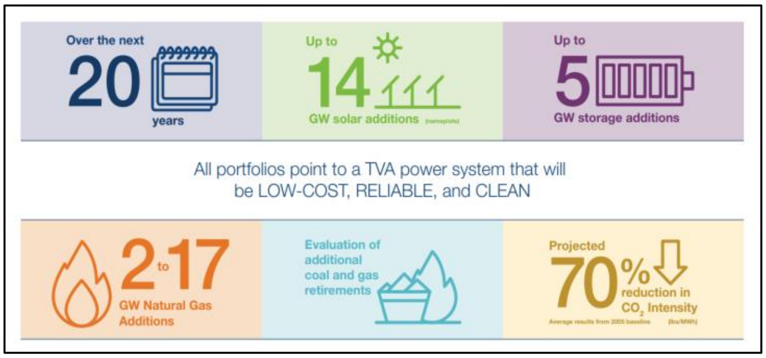
Conclusion: Alternative A is a practical and reasonable near-term implementation plan. There is alignment about the retirement of CUF and the need for replacement capacity. Adding natural gas combined cycle generation to the existing Cumberland site is an executable and reliable plan within the required timeframe. In contrast, orchestrating a symphony of assumed capabilities and costs of energy efficiency, solar, wind, and batteries along with the accompanying transmission upgrades is simply not a viable or rigorous approach as a near-term alternative that meets system reliability requirements. TVA's thorough and broad long-term planning consistently identifies the need for a diverse set of resources and load reduction measures, along with natural gas generation, solar and storage resources, with the amounts of each driven by future market conditions.

Supplemental Observation: The Inflation Reduction Act influences the amount and timing of resources within the ranges contained in the IRP. The comprehensive impacts of the Inflation Reduction Act (IRA) are uncertain and will take time to fully understand. Even so, questions about the effects of the IRA can be qualitatively assessed by considering whether the potential impacts would trend resource amounts higher or lower within the 2019 IRP ranges. While the IRA impacts must be more fully modeled and explored, fundamental concepts and conclusions will remain unchanged, such as the escalating complexity of adding renewable resources, the need for broad and rigorous analyses, and ultimately the need for dispatchable generation as part of a diverse and reliable generation portfolio.

OBSERVATION #1: THE BOARD APPROVED 2019 IRP PROVIDES SOLID BASIS AND ANALYTIC FRAMEWORK FOR FUTURE RESOURCE DECISIONS

The TVA 2019 IRP, as approved by the TVA Board, provides a roadmap to meeting forecasted energy demand using both supply and demand-side resources to ensure reliable service to customers in the most cost-effective manner. The plan outlines clear and achievable long-term goals and aspirations that will bolster TVA's potential to incorporate increasing amounts of renewable energy capacity and distributed energy resources. More specifically, it frames how TVA will offer low-cost and reliable electricity, facilitate environmental stewardship, and spur economic development over the next 20 years, all while ensuring system reliability. As shown below, TVA's study results underscore its commitment to a diverse portfolio that recognizes the inherent and unique tradeoffs associated with balancing competing priorities.

Figure 1: TVA's 2019 IRP Direction



The objective of the IRP process is to evaluate competing investment and purchase decisions to meet customer demand. The range of options available to utilities to balance supply and demand are expanding as new generation, load control, storage, and smart grid technologies become available and affordable. The characteristics of supply and demand resources are changing as well. Historically, load was viewed as a fixed obligation which utilities planned to meet with dispatchable supply. Higher penetration of intermittent generation and controllable loads mean that utilities must plan for a future in which both demand and supply behave in ways that are different from the past.

TVA's 2019 IRP reflects a robust evaluation of a diverse set of both supply-side and demand-side options to meet its customers' need for energy at the lowest cost over the forecast period, including environmental and economic costs. TVA employed a strategy combining investments and expenditures on traditional energy supply resources, distributed energy resources (DER), and comprehensive energy efficiency programs. These investments include diverse resources like renewables, battery storage, and DER, as well as more traditional supply-side resources that will be critical to ensuring grid reliability and resilience as new technologies emerge and mature.

Importantly, the IRP recognizes TVA's role as an environmental steward by outlining a roadmap by which TVA will dramatically reduce its greenhouse gas emissions over the next 20 years. The IRP shows that, by 2038, TVA will have reduced greenhouse emissions by an average of 70 percent from 2005 levels across all strategies studied. TVA's subsequent "Aging Coal Fleet Evaluation" (May 2021) and "Strategic Intent and Guiding Principles" (May 2021) build on the recommendations from the IRP and lay out TVA's current strategy to phase out its coal fleet by 2035, along with adding 10,000 MW of solar and leveraging new technology; all together supporting TVA's plan to 70% carbon reduction by 2030, development of a path to approximately 80% carbon reduction by 2035, and aspiration to achieve net-zero carbon emissions by 2050.

To achieve these objectives, TVA utilized a least-cost based analysis that weighed a range of future strategies to gauge how certain power generation portfolios and demand reduction measures could perform under a diverse array of external market and regulatory conditions. This analysis was informed by an IRP Working Group comprised of twenty members ranging from government officials to advocacy groups, each representing unique interests in the Tennessee Valley. Together, this group assisted TVA in designing five distinct strategies, employable across six different future scenarios, which resulted in thirty different alternative resource plans. This broad list of alternative resource plans laid the foundation for a robust analysis.

Based on TVA's mission of providing clean, dependable power to customers in the Tennessee Valley at a low-cost, TVA outlined five performance categories to evaluate resource plans. The performance categories included: Cost, Risk, Environmental Stewardship, Operational Flexibility, and Valley Economics. The figure below lists the five performance categories as well as the 14 different metrics used to measure the performance of each of the 30 different resource portfolios.

Figure 2: TVA's 2019 IRP Scorecard

			TVA Mission	
IRP Scorecard Metrics		Low-Cost Reliable Power	Economic Development	Environmental Stewardship
Cost	PVRR ($Bn)	✓	✓	
	System Average Cost ($/MWh)	✓	✓	
	Total Resource Cost ($Bn)	✓		
Risk	Risk/Benefit Ratio	✓		
	Risk Exposure ($Bn)	✓		
Environmental Stewardship	CO2 (MMTons)		✓	✓
	CO2 Intensity (lbs/MWh)		✓	✓
	Water Consumption (MMGallons)			✓
	Waste (MMTons)			✓
	Land Use (Acres)			✓
Operational Flexibility	Flexible Resource Coverage Ratio	✓		
	Flexibility Turn Down Factor	✓		
Valley Economics	Percent Difference in Real Per Capita Income	✓	✓	
	Percent Difference in Employment		✓	

Each category is underpinned by complex analysis, which augments the broader evaluation. For example, TVA executed stochastic analysis to understand the risks and uncertainty within the planning assumptions for each portfolio. More specifically, Monte Carlo simulations were used to assess the multitude of possible futures and the relevant likelihoods. The Monte Carlo simulations, which are employed to emulate the probability of different outcomes in a model with multiple random variables, covered 16 input variables under four main risk categories. The evaluation of the scenarios' uncertainties takes into consideration the number of realistic future scenarios and the probability distribution tied to the expected forecasts. As a result, the probability distributions and ranges of the 16 variables were used to simulate a range of plausible outcomes at the 95th and 5th percentile, which provides important insight into the ranges of outcomes and risk trade-offs across all 30 resource plans.

The energy market and the macro environment are ever evolving and require ongoing planning and monitoring. The results of the IRP analyses indicate the most influential macro environment indicators on future resource plans, which include demand for electricity, natural gas prices, regulatory requirements, cost and performance of emerging technologies, customer expectations, operating costs of existing units, and the cost and performance of wind and solar. These indicators, or signposts, will impact the amount and timing of future resource decisions.

Summary

TVA's 2019 IRP represents both the analytical rigor and broad scope necessary to serve as the backdrop for near-term resource decisions that are consistent with the long-term strategy. Planning over a twenty-year horizon inherently relies on future projections for a multitude of modeling inputs and drivers. As TVA did, analyzing a broad set of resources, portfolios, inputs, future worlds, and sensitivities provides a robust view of possible future outcomes. TVA also measured its results against a meaningful set of performance metrics to clearly understand the trade-offs between resource portfolios and strategies across a set of scenarios. Broadening the analytical scope to include analyses of reserve margin, impacts of intermittent resources, and the benefits of flexible resources was highly relevant as TVA expects to be adding significant amounts of renewable energy. Including public input and working group input in the planning process is also an important element of a comprehensive planning process.

OBSERVATION #2: THE CUMBERLAND RETIREMENT AND RESULTING REPLACEMENT RESOURCES REPRESENT AN EARLY STEP OF A BROADER STRATEGIC PLAN

As part of its 2019 IRP and subsequent Aging Coal Fleet Evaluation, TVA evaluated the economics, reliability, portfolio fit, and environmental factors associated with its coal fleet. In furthering its analysis of the continued operation of its coal fleet, TVA determined that the first Cumberland unit should be retired as early as 2026, followed by the second unit as early as 2028. Coal plant retirements (and even the potential of early coal plant retirements) are entirely consistent with the direction of the 2019 IRP. In fact, the retirement of CUF is not disputed in the Grid Strategies or Synapse reports; instead, the reports take issue with how to replace the lost capacity from the CUF retirement.

Resource planning involves a series of tactical steps to implement the long-term strategy outlined in the IRP. At any given time, TVA is taking multiple actions to move along its long-term strategic path. For instance, TVA is completing a DSM market potential study, deploying up to 8 GW of solar by 2028, deploying up to 2,400 MW of battery storage by 2028, investing in transmission infrastructure to support higher penetration of renewable energy, as well as taking steps to support the addition of natural gas generation. During implementation, signposts are monitored for material shifts in critical IRP inputs then, ultimately, the process repeats with a full-scale check-in on progress and direction in the next IRP.

Therefore, the evaluation of near-term implementation steps, such as the replacement of CUF capacity at issue here, should be more about testing the consistency of the replacement plan with the strategy outlined in the 2019 IRP instead of attempting to reset the broader direction or decisions. In fact, many of the arguments in the Synapse report and Grid Strategies report represent fundamental differences in future industry characterizations and resource alternatives already explored by the 2019 IRP. The Synapse report, Grid Strategies report, and TVA's 2019 IRP all support the adoption of large amounts of solar and batteries. In contrast though, an important component of TVA's plan to meet system reliability needs at lowest cost is the inclusion of both combined cycle and simple cycle natural gas generators. More precisely, the elemental disagreement at hand is the need for new dispatchable generation. While both the Synapse and Grid Strategies reports suggest large amounts of renewable resources can be added to the system without impacting system reliability and resilience, TVA appropriately recognizes that increasing the amount of intermittent generation and resources based on emerging technologies will require dispatchable generation to ensure that customer energy and capacity needs are met around the clock. Given the significant amount of solar, battery storage, and DER expected in the medium-term, it is prudent for TVA to deploy new dispatchable generation by the time the two CUF units are retired at the end of their lives in 2026 and 2028.

The following sections of this report explore the areas where the Synapse report and Grid Strategies report disagree with TVA's assessments and direction. Based on a review of both reports, retiring CUF and selecting Alternative A represent reasonable near-term implementation steps entirely consistent with TVA's broader direction and analytic conclusions as outlined in the 2019 IRP.

OBSERVATION #3: LONG-TERM RESOURCE PLANS THAT EXCLUDE NATURAL GAS RELY ON OVERLY OPTIMISTIC ASSUMPTIONS

Even though the Synapse report, Grid Strategies report, and TVA's 2019 IRP all support the adoption of large amounts of solar and battery resources, there are fundamental differences in the assumed capital and operating costs of generating resources, as well as the expected contributions of these resources to system reliability and resiliency. To set the strategic direction outlined in the 2019 IRP, TVA evaluated six different strategies across five different future world scenarios, varying the ranges of 16 inputs, assessing 14 different performance metrics, and then evaluating 10 additional sensitivities. In contrast, the Synapse report modeled two scenarios by strategically adjusting input assumptions that drive additional adoption of solar, storage, energy efficiency, behind-the-meter resources, and wind. Conversely, the Grid Strategies report presented a narrow version of a lifetime cost analysis by substituting certain resource characterizations with more optimistic assumptions.

The Synapse report and Grid Strategies report include assumptions about critical inputs to the IRP analysis that are optimistic when compared to publicly available data: the availability of low-cost wind imported into the TVA service territory via inter-regional transmission projects, low-cost energy efficiency measures, and unlimited operational flexibility of battery storage resources. The points directly below highlight how using alternative and more realistic assumptions would impact the conclusions of the Synapse and Grid Strategies reports.

Wind

TVA does not include the addition of onshore wind resources in its 2019 IRP due to its high capital cost, while the Synapse report includes the addition of over 3,600 MW by 2030 and a total of 5,400 MW of wind by 2042 via imports from the Midcontinent Independent System Operator (MISO) and the Southwest Power Pool (SPP). The Grid Strategies report and Synapse report assert that the reason for this difference in the projected addition of wind resources is caused by TVA's overestimation of capital cost estimates for onshore wind. In its 2019 IRP, TVA used $1,807/kW[1] for the MISO and SPP regions ($1,904/kW for the Tennessee Valley) based on actual completed wind project costs in 2016 in the Interior region of the United States[2]. Importantly, for MISO and SPP wind projects, TVA also included the cost of interconnection, including network upgrades, of $192/kW[3] resulting in overnight costs without interconnection costs of $1,615/kW. This estimate is very similar to the 2020 National Renewable Energy Laboratory (NREL) Annual Technology Baseline (ATB)

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1 2019$ escalated using 1.8% inflation adjustment from the 2016$ source data
2 U.S. Department of Energy's 2016 Wind Technologies Market Report, Figure 44
3 2019$

estimate of $1,605/kW[4]. Subsequently, the 2021 NREL overnight wind cost estimates dropped to $1,376/kW[5] based on its modeling of the underlying components for a generic wind project. In stark contrast, the U.S. Department of Energy's 2022 Land-Based Wind Market Report showed costs of wind for SPP and MISO of $1,500/kW and $1,600/kW[6] respectively, based on actual 2021 completed project costs. These comparisons demonstrate both the reasonableness of TVA's cost estimates and the importance of analyzing a range of inputs as TVA did. If the 5,400 MW of wind modeled in the Synapse report reflected more reasonable cost estimates and interconnection costs, the additional overnight capital cost would have increased by $2.3 billion.[7]

In addition to the capital cost differences, the Grid Strategies report and Synapse report fail to recognize the difficulty in building inter-regional transmission projects to move wind output from its source to load centers. These resource intensive projects tend to have lengthy planning, approval, and implementation timelines. The Grid Strategies report reference to the Southern Cross transmission line is an excellent example of the challenges and high cost of building inter-regional transmission. The cited news article indicates that the Southern Cross project[8] will cost $2 billion with 2,000 MW of capacity, or $1,000/kW for the cost of transmission alone. Interestingly, the article referenced by the Grid Strategies report also notes that even if the project starts in 2023 and is completed in 2026 it will have been 17 years from conception to completion. While improvements in inter-regional transmission planning are promising, optimistically assuming readily available transmission capacity to import wind from neighboring regions as replacement capacity for the retirement of CUF is not realistic.

Importantly, TVA's 2019 IRP included a sensitivity case to assess the impact of low-cost wind. Assuming a cost of roughly half the base case, TVA's sensitivity analysis showed that 4,200 MW of wind could be economical and displace 3,100 MW of solar generation by 2038. The 2019 IRP analysis of wind provided the key conclusion that if wind costs decline significantly compared to alternative resource options and there is access to a higher wind capacity factor, then wind can be a viable replacement for future capacity retirements. At this time, however, onshore wind is not economic compared to alternative resources. Therefore, TVA is focused on the near-term addition of up to

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4 Based on the average of Class 4 and Class 6, the NREL wind overnight costs also excluded transmission interconnection costs

5 2019 cost estimate in 2019$, from NREL's 2021 Annual Technology Baseline

6 2021$

7 This is a conservative estimate based on 2019 costs. TVA's 2019 IRP modeled wind costs increasing at a rate moderately below inflation while NREL cost forecasts decline significantly over the planning horizon. These differences in expected future costs would result in a larger capital cost difference in future years.

8 The Southern Cross transmission project is proposed to be a 400-mile high-voltage direct current line from Texas through Louisiana and Mississippi to western Arkansas

8,000 MW solar by 2028, 2,400 MW of battery storage by 2028, and adding dispatchable gas generation to prepare the system for higher levels of renewable energy.

Energy Efficiency

By 2028, TVA's demand-side resource portfolio is expected to include up to 1,800 MW of peak reduction capabilities. However, the Synapse and Grid Strategies reports argue that more savings are available at a low cost. The Grid Strategies report assumes the costs of energy efficiency will be $10-$25/MWh[9] while the Synapse report assumed a cost of $27/MWh[10]. Neither the Grid Strategies report nor the Synapse report provide specifics about which end use measures or delivery mechanisms could be used to achieve future energy savings and instead rely on broad expectations based on backward looking data references. Contrary to those assumptions, historical energy efficiency performance and costs are not a reliable indicator of the future. As low cost and low investment measures are exhausted, such as light-emitting diode (LED) lighting, and other efficiency building codes and appliance standards usurp utility energy efficiency offers, future utility programs are likely to be much more costly with fewer savings than historically experienced.

The Synapse report incorporated two major assumptions regarding energy efficiency into its modeling with regards to the Clean Portfolio Replacement scenario. First, the assumption about the highest adoption case of behind-the-meter solar and storage and second, the inclusion of an energy efficiency portfolio reaching and maintaining 1% incremental annual energy savings. For the behind-the-meter solar and storage impacts, the Synapse report relied on TVA's 2019 IRP estimates, but it appears the Synapse report did not include the cost to drive those levels of adoption. Importantly, TVA's 2019 IRP estimates of behind-the-meter solar and storage adoption rely on TVA providing programmatic incentives to participating customers which cover the full incremental cost of the installations. The present value of those costs over the planning period total $479 million, a meaningful amount assumed away in the Synapse report.

Next, for the assumptions about future energy efficiency savings and costs, the Synapse report relied on a study covering 2011-2017 to support its cost estimates and a study of 2020 utility program performance to support its future energy savings targets. A mainstay of historical utility energy efficiency programs was compact fluorescent lamp (CFL) and LED lighting upgrades. However, electric utilities are now competing with market transformations and federal efficiency standards for future energy savings. That trend will also likely impact commercial lighting savings from LEDs. In fact, the IRA allotted $1 billion to assist the adoption of more efficient building codes; a change that would significantly reduce future savings opportunities for utility-sponsored energy efficiency programs. Energy savings outside the lighting category tend to have higher rebates as well as higher

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9 Grid Strategies report, page 29

10 Synapse report, page 30

out-of-pocket matches from participating customers. Furthermore, if utilities continue to allocate more energy efficiency resources towards disadvantaged communities, then the future costs of savings will be significantly higher as those program designs include significantly higher rebates and are not necessarily required to be cost effective. Connecticut is a concrete example of a recently approved energy efficiency plan[11] to demonstrate this point. Connecticut has been rated in the top 10 on the American Council for an Energy Efficient Economy's scorecard for more than a decade. Importantly, Connecticut's most recently approved electric energy efficiency plan for 2022-2024 includes annual savings of 0.7% of load with a first-year cost of $1.05 per kWh. The Synapse Clean Replacement Portfolio scenario assumed energy savings would begin at 0.1% of load and ramp up to 1% by 2035. Being conservative and starting with $0.2225 per kWh first-year cost[12] and ramping up to and continuing at an inflation adjusted[13] $1.05 per kWh first-year cost in 2032 (when annual savings reach 0.7% of load) would increase the planning horizon present value cost to Synapse's Clean Replacement Portfolio by $8.1 billion[14] and would result in an *annual* budget of $2 billion in 2035 to achieve 1% savings, which would then continue in perpetuity.

The Grid Strategies report made similar assertions about the availability of low-cost energy efficiency. To support its levelized cost range of $10-$25 per MWh for energy efficiency, the Grid Strategies report referenced a figure in TVA's 2019 IRP. While it is true TVA's estimates for commercial and industrial energy efficiency costs are within the levelized $10-$25 per MWh range, it is also true the residential energy efficiency levelized cost range exceeded $250 per MWh, a fact the Grid Strategies report failed to acknowledge. Moreover, the amount of savings available at those cost levels in TVA's 2019 IRP was constrained to reflect adoption limitations with the underlying delivery strategies and incentive levels. This point was entirely ignored by the Grid Strategies report, which referenced the same source as the Synapse report to support the assertion that more energy efficiency savings were readily available.

In response to feedback during the 2019 IRP process, TVA analyzed a sensitivity case of adding significantly more energy efficiency and demand response. The analysis indicated that about 2,100 MW of additional demand-side resources were economically reasonable compared to the base case if higher volumes could be realized at the assumed costs. In the model, the additional demand-side resources displaced about 2,200 MW of solar and about 2,000 MW of combustion turbine capacity. The overall results showed a similar lifetime cost, higher system average cost, and 10 percent lower

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11 https://portal.ct.gov/-/media/DEEP/energy/ConserLoadMgmt/Final-2022-2024-Plan-to-EEB-1112021.pdf

12 The equivalent first year cost per kWh for the levelized cost of 2.7 cents per kWh, using an 8% discount rate (consistent with TVA's 2019 IRP) and 12-year useful life (consistent with the Synapse report)

13 Assuming 2.5% inflation

14 Assumes the Synapse report multiplied the annual cumulative savings by $0.027 per kWh for each year of the planning horizon

carbon emissions. The sensitivity case clearly demonstrated the amount and cost of the demand-side savings is an important factor that will drive the amount of future resources needed, which is also why TVA is actively conducting a market potential study to inform the future of its energy efficiency and demand response portfolio.

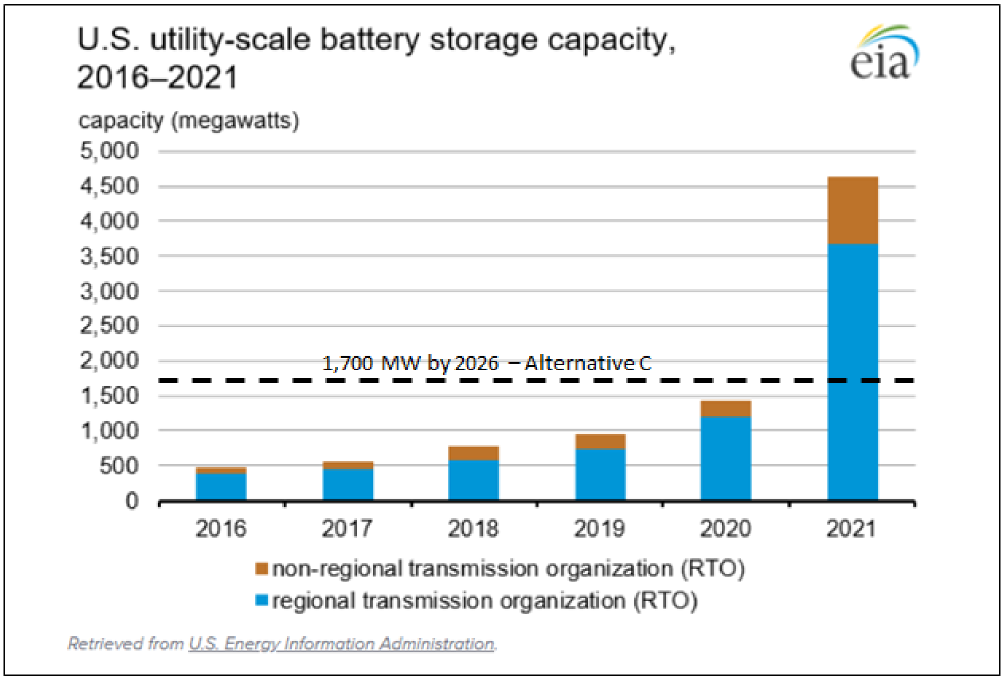
Storage

Storage is a meaningful element of TVA's future resource additions. The 2019 IRP range includes battery storage up to 2,400 MW by 2028 and up to 5,300 MW by 2038 (depending on technology costs, performance, and load growth). The Grid Strategies report characterizes batteries as a resource akin to a baseload generating resource capable of providing baseload energy and capacity across a majority of hours, while the Synapse report adds 32,000 MW of battery storage plus nearly 30,000 MW of solar in the Solar/Storage Replacement scenario. To put this in context, the 2042 TVA winter peak with reserve margin is roughly 40,000 MW being served by 29,100 MW of other generation resources (nuclear, gas, hydro, and behind-the-meter solar) and the Synapse model needed an additional 30,000 MW of solar and 32,000 MW of battery storage to meet the energy and demand needs of the system; meaning there would be 91,100 MW of nameplate capacity to serve 40,000 MW of peak winter demand.

While battery storage is making technological advancements, industry understanding and modeling of how large amounts of battery storage will impact the grid is based on limited experience. In 2019, the U.S. Energy Information Administration indicated there was a total combined battery storage capacity of about 1,000 MW which grew to 1,500 in 2020 and then to over 4,500 in 2021.[15] As part of Alternative C, adding 1,700 MW of storage by 2026 for the CUF retirement would result in TVA adding, owning, and operating more battery storage capacity over the next 4 years than the entire United States had in 2020. The figure below illustrates how historical battery storage adoption across the U.S. compares to Alternative C and gives further context to the already significant battery storage ranges in TVA's 2019 IRP.

15 Data from the *Annual Electric Generator Report*

Figure 3: EIA U.S. Utility-Scale Battery Storage Capacity 2016 - 2021



In assessing the economics of adding battery storage to the TVA portfolio of resources over the twenty-year forecast period, the Synapse report relied on NREL's battery storage costs estimates. In characterizing battery storage, NREL selected a fixed operations and maintenance expense (FOM) for battery storage and assumed it would be sufficient to maintain the battery's design capacity over its useful life. However, NREL noted: "If the battery is operating at a much higher rate of cycling, then this FOM value might not be sufficient to counteract degradation."[16] This highlights the uncertainty inherent in the Synapse report's conclusions and undermines the Grid Strategies report assumptions about the long-term capabilities of batteries. As an analogy, consider tips and guidance on how to prolong the life of an electric vehicle battery. A recent AAA article recommended the following practices to prolong vehicle battery life: opt for slow charging, when possible, keep the battery charge comfortably above zero, limit how often you fully charge the battery, and pay attention to the battery temperature[17]. These electric vehicle operation strategies differ moderately across vehicle manufacturers, but they all support the common conclusion that how batteries are used and charged directly impacts performance and longevity.

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[16] Cole, W., Frazier, A., Augustine. *Cost Projections for Utility-Scale Battery Storage: 2021 Update.* NREL. June 2021. https://www.nrel.gov/docs/fy21osti/79236.pdf.

[17] https://mwg.aaa.com/via/car/how-extend-life-electric-vehicle-batteries

NREL's 2038 'Moderate' estimate for FOM expense for a 4-hour capable battery is about $28 per kW year (in 2038$[18]), which means the annual FOM expense for 32 GW of batteries in 2038 from Synapse's Solar/Storage Replacement scenario would be $902 million. To understand the uncertainty of FOM alone, it is important to understand NREL's FOM cost estimate is assumed to be a static 2.5% of the battery cost in each of NREL's FOM scenarios and instead the FOM ranges vary proportionally with capital cost.

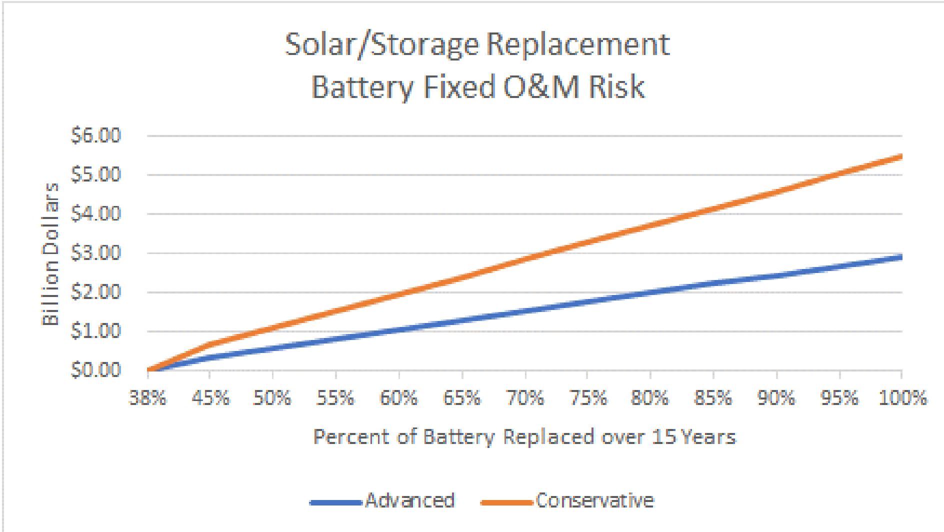
While battery storage has the potential to provide important system benefits, neither the Synapse report or Grid Strategies report appear to consider battery performance specifications and/or specify a technology. Battery storage technology and performance factors are critically important to system reliability and stability. For instance, a battery's useful life is impacted by the number of times it is cycled (i.e., how many times it is dispatched) and the depth of those discharges (i.e., how much of its capacity is used when it is dispatched). It is logical to assume that as the more battery capacity is relied upon for peak load needs and system reliability needs, they will experience more cycles and deeper discharges. In particular, the Solar/Storage Replacement scenario from the Synapse report would rely heavily on batteries for peak loads and system reliability needs.[19]

The figure below directly illustrates the FOM risk of reducing battery storage life through increased operational use. NREL assumes a 2.5% annual FOM expense which implies over the 15-year life of the battery, 37.5% of it has been replaced at some time during its life (conservatively assuming 100% of the FOM dollars go to new battery cells). The figure below shows how the FOM expenses increase relative to the base of 37.5% up to replacing 100% of the battery over its 15-year life. It is apparent for the Solar/Storage Replacement scenario, which includes 32 GW of battery storage, the FOM uncertainty alone could increase the costs of the scenario materially.

[18] NREL's 2021 Annual Technology Baseline provided utility scale battery storage costs in 2019$. The 2019$ amount is about 18 per kW and applying an annual 2.5% inflation factor results in about $28 per kW.

[19] The Synapse report appears to assume running a base case portfolio through a production cost model that solves for enough resources, including imports, is sufficient to support a statement that the scenario provides the same level of reliability as portfolios with natural gas generation. Such a conclusion must rely on side-by-side stress testing of the portfolios with variations in inputs as well as assessing performance metrics beyond the present value of revenue requirements.

Figure 4: Battery Fixed O&M Expenses, Advanced and Conservative Cases



Summary

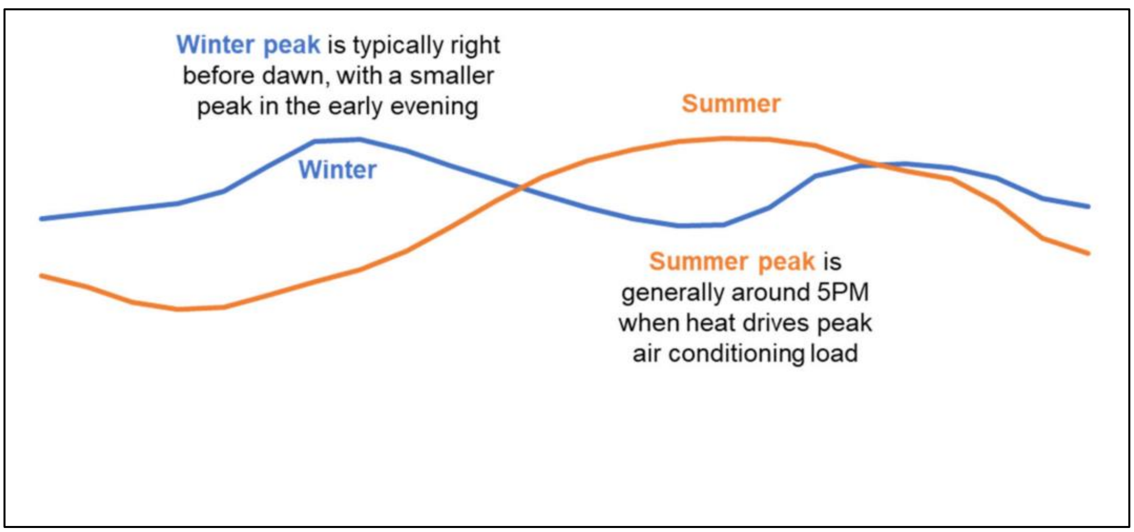
Cost-effective future resource plans that exclude natural gas rely on compounding assumptions, which are favorable yet unrealistic. This section highlights the need to evaluate a range of resource portfolio strategies over iterations of future scenarios with a multitude of critical inputs and sensitivities, and then evaluate the performance using pertinent metrics. Strictly focusing on idealized long-term future assumptions is not a persuasive methodology to reset TVA's overall resource direction and strategy, which is methodically outlined in its 2019 IRP.

OBSERVATION #4: NEAR-TERM DEPLOYMENT OF COMBINED CYCLE PROVIDES A SOLID FOUNDATION FOR AGGRESSIVE RENEWABLE ENERGY DEPLOYMENT

A reliable flow of power to our electricity grid is no longer the only measure by which customers assess the performance of their electric utility. Customers are increasingly demanding that electricity supply be both reliable and clean. Adding solar and wind resources achieves environmental objectives, but when the sun isn't shining or the wind isn't blowing, other types of generating resources are needed to maintain critical grid reliability. A diverse energy mix offers reliability and resilience, which has proven to be particularly valuable during difficult operating conditions, such as peak power demand during high summer or bitter cold during deep freezes. The optionality offered by a diverse portfolio of generating resources also supports affordability. Should the price of one fuel spike, or should bad weather compromise the supply of one power source, another lower cost option can be substituted, holding down energy prices for consumers.

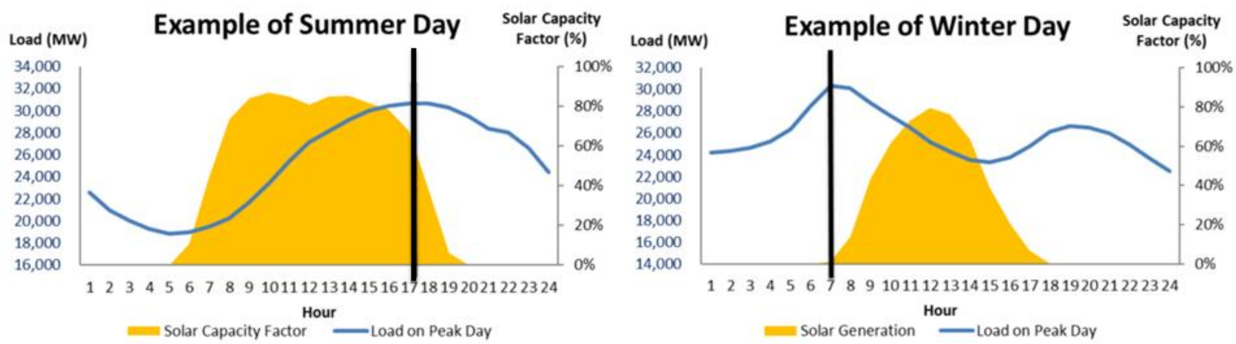
In operating a reliable system, the goal is to have enough capacity available to meet peak demand. As shown in Figure 5 below, the TVA winter peak occurs at approximately 7am, while the TVA summer peak occurs at approximately 5pm.

Figure 5: TVA Winter and Summer Peak Day Load Profiles



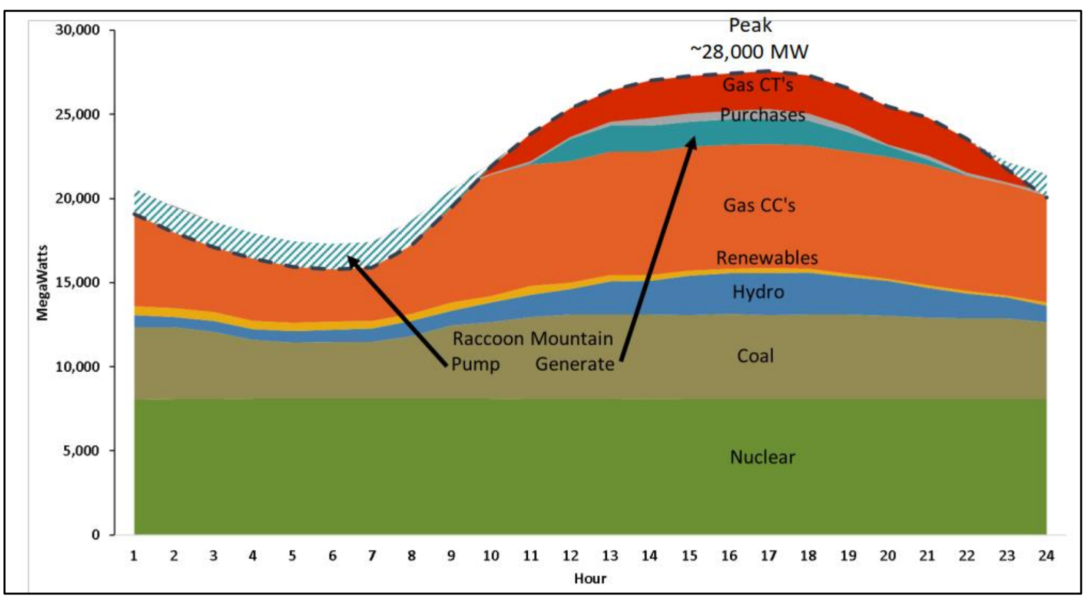
As can be seen below, solar output is declining as the summer peak hour approaches; and, although solar output increases later in the morning during the winter, it is completely unavailable for the near peak pre-dawn loads.

Figure 6: Solar Output on Peak Summer and Winter Days



Wind output also mismatches with these peak loads, with summer wind output at 14% of its capacity at the time of summer peak and 31% of its capacity at the time of winter peak. This mismatch in solar and wind output compared to peak demand requires that other resources, including nuclear and fossil resources, be available for dispatch to meet peak demand. As shown below, TVA dispatches its diverse generating fleet of nuclear, coal, gas, hydro, and renewables by both availability and cost. In the lower load hours, these resources are sufficient to meet customer demand. However, in the peak hours, gas fired units are crucial in meeting peak demand in the summer and winter.

Figure 7: TVA Load Dispatch on a Typical Summer Day



The broader industry has been exploring the place wind and solar have in the evolving grid. Importantly, there is no bulk power system operating today with significant penetration of wind and solar resources, limiting the ability to learn from others. These resources differ from fossil and nuclear generation in that their ability to produce power is dependent on the weather, which creates uncertainty in terms of their availability. Also, these machines' electrical properties are unique from those traditionally built in that they are inverter based (i.e., electronically connected to the grid rather than mechanically connected).

Due to environmental mandates requiring "clean" generating resources by a certain date, and the uncertainty around the impact of a high penetration of zero-emitting generating resources on the power system, system operators have conducted highly detailed studies to explore how wind and solar growth would affect reliability and resiliency. These studies, as further described below, have shown that the complexity of renewable integration escalates with the growing penetration of renewable energy, requiring significant physical and operational changes to the bulk power system. Over some renewable penetration ranges, complexity is constant when spare capacity and flexibility exist. However, at specific penetration levels, complexity rises dramatically as the excess capacity and flexibility are exhausted. These represent system inflection points, where the underlying infrastructure, system operations, or both need to be significantly modified to reliably achieve the next tranche of renewable deployment.

MISO undertook an assessment to systematically find system integration inflection points driven by increasing renewable integration.[20] The MISO assessment found that when the percentage of annual load served by renewable resources is less than 30% system-wide, the integration of wind and solar faces challenges but appears manageable with significant changes to transmission expansion, operating, market, and planning practices within the existing framework. Above the 30% level, significant system-wide complications arise, driven by the increased variability of wind and solar, changes in resource availability, and an overall lack of transmission capacity in the region. Addressing these complications through system upgrades and operational changes can enable the grid to be operated reliably with up to 50% of the energy served by wind and solar resources.[21]

In addition, NREL conducted a study to analyze the effects of increased wind and solar penetration on the operation of the bulk power system and found that estimated U.S. electricity demand in 2050 could be met with 80% of generation from renewable electricity technologies with varying degrees of dispatchability. However, this amount of renewables generation on the system would require a mix of flexible conventional generation and grid storage, additional transmission, more robust load response measures and changes to power system operations. While this analysis suggests such a high renewable generation future is possible, a transformation of the electricity system would need to occur to make this future a reality. This transformation would involve every element of the grid, including adequate planning and operating reserves, increased flexibility of the electric system,

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20 MISO's Renewable Integration Impact Assessment Summary Report, February 2021.

21 Id., page 13.

expanded multi-state transmission infrastructure, development and adoption of technology advances, new operating procedures, evolved business models, and new market rules.[22]

TVA's Planning Incorporates the Dynamic Impacts of Increasing Renewables

In order to underpin TVA's 2019 IRP to understand detailed system outcomes under a wide range of operating conditions, Astrapé was retained to build and run the Strategic Energy and Risk Valuation Model (SERVM) model to assess reserve margin and loss of load impacts from the addition of increasing level of renewables on the system. The model reflects more than 30 years of historical load and weather relationships, demand-side resource operating constraints, details about the operating capabilities of TVA's existing supply-side generation resources, weather impacts on hydroelectric generation capabilities, ancillary service requirements, specific operating reserve requirements, as well as import and export constraints for 20 zones of neighboring systems. The model is capable of hourly and sub-hourly simulations providing rich insights to real-world operational outcomes.

Beyond reserve margin analysis, loss of load modeling in SERVM is a useful methodology to determine capacity levels needed from renewable resources because it accounts for the dynamic effects of adding renewables while ensuring overall reliability targets are achieved. In fact, the capacity levels of solar and storage needed in Alternative C were modeled using this approach. First, TVA modeled the solar capacity needed to replace the lost generation from a retired CUF unit which resulted in 3,000 MW of solar capacity with a 22% capacity factor to replace the CUF generation.[23] Then, the SERVM model was run with the 3,000 MW of solar to determine the level of battery storage needed to maintain the industry reliability standard of a one-day-in-ten years loss of load event, resulting in 1,700 MW of battery storage capacity needed. In contrast, the dynamic reliability effects of adding a dispatchable combined cycle plant are expected to be less than adding increased renewables resources and the loss of load modeling is not a necessary step to determine the combined cycle capacity amount. Further, combined cycle units have much larger ranges of modularity than renewable resources and it was determined a two-unit combined cycle plant with a 1,450 MW capacity would be sufficient to meet reliability requirements. For instance, the next capacity increment of a combined cycle plant would be another 725 MW, far more than the amount needed. Finally, combined cycle units do not have the same energy limitations as batteries, which have typical durations of 4 hours. Combined cycle units can run across many hours and days to support prolonged periods of high loads, which reduces relative risk for a loss of load event.

The Grid Strategies report highlighted concerns about the addition of combined cycle generation to replace the retired CUF generation in terms of natural gas reliability and correlated outages. In fact,

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22 National Renewable Energy Laboratory Renewable Electricity Futures Study, 2012.

23 Note the Draft EIS stated 'approximately 25%' while the underlying analysis reflected a 22% capacity factor based on TVA's system experience with existing solar resources.

TVA's natural gas generating fleet has several advantages that mitigate the risk of fuel supply outages in its natural gas generating fleet. According to TVA's 10-K filing for the fiscal year ending September 30, 2021:

- 80 of TVA's combustion turbines (about 80%) were dual-fuel capable, and TVA has fuel oil stored on each of these sites as a backup to natural gas.
- Transportation of natural gas occurs across nine separate pipelines, with approximately 66 percent being transported on two pipelines.
- Approximately 1,517,000 million British thermal units is maintained per day of firm transportation capacity on seven major pipelines, with approximately 59 percent of total firm transportation capacity being maintained on two pipelines.
- TVA utilizes natural gas storage services at seven facilities with a total capacity of 7.25 billion per cubic feet (Bcf) of firm service and 5.00 Bcf of interruptible service to manage the daily balancing requirements of the nine pipelines used by TVA, with approximately 59 percent of the total storage capacity being maintained at two facilities. During 2021, storage levels were generally maintained at between 40 and 80 percent of the maximum contracted capacity at each facility. As TVA's natural gas requirements grow, it is anticipated that additional storage capacity may need to be acquired to meet the needs of the generating assets. In 2022, TVA expects to increase its storage portfolio by approximately 10 percent.

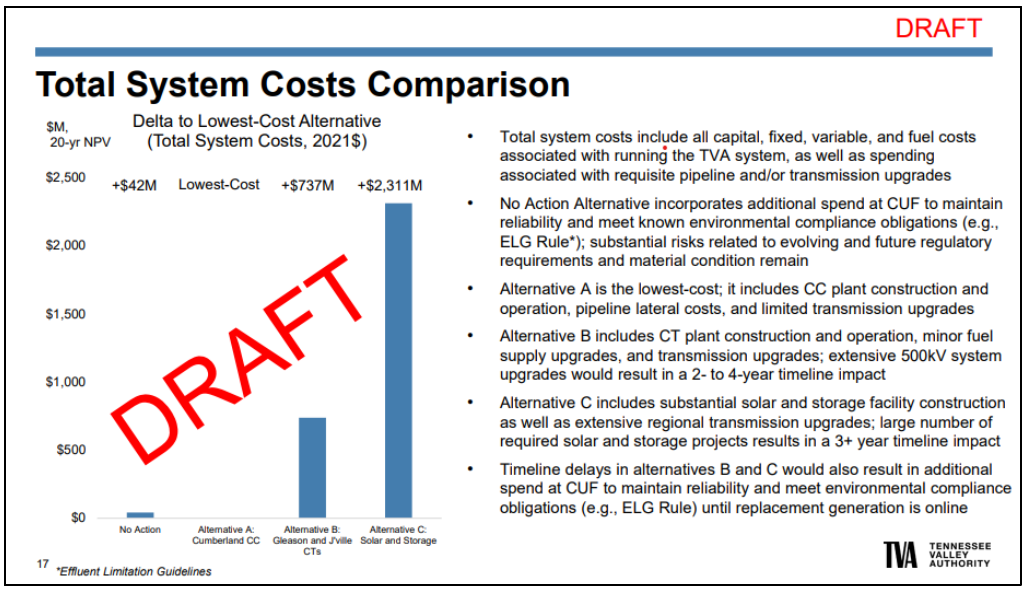
Summary

A diverse generation portfolio offers reliability and resiliency benefits and is particularly valuable during challenging operating conditions, like peak power demand during high summer temperatures or bitter cold during deep freezes. Industry studies have shown that the complexity of renewable integration escalates with the growing penetration of renewable energy. Flexible and dispatchable resources will be critical to meeting system reliability and resiliency needs, as TVA increases the renewable resource capacity on its system. Near-term deployment of combined cycle generation under Alternative A provides a solid foundation for aggressive renewable energy deployment while accelerating the retirement of TVA's coal fleet.

CONCLUSION: ALTERNATIVE A IS A PRACTICAL AND REASONABLE NEAR-TERM IMPLEMENTATION PLAN

The retirement of the CUF unit is not controversial. Instead, the issues are about how much and what types of replacement capacity should be used. The figure below shows the lifetime cost differences between the alternatives presented in the Draft EIS. It is apparent Alternative A is the least-cost outcome while conversely Alternative C is the costliest alternative. A significant value driver of Alternative A is that it can be implemented quickly, resulting in an earlier retirement of CUF and displacement of more costly generation resources serving load. The following discussion contrasts the implementation characteristics of Alternative A and Alternative C, which supports the modeling timelines within the figure below.

Figure 8: Cost Comparison of Alternatives[24]



Feasibility of Alternative A

Alternative A includes a proposed combined cycle plant at the existing Cumberland site which allows for a readily available transmission interconnection and requires a 32-mile natural gas pipeline extension. The site work would begin in 2023 while the physical construction would begin in the fall of 2023 with commercial operation as early as the summer of 2026. Alternative A was identified as TVA's preferred alternative in the Draft EIS in part because it has several factors that reduce execution risk; some of which center around the Cumberland Reservation being an existing

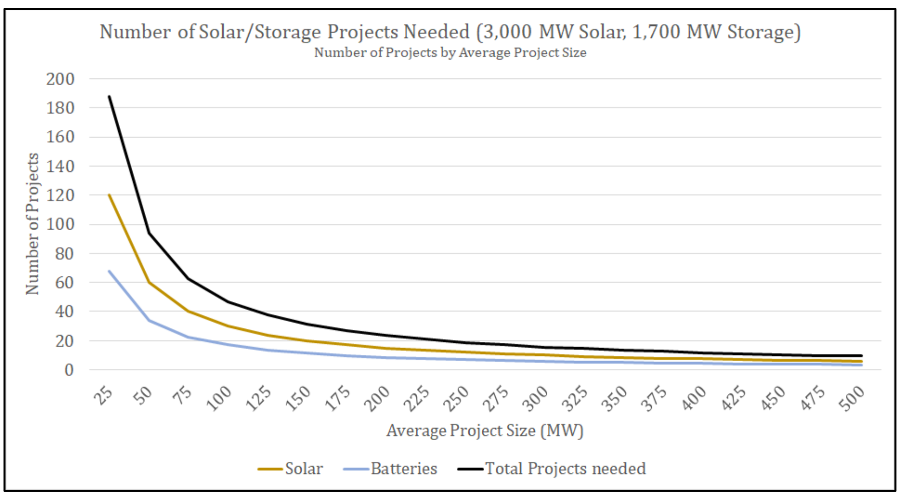
24 https://tva-azr-eastus-cdn-ep-tvawcm-prd.azureedge.net/cdn-tvawcma/docs/default-source/environment/cuf_eis_alternativesevaluation_20220423-vfinal21a071b9-0fd1-4a8a-841a-8d9e74ba3ba5.pdf?sfvrsn=a7efe477_5

brownfield generation site. The brownfield location allows for repurposing existing resources and infrastructure while concurrently avoiding the need to supplement the existing transmission once CUF is shuttered. It is noteworthy that combined cycle natural gas plants are a mature technology with 42 GW installed from 2015 through 2022 in the United States.[25] Alternative A would certainly reflect the risks of typical major construction projects; even so, the project timelines and scope appear to be achievable given general expectations about how long it takes to complete a project of this nature.

Feasibility of Alternative C

Alternative C requires 3,000 MW of solar plus 1,700 MW of battery storage. In this alternative, the specific projects and accompanying locations to provide the necessary capacity are not known at this time. Further, it is unknown how many projects would be needed because the size of each project can vary with its location and design. To illustrate the challenge, the figure below shows the number of projects needed based on average project size. TVA's current interconnection queue for solar and storage indicates an average project size of 138.5 MW which would require 34 projects to achieve a combined 4,700 MW of solar and storage capacity. In addition, even if the average project size is larger, the number of projects implemented could be higher because the portfolio of projects could be comprised of many smaller projects along with a few much larger projects. To complicate the task further, each of the projects would have unique project development timelines, studies, and environmental impacts.

Figure 9: Solar and Storage Projects Needed for Alternative C

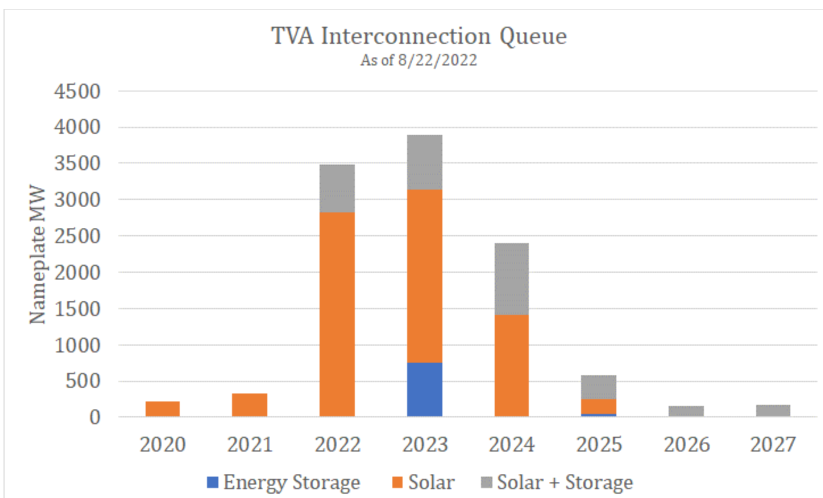


The backdrop for near-term decisions is TVA's 2019 IRP and strategic direction outlined in the subsequent Strategic Intent and Guiding Principles (May 2021) document, so it is important to consider TVA's broader plan to add up to 10,000 MW of solar by 2035, complemented with storage.

25 U.S. Energy Information Agency, Electric Power Annual 2020 published March 2022, Table 4.8.A

Alternative C requires an additional 1,700 MW of battery storage and 3,000 MW of solar by 2026 on top of these planned additions. The figure below shows TVA's interconnection queue for solar and storage by year. The data shows a total of 822 MW of proposed storage projects and possibly another 1,168 MW of storage if 38%[26] of the solar/storage projects are battery storage capacity. Additionally, TVA's 2021 10-K includes nearly 250 MW of battery storage under Power Purchase Agreements (PPA) with power delivery expected to commence in either 2023 or 2025. Therefore, with only 1,740 MW of battery storage remaining in the queue, TVA would need every single storage project to be completed on schedule to support Alternative C; leaving no battery storage capacity available to complement the large amounts of planned solar additions. Moreover, the total solar capacity in TVA's interconnection queue is 10,400 MW with 6,561 of those megawatts having completed a system impact study. Per TVA's 2021 10-K, TVA has nearly 2,000 MW of solar PPAs and self-directed solar projects planned with power delivery expected to commence between 2022 and 2025. While there are more planned solar projects than storage, TVA's interconnection queue demonstrates that its planned levels of solar will need a significant portion of proposed solar projects to be completed; and even so, those levels could be insufficient to meet the needs of both the CUF retirement as well as keeping TVA on track to reach up to 10,000 MW of solar by 2035.

Figure 10: TVA's Interconnection Queue



Interestingly, there are still projects from 2020 in the queue that have not been completed which highlights the fact that not all projects get completed and not all projects get completed on schedule. The current TVA interconnection queue[27] shows, on average, it takes 3.25 years from the time a solar

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[26] The interconnection queue only provides the total capacity for each project. It is assumed that the capacity reported is the capacity of the solar arrays with an unknown amount of storage. For estimation purposes, 38.5% was used based on NREL's 2021 Annual Technology Baseline solar plus storage project being characterized as 130MW of nameplate solar plus 50 MW of battery storage capacity.

[27] As of August 22, 2022

and/or storage project is listed in the queue until the time it is forecasted to be in-service. In addition, recent major solar projects that TVA has contracted with were completed, on average, 1.6 years behind the initial in-service provided when the project entered the interconnection queue. This indicates it is reasonable to expect (or at least plan for) solar and storage projects to take close to 5 years from the time a project joins the interconnection queue to the time it is commercially operational, on average. To further highlight the risk of taking the interconnection queue forecasted in-service dates at face value, as of August 22, 2022 there were 3,344 MW of solar projects having completed a system impact study and expected to be in-service before September 30, 2022 (and by 2021 yearend); only one project of 147 MW was listed as in the construction phase.

In addition to the complexity and scale of project development for Alternative C, the accompanying transmission and distribution upgrades have not been fully studied, primarily because the location of the new solar and storage projects are not fully known. In fact, those system impact studies are an important part of the interconnection process. Further, the Draft EIS indicates transmission upgrades could be needed at the CUF site to support system stability while additional transmission support for the Nashville area could be needed. In contrast, the Grid Strategies report assumes no transmission upgrades would be necessary because a combination of solar, battery storage, and other devices like a synchronous condenser can be installed in strategic locations to avoid costly system upgrades. To the contrary, because power plant retirements fundamentally change the flow of power on the transmission system, a holistic analysis of the transmission system is needed to confirm the necessary remedies. In the meantime, it is reasonable to expect transmission upgrades will be needed; especially for the retirement of CUF, one of the top ten largest coal plants in the U.S.

Summary

There is alignment about the retirement of CUF, which will result in additional capacity additions. Adding natural gas combined cycle generation to the exiting Cumberland site is an executable and reliable plan within the required timeframe, resulting in the accelerated retirement of a large coal unit. In contrast, adding significant near-term amounts of solar and storage beyond TVA's stated intention of up to 10,000 MW by 2035 would exhaust or go beyond TVA's current interconnection queue, requiring TVA to find resources outside its control area and heightening the risk of needing transmission upgrades to support system stability with the retirement of CUF.

Furthermore, as the Synapse report recommends, changing courses entirely and orchestrating a symphony of assumed capabilities and costs of energy efficiency, solar, wind, and batteries along with the accompanying transmission and distribution upgrades is simply not viable or based on a rigorous approach that meets system reliability requirements. TVA's thorough and broad long-term planning consistently identifies the need for natural gas generation, along with solar and storage, while the long-term amounts will be driven by future market conditions.

SUPPLEMENTAL OBSERVATION: THE INFLATION REDUCTION ACT INFLUENCES THE AMOUNT AND TIMING OF RESOURCES WITHIN THE RANGES CONTAINED IN THE IRP

TVA's 2019 IRP considered a wide range of strategies, scenarios, and sensitivities. As a result, TVA's long-term plans reflect ranges of future resource needs anticipating the need to adjust resources levels up or down depending on market conditions at the time of the decision. The comprehensive impacts of the IRA are uncertain and will take time to fully understand. Even so, because TVA's analyses explored a wide range of possible future outcomes, questions about the effects of the IRA can be qualitatively assessed by considering whether the potential impacts would trend resource amounts higher or lower within the 2019 IRP ranges. To that end, the figure below summarizes the potential IRA impacts to the level of future resources within the 2019 IRP ranges.

While the IRA impacts must be more fully modeled and explored, fundamental concepts and conclusions remain unchanged, such as the escalating complexity of adding renewable resources, the need for broad and rigorous analyses, and ultimately the need for dispatchable generation as part of a diverse and reliable generation portfolio. From a near-term perspective, the practicality of Alternative A over Alternative C is unchanged. While the IRA would improve the economics for Alternative C, the cost improvements would not eliminate its implementation barriers.

Figure 11: Potential Impacts Within 2019 IRP Resource Ranges

Resource Type	2019 IRP Range	Potential IRA Impact Within 2019 IRP Resource Ranges
Peak Demand	-0.7% to 1.7%	Uncertain net impact: load growth by electrification and focus on domestic manufacturing offset by load reductions from building codes and efficiency funding
Solar	Up to 14 GW	Uncertain net impact: improved wind economics reduce solar within the range, improved solar economics increase solar within the range, net load impacts are uncertain
Storage	Up to 5 GW	Trend up within the range if storage economics sustainably improve
Wind	Up to 4.2 GW if economic	Trend towards adding wind to the portfolio with the amount and timing uncertain, additional wind reduces solar, transmission uncertainties largely unchanged
DSM	Up to 2.1 GW if economic	Downward pressure: Federal funding for state administered programs and efficient building codes reduce utility sponsored opportunities
Combustion Turbine	Up to 8.6 GW	Downward pressure: trend lower within the range if more economic wind, trend lower within the range if battery storage is more economic, long-term gas prices are uncertain, net load impacts are uncertain, reliability needs unchanged or enhanced
Combined Cycle	Up to 9.8 GW	Downward pressure: trend lower within the range if more economic wind, trend lower within the range if battery storage is more economic, long-term gas prices are uncertain, net load impacts are uncertain, reliability needs unchanged or enhanced

WILLIAM (BILL) R. DAVIS
ASSISTANT VICE PRESIDENT

Mr. Davis is an energy industry professional with sixteen years of experience from a major Midwest electric and gas utility (Ameren). His career covers a variety of topics including load research, sales and revenue forecasting, integrated resource planning, project oversight, renewable energy standards, rate design, class cost of service studies, standby rates, demand-side resources pre-approval filings, demand-side resources market potential studies, implementation of energy efficiency portfolios, design of performance mechanisms for demand-side portfolios, lost revenue recovery, and prudence reviews.

PROFESSIONAL HISTORY

Concentric Energy Advisors, Inc. (2022 – Present)

Assistant Vice President

Ameren – St. Louis, MO (2005 –2021)

Director, Energy Solutions (2016 –2021)

Economic Analysis and Pricing Manager (2013 –2016)

Senior Corporate Planning Analyst (2011 – 2013)

Senior Load Research Specialist – Corporate Planning (2007 –2011)

Forecasting and Load Research Specialist–Corporate Planning (2005 - 2007)

Caterpillar Inc. – Peoria, IL (Feb. 2004 - May 2005)

Advanced Quantitative Analyst – Business Economics Group

EDUCATION

Illinois State University

Bachelor of Science in Economics (2002)
Masters of Science Degree in Economics (2003)

PROFESSIONAL EXPERIENCE

- Provided strategic direction for Ameren Missouri's energy efficiency and renewable energy programs. Responsible for the planning, implementation, and evaluation of Ameren Missouri's annual $50-$70 million energy efficiency portfolio
- Served as public spokesperson for energy efficiency on live or recorded television and radio.
- Responsible for meeting or exceeding Ameren Missouri's approved energy efficiency performance targets; resulting in annual $6-$13 million of additional revenue.

- Collaborated with regulators, interveners, including political and special interest groups, to obtain consensus, support, and/or regulatory approval
- Analyzed the economic and financial impacts of regulatory and legislative initiatives
- Developed and analyzed pricing options for Ameren Missouri's retail customers.
- Led cross-functional projects including workgroups such as budgeting, demand-side management, regulatory, legal, forecasting, power operations, transmission and distribution planning, treasury, environmental, renewables, and power trading
- Team leader to implement a custom application that automated and streamlined project oversight reporting and workflows
- Provided oversight for projects in excess of $10 million to ensure projects follow proper project management procedures and reduce risk associated with project execution
- Acted as a change agent to drive behavioral changes in project management practices
- Provided expert testimony to the Missouri Public Service Commission in Ameren Missouri's electric rate case regarding a proposal to mitigate the negative financial effects to the company caused by the implementation of energy efficiency programs
- Championed the analysis and adoption of a new residential rate design for Ameren Missouri's natural gas distribution business that significantly reduced the volatility of revenues and prevented a sustained annual revenue shortfall
- Provided quantitative analysis and recommended actions directly to Ameren executive leadership regarding long-term resource and regulatory decisions
- Team leader for Ameren Missouri's 2011 Integrated Resource Plan which provides the long-term direction for future demand-side and supply-side resource decisions
- Statistical modeling to forecast long-term electric and gas sales to support resource planning and budgeting. Other responsibilities include load research, sample design, weather normalization, margin impacts of weather, unbilled estimation, profiling, revenue/customer forecasting, regulatory support, and process optimization

Accomplishments

- Public Utilities Fortnightly Under 40 class of 2020. Public Utilities Fortnightly is the forum for stakeholders in utility regulation and policy and the Under 40 classes are a nomination-based recognition of rising stars in the public utility industry.
- 2019/2020 Leadership St. Louis Class. The Leadership St. Louis program is an immersive experience into the community to learn directly about regional challenges and opportunities.
- 2018 Zhi-Xing Eisenhower Fellow, one of nine Americans to spend 4 weeks in China for a cultural immersion and professional development experience. The Eisenhower Fellowship mission is to connect innovative leaders in a global network committed to creating a world more peaceful, prosperous and just.
- Leadership Missouri Class of 2014 graduate, which is a program hosted by the Missouri Chamber of Commerce designed to enhance leadership skills and deepen knowledge of the state's opportunities and challenges
- Project leader of an End-to-End Energy Efficiency Study which received Technology Transfer Award from the Electric Power Research Institute

SPONSOR	DATE	CASE/APPLICANT	DOCKET	SUBJECT
Illinois Commerce Commission				
Ameren Illinois Company	2012	Ameren Illinois	Docket No. 12-0244	Cost benefit analysis
Missouri Public Service Commission				
Union Electric Company	2010 2011	Ameren Missouri	Case No. ER-2011-0028	Alternative ratemaking approaches
Union Electric Company	2012	Ameren Missouri	Case No. ER-2012-0166	Revenue requirement and rate design
Union Electric Company	2012 2016	Ameren Missouri	File No. EO-2012-0142	Pre-approval, alternative ratemaking (energy efficiency)
Union Electric Company	2014 2015	Ameren Missouri	File No. ER-2014-0258	Rate design, pricing, cost of service
Union Electric Company	2014	Ameren Missouri	Case No. ER-2015-0132	Revenue requirement (energy efficiency)
Union Electric Company	2014	Ameren Missouri	File No. EC-2014-0224	Cost of service, pricing
Union Electric Company	2014	Ameren Missouri	Case No. EA-2014-0136	Renewable energy justification
Union Electric Company	2015 2016 2017 2018	Ameren Missouri	File No. EO-2015-0055	Pre-approval, alternative ratemaking (energy efficiency)
Union Electric Company	2015	Ameren Missouri	Case No. ER-2016-0131	Revenue requirement, incentive ratemaking (energy efficiency)
Union Electric Company	2015	Ameren Missouri	File No. ET-2016-0152	Pricing, Tariff design
Union Electric Company	2016 2017	Ameren Missouri	File No. ER-2016-0179	Rate design, cost of service study, tariff design
Union Electric Company	2016	Ameren Missouri	Case No. ER-2017-0149	Revenue requirement, incentive ratemaking (energy efficiency)

SPONSOR	DATE	CASE/APPLICANT	DOCKET	SUBJECT
Union Electric Company	2017	Ameren Missouri	File No. ER-2018-0144	Revenue requirement, incentive ratemaking, prudence review (energy efficiency)
Union Electric Company	2018	Ameren Missouri	Case No. ER-2019-0151	Revenue requirement, incentive ratemaking (energy efficiency)
Union Electric Company	2018 2020	Ameren Missouri	File No. EO-2018-0211	Pre-approval, alternative ratemaking (energy efficiency)
Union Electric Company	2019	Ameren Missouri	Case No. ER-2020-0147	Revenue requirement, incentive ratemaking (energy efficiency)
Union Electric Company	2020	Ameren Missouri	Case No. ER-2021-0158	Revenue requirement, incentive ratemaking (energy efficiency)

Appendix P – Cooperating Agency Comments

This document incorporates comments received from U.S. Environmental Protection Agency (USEPA) in response to their review of the draft Environmental Impact Statement (DEIS) and presents TVA's responses to those comments. The table below incorporates comments submitted via letter to TVA and those comments provided in the tracked change version of the Draft EIS submitted to EPA for review.

Response to EPA Comments on the Draft EIS Document

Section	Commentor	Comment	Comment Resolution/Updates to the Document
3.7	EPA	Recommend deleting this sentence, as it is not a relevant comparison. SF6 has 26000 times the global warming potential of CO2, and SF6 has a lifespan of over 3000 years. Hence, even very small amounts of SF6 contribute to climate change and most of the SF6 produced will eventually contribute. Irrespective of the relatively small onsite leaks, the lifecycle of SF6 starting from manufacturing, is what produces significant SF6 emissions. Hence, EPA has partnered with utilities to reduce and phase out the use of this pollutant, as have other countries. Given that the life of a switchgear is over 30 years – EPA suggests that TVA's upgrade of its system and installation of new switchgears represents the ideal time to switch to SF6-free switchgears, which would represent reasonable mitigation, and prevent over 30 years of production of additional SF6 for the TVA system. In addition, the SF6 free switchgears are reported to have lower operation and maintenance costs and higher reliability. EPA would be happy to connect TVA with further resources on SF6 free switchgears.	Sentence has been deleted from the DEIS.
3.7.1.1.6	EPA	DEIS should include any applicable General Conformity analysis in the DEIS or provide an explanation of why the analysis is not required.	Additional language added: General Conformity is discussed further in Section 3.7.2.3.1.2.
3.7.1.1.8.3	EPA	Consistent with the January 9, 2023, CEQ interim GHG guidance, EPA recommends that TVA avoid representing GHG emissions as a small fraction of global or domestic emissions, "because this approach does not reveal anything beyond the nature of the climate change challenge itself—the fact that diverse individual sources of emissions each make a relatively small addition to global atmospheric GHG concentrations that collectively have a large effect." https://www.federalregister.gov/documents/2023/01/09/2023-00158/national-environmental-policy-act-guidance-on-consideration-of-greenhouse-gas-emissions-and-climate	The DEIS has been updated to clarify that a geographic emissions analysis methodology was employed to illustrate the contribution of Kingston emissions to local, regional, and national GHG emissions and by comparing the anticipated contributions under Action Alternatives A and B.
3.7.2.3.1.2	EPA	EPA recommends revising this statement to more accurately disclose that the BACT requirements would only be applicable to CO in this case. It could be inferred that the facility would be required to apply BACT for all pollutants/equipment.	TVA expects to net out of BACT review for all pollutants except CO. The emissions of CO would be reduced through the use of Catalytic Oxidation (CATOX) emission control system. TVA is currently in discussions with the equipment vendor to see if CO emissions from the CATOX system can be further reduced so that KIF may "net out" of PSD review.

Response to EPA Comments on the Draft EIS Document

Section	Commentor	Comment	Comment Resolution/Updates to the Document
3.7.2.3.1.2	EPA	EPA recommends deleting or revising this statement, as in this context it is misleading given that the facility, under the preferred alternative, appears to net out of PSD for all pollutants but CO, and because the emissions from the preferred Alternative A are significant. Netting out of PSD review, for a grandfathered coal-fired facility of this size, does not ensure that air quality effects of the preferred alternative are not significant. Emissions of PM10, NOx, CO, VOC and CO2 are all above the PSD significance thresholds and would require modelling and BACT if the facility was a greenfield source and TVA was not shutting down a coal-fired plant that was never required to go through PSD. EPA recommends that the above be more clearly disclosed in DEIS.	See immediately preceding response to EPA's comments on this section. TVA has revised the language to state that ..."impacts will not exceed the NAAQS" as will be demonstrated through the permitting process and by meeting the requirements and limitations of the air permit issued by the permitting agency for the construction of the replacement generation. There will be a net reduction in emissions of all criteria pollutants compared to the existing coal plant operations, which is an air quality benefit. The net reduction in emissions is an appropriate measure for assessing air quality since TVA's proposed action is to retire and replace generation of the existing coal-fired plant.
3.7.2.3.1.2	EPA	It is unclear why TVA is using industry average capacity factors for emissions calculations, rather than TVA system forecasts for TVA Kingston under the proposed alternatives. 55% and 10% seem low given that these will be new state of the art CC and CT that TVA has indicated would displace older less efficient capacity elsewhere in the system and are needed for growth in the immediate region. The assumed low-capacity factors would seem to support that TVA could use natural gas capacity elsewhere in the system, such as Gallatin or Johnsonville, in the near term to allow time for long distance transmission grid updates (needed for renewables) and avoid the need for investment in and associated impact of a new 122 mile NG pipeline.	Since the individual GHG LCA evaluates each individual replacement resource option, it uses industry average capacity factors. The TVA system-wide LCA provides a more thorough and accurate view of overall GHG effects when comparing each alternative as it is based on simulated system-wide generation dispatch. It provides critical context into how the specific resource retirements and replacements, underpinning the assumptions of each of the Proposed Action Alternatives, integrate into the system overall. The system-wide comparison of emissions is the most effective way to accurately identify incremental emission differences between the alternatives because it illustrates how the entire TVA system is expected to operate with each alternative. Other sites that had existing gas were evaluated, including Gallatin and New Johnsonville, but were later dismissed from consideration due to several factors including the need for grid stability in the KIF area, the transmission upgrades or new construction that would be required, and additional environmental factors. Please see Sections 2.1.4, 2.1 and response to Comment 2 below for additional information.

Response to EPA Comments Submitted by Letter

Comment Number	EPA Recommendations	TVA Response
1	The EPA is concerned that the Draft EIS does not adequately explain why an alternative was not preserved that allows for the transitional and peaking capacity that TVA requires to bridge to renewable energy and that does not require the construction of a new 122-mile pipeline. Given the capacity of the TVA system, it is unclear why this transitional and/or peaking capacity cannot be generated at TVA sites that would not require this extensive investment in long-term pipeline infrastructure. The 2019 IRP and Alternative A may not be aligned with subsequent developments such as TVA's carbon commitments, nor the significant incentives under the 2022 IRA that make many of the alternatives to combustion turbines much more cost effective. The analysis does not fully account for expected cost decreases of renewable energy and higher future natural gas prices. Most experts expect the costs of renewable energy production and battery storage to continue to fall along the timeline of this project due to subsidies from the IRA and other market factors. Similarly, the price of natural gas is expected to increase over time, particularly as U.S. exports of natural gas continue to climb. Appendix I, for instance, conducts system-wide Lifecycle Analysis modeling to project future GHG emissions. The Draft EIS notes that this "system-wide LCA reflects TVA's broader asset strategy and target power supply mix set by the 2019 IRP." However, it does not present the assumptions that underlie the model or the modeled distribution of future power generation. Also, in its rejection of alternatives involving renewables and storage, the Draft EIS uses the Energy Information Administration's (EIA) 2022 Annual Energy Outlook data to compare Levelized Cost of Electricity (LCOE) for gas with battery storage. The EIA Annual Energy Outlook 2023 report has just been released, which accounts for the IRA and should provide an updated accounting of levelized costs of electricity storage (LCOS). However, if TVA uses the LCOE to compare renewables and CC natural gas, the load profiles must be consistent across the options for the comparisons to be valid. Including the IRA incentives, the correct comparison should be between renewables plus batteries with the appropriate load profile for each and CC natural gas with the same load profile. As EIA notes, LCOE does "not capture all of the factors that contribute to actual investment decisions, making direct comparisons of LCOE across technologies problematic and misleading as a method to assess the economic competitiveness of various generation alternatives" (https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf). EIA then enumerates the limitations of using LCOE alone. Rather, EIA suggests using Levelized Avoided Cost of Electricity (LACE), along with LCOE and LCOS, to "provide a more intuitive indication of economic competitiveness for each technology than either metric separately when several technologies are available to meet load."	Transitional and/or peaking capacity does not meet the purpose and need of placing 1500MW of firm, dispatchable power in commercial operation by the end of 2027 to replace the generation lost by retiring the Kingston coal units. Further, Alternative B, the renewables and storage alternative, that assesses the solar/battery option was not selected as the Preferred Alternative because it fails to fully meet the Purpose and Need to have replacement generation in commercial operation as it will not be feasible by 2027. Within the context of the DEIS, the reference to LCOE is used merely as an example to compare the cost of different resources. Please refer to the Alternatives Evaluation in Appendix B for TVA's resource cost assumptions and overall cost comparison of alternatives that led to the selection of the Preferred Alternative. Although additional regulatory guidance has been published between the 2019 IRP and this DEIS, these regulations, executive orders, and guidance have been evaluated and incorporated where applicable and where there is enough information available about how each particular regulation, order, or guidance will affect TVA's actions regarding its generation fleet. The 2019 IRP continues to align with Alternative A, the Preferred Alternative, of the Draft EIS. The Preferred Alternative would provide firm, dispatchable generation and would provide and enable the facilitation and the implementation of 10,000 MW of solar and additional BESS resources outlined in the target supply mix of the 2019 IRP. Additionally, please refer to Section 2.1.4 to see more information on Alternatives Considered But Eliminated From Further Discussion and Section 1.2.2 to see more information on the IRA.

2	The EPA recommends that TVA consider a reasonable range of alternatives that reduce the size of their future carbon liabilities. Only considering two alternatives fails to disclose the available options between those two "endpoints" of a natural gas facility and 100% renewable. Another alternative could provide a transition strategy (perhaps comprised of a combination of peak shaving, increased generation from other production units, energy efficiency, and demand-management) that bridges the gap before sufficient renewable energy generation can completely meet the required long term generation capacity. Another alternative could provide a transitional solution that continues to meet capacity requirements through other strategies until sufficient renewable energy generation is fully available. In the Letter Agreement and Schedule document from Dawn Booker, Alternative A includes a 3-5 MW solar site and a 100 MW battery storage site. This is a comparatively small use of solar and does not seem to reflect future forecasts of increasing use of renewables. Moreover, the description of Alternative A in the "Draft Air Quality & GHG" section does not include solar, and Appendix I does not include any solar-related calculations. The EPA recommends considering a more substantive solar and battery component with Alternative A. The EPA recommends that the solar facility and battery storage facility be appropriately reflected in the calculations supporting Alternative A. Additionally, the analysis should assess wind power as a viable part of the TVA system, as an alternative, or in combination with existing alternatives. Wind potential in the southeast is growing and as the costs of technology decreases, several modeling efforts find that an expansion of wind is optimal for this area. Wind energy resources: • https://www.nrel.gov/gis/wind-supply-curves.html • https://www.biologicaldiversity.org/programs/energy-justice/pdfs/TVAs-Clean-Energy-Future.pdf • https://www.rff.org/events/rff-live/future-generation-exploring-the-new-baseline-for-electricity-in-the-presence-of-the-inflation-reduction-act/?mc_cid=fb2ba4aca8&mc_eid=73413f18e1 If TVA believes that the models and experts are incorrect about wind potential in the southeast, the TVA analysis should provide its support for this determination and explain why wind power is not being evaluated.	This proposed action is one piece of TVA's overall Asset Strategy, which blends a combination of resource technologies to allow TVA to support affordable, reliable, and cleaner energy for its customers. TVA's asset strategy, as reflected in the target supply mix adopted by the TVA Board through the 2019 IRP, already contemplates the blending of resources to provide the least-cost, optimal portfolio under a variety of future conditions, including the addition of 10,000 MW of solar by 2035. A key beneficial result of TVA's Asset Strategy is the reduction of carbon emissions. See DEIS Sections 1.1 and 1.2. As discussed in detail in DEIS Section 1.1, this action is a specific, discrete component of that asset strategy and is consistent with the need established by the 2019 IRP to establish new capacity in the TVA region, increase reliability and flexibility, increase energy efficiency, and meet TVA energy production goals. In conducting an alternatives analysis, agencies must "[e]valuate reasonable alternatives to the proposed action, and for alternatives that the agency eliminated from detailed study, briefly discuss the reasons for their elimination." 40 CFR § 1502.14(a). An agency must consider a reasonable number of alternatives, which are bounded by the purpose and need for the proposed agency action. Id. at § 1502.14(f), § 1502.13; see also Coal. for the Advancement of Reg'l Transp. v. Fed. Highway Admin., 576 F. App'x 477, 481 (6th Cir. 2014); Citizens Against Burlington, Inc. v. Busey, 938 F.2d 190, 195 (D.C. Cir. 1991) ("[A]n alternative is reasonable only if it will bring about the ends of the federal action."). In addition to the No Action Alternative, TVA considered two action alternatives in the Draft EIS: Alternative A- the retirement of KIF and construction and operation of a combined cycle (CC) and dual fuel Aero CT gas plant with 3-4 MW Solar and 100 MW Battery, on the KIF Reservation; Alternative B- the retirement of KIF and construction and operation of solar and storage facilities, with a portion in located in East Tennessee. The purpose of the proposed action is to retire the KIF coal units by the end of 2027 followed by the decommissioning of those units, and to implement replacement generation that can supply at least 1,500 MW of firm, dispatchable power by the end of 2027. The need for the Proposed Action is to ensure that TVA is able to meet required year-round generation and maximum capacity system demands and planning reserve margin targets, particularly during peak load events, upon the retirement of the coal units. TVA is evaluating implementing solar and battery throughout the valley. However, for purposes of this project, replacement generation is needed in the KIF area to fill the void left by the retiring Kingston coal units and there are limitations to the amount of on-site solar and BESS that the Kingston Reservation can accommodate. The proposed amount of solar and BESS that would be paired with the proposed gas units would be sufficient to provide station service support. Since solar and BESS components included in the preferred Alternative A would not contribute to air impacts, they were not included in air quality evaluation. Additional language has been added to the DEIS to clarify this point. The Draft EIS evaluates other potential renewable energy resources and other potential blended alternatives, many of which would not require a new natural gas pipeline. TVA concludes that these alternatives would not meet the project's purpose and need to retire all nine KIF coal units and to implement replacement generation that can supply at least 1,500 MW of firm, dispatchable power by the end of 2027. As part of the Scoping of this project, an additional action alternative – a gas alternative - was considered that would evaluate two CT plants at alternative locations in the Valley that either already had natural gas already provided or would require minimal additional gas pipeline construction. This alternative was later dismissed from detailed consideration due to site environmental, transmission needs, and timing concerns that made the alternative incompatible with

		the purpose and need of TVA's proposal in this EIS. Likewise, Section 2.1.5 of the DEIS discusses other alternatives and the reasons why TVA eliminated them from detailed study. See Section 2.1.3.2. of the Draft EIS (Site Evaluation for New CC / dual fuel Aero CT Plant) for an explanation of the benefits of locating the CC plant on the KIF Reservation and factors TVA used to select it as the site for the CC/Aero CT plant. Among other reasons, locating the CC/Aero CT plant on the Kingston reservation will support the local transmission system, takes advantage of existing transmission interconnection to the TVA system, fills the critical need for power in the Knoxville area resulting from the retirement of the coal plant, and would allow for the majority of the pipeline to be sited along an existing natural gas pipeline right-of-way, reducing potential environmental effects. Kingston Fossil's (KIF) location on the transmission system, specifically on the 161 kilovolt (kV) system near the Knoxville load center, makes KIF an integral part of the systems power flows and stability. The retirement of KIF would create a large gap in the power system in the Knoxville area and decreases the system stability for Watts Bar and Sequoyah nuclear plants. Significant transmission system upgrades in the local area would be needed if replacement generation is not provided and located on the 161 kV system near Knoxville. Retirement of Kingston Fossil without replacement generation in the area or without extensive transmission upgrades would significantly impact the ability to add additional load in the area, degrade the stability of Watts Bar and Sequoyah nuclear plants to a point where generation would need to be curtailed, and potentially violate NERC Transmission Planning (TPL-001) standard criteria. As discussed previously, the time necessary to make extensive transmission upgrades would be incompatible with the purpose and need for the project. Upon consideration of all siting criteria (including, but not limited to, transmission availability, required transmission upgrades (both those directly associated with the CC and regional upgrades required for grid stability), air permitting prospects, staffing, fuel supply, etc.), TVA determined that the Kingston Reservation was the preferred location. Further, the proposed CC/dual fuel Aero CT plant at KIF along with 3-4 MW of solar and 100 MW battery could be built and made operational sooner than other alternatives, which reduces economic, reliability and environmental risks. The timing for the replacement generation is an important criterion since TVA must replace the generation of the retiring coal units by the end of 2027. Section 2.1.5 further details alternatives that were "considered but not carried forward" for more detailed analysis because they do not meet the project purpose and need. In particular, in Section 2.1.5, TVA evaluated a number of other resource options for replacement generation, including: natural gas-fired CC, natural gas-fired CT, battery energy storage systems (BESS), utility-scale photovoltaic (PV) solar, hydro pumped storage, small modular reactors, wind, energy efficiency, demand response, and distributed generation. TVA also evaluated other blended alternatives, including one that combines a lower amount of natural gas with other technologies, such as solar and battery storage. These alternatives were not carried forward for more detailed review because…See Section 2.1.5 for explanations as to why these options did not meet the project's purpose and need. Section 1.2 of the KIF Retirement draft EIS discusses the recently enacted Inflation Reduction Act (IRA; Public Law No: 117-169) and the attributes of this act that would improve pricing and availability for renewable and storage resources. While the provisions of the IRA provide substantial incentives for various forms of clean energy, for a number of reasons, those provisions are of limited applicability with respect to the generation choice decisions confronting TVA at Kingston. TVA is optimistic that the IRA will enable faster adoption of renewable resources on TVA's system in the long term but its enactment does not alleviate the transmission-related time constraints described in the Draft EIS for Alternative B that impair the ability of this alternative to fully meet TVA's purpose and need for firm, dispatchable generation by the end of 2027. For these reasons, the IRA does not alter TVA's selection of the preferred

		alternative (Alternative A) nor does it change the least-cost planning analysis that led to TVA's adoption of the target supply mix in the 2019 IRP. There are several market factors, including supply chain limitations, that are affecting both cost and availability of panels and other equipment to accelerate the installation of solar generation s. Regulatory initiatives to reduce greenhouse gas emissions have increased solar demand, putting pressure on manufacturers and the transportation industry. Solar panels are primarily produced overseas, and, at this time, the U.S. has little competitive onshore solar manufacturing capability. One example of this is Polysilicon, which is produced in China, and the prices of Polysilicon have significantly increased since before the pandemic. Additionally, U.S. tariffs on Chinese imports, recent anti-dumping investigations on Southeast Asian imports, and enforcement process uncertainty with the Uyghur Forced Labor Prevention Act have created supply uncertainty on obtaining solar panels from primarily available sources. Ocean freight costs have also increased, which puts downward pressure on the supply of solar panels sourced from outside of the U.S. Although shipping costs are trending downward, levels remain higher than pre-pandemic. Additional demand and cost for materials, such as steel, for which solar racking and tracking equipment is highly dependent, has also increased significantly. These impacts have led to a reversal of decades-old trend of decreasing solar prices and has led to many solar projects being postponed or canceled. While the IRA incentivizes the transition of the solar supply chain to the U.S., it is projected that it will take 3-5 years for domestic supply chain to mature and ease the current constraints on the supply. Additionally, the tax incentive provisions of the IRA are likely to take more time to implement than is available to TVA for purposes of choosing replacement energy for the KIF Plant. The selected replacement generation must be in place and operational prior to the retirement and demolition of KIF by the end of 2027. The Treasury Department must issue guidance to establish certain qualifications and processes for tax incentive provisions, which could take up to a year, if not longer. Wind was considered but dismissed as a resource option due to low wind speeds in the Tennessee Valley and higher transmission costs for out-of-Valley wind. Recent market intelligence indicates that wind is not cost competitive in the Valley.

3	Range of Alternatives and Consideration of IRA Incentives: The range of alternatives considered within the Draft EIS, which is limited to only two action alternatives, appears to be constrained by TVA's 2019 IRP. However, there have been significant statutory, regulatory, and technology changes since then. There is relevant Inflation Reduction Act (IRA) tax guidance likely to come out during the EIS process, and other analysts have worked with statutory language alone to generate estimated cost projections. Also, other utilities are finding creative and aggressive ways to reduce emissions on a timeline comparable with TVA's. • Virtual Power Plants – https://pv-magazine-usa.com/2023/03/08/sunnova-to-deploy-solar-and-storage-virtual-power-plant-in-texas/ • 100% Renewable Micro-grids – https://www.energy-storage.news/first-100-renewable-multi-customer-microgrid-online-in-california/ • Solar in public buildings – https://generation180.org/wp-content/uploads/2022/12/BrighterFuture2022.pdf Additionally, other companies have plans to retire coal plants in similar timeframes where they have developed lower GHG alternatives than a natural gas combined cycle unit. For example, instead of replacing a retired coal plant with CC natural gas plant as originally planned, Xcel Energy offered a new alternative that relies significantly on solar and wind for generation (see https://cubminnesota.org/xcel-is-no-longer-pursuing-gas-power-plant-proposes-more-renewable-power/). TVA's option for potential hydrogen co-firing, while welcome, is less aggressive than that of other utilities.	Please see response to Comment #2. TVA is situationally different from the other utilities in EPA's comment. Further, TVA is constrained in its decision-making by its statutory obligations to engage in least-cost planning and the provision of reliable, affordable electricity to the 6 million patrons of the Tennessee Valley Service Area. TVA has committed to ensuring that the design of the Alternative A CC/Aero CT plant would enable and accommodate potential future modifications for carbon capture and the combustion of hydrogen (CC units only) as a replacement or supplemental fuel for natural gas when these technologies mature to scale. The proposed CC units under Alternative A would be designed to be 5 percent hydrogen capable at commissioning by adding balance of plant equipment that includes areas for future hydrogen storage, appropriately sized piping, and a blending station during the original construction. TVA would also purchase a CC unit capable of burning at least 30 percent hydrogen, by volume, with modifications to the balance of plant once a hydrogen source is available. TVA would only consider burning hydrogen as a part of test burns or normal operations when it is commercially available at an acceptable chemical content that would reduce carbon emissions and be price competitive in the market at that time. It is important to note that once a viable option for future mitigation projects is identified, TVA would conduct additional analyses to determine proposed pipeline routes, costs, storage requirements, or other needs with hydrogen fuel incorporation. TVA would analyze the site- specific impacts associated with any future mitigation that is planned as additional details become available. TVA has considered the USEPA's draft whitepaper on reducing GHG emissions from CTs (USEPA 2022b) and anticipates the efficiency, effectiveness, scalability, and economics of these systems to improve in the next several years, allowing for more informed decisions in the future when adequate storage locations or pipelines are identified for both the delivery of hydrogen and the storage or use of captured CO_2. TVA is exploring partnerships with federal agencies and peer utilities to advance the research and development of both alternative fuels and CCS technology, which could enable their use at existing or future TVA facilities. In addition to the current cost and maturity challenges with CCS, the potential geological features (i.e., karst instability and tendency to develop sinkholes) of the Kingston Reservation pose further challenges to the consideration of CCS at this site.
4	The EPA recommends against applying the SC-GHG estimates developed under EO 13783 that has since been revoked, because they fail to reflect the full impact of GHG emissions in multiple ways. First, those estimates fail to capture many climate impacts that can affect the welfare of U.S. citizens and residents. Examples of affected interests include direct effects on U.S. citizens and assets located abroad, international trade, tourism, and spillover pathways such as economic and political destabilization and global migration that can lead to adverse impacts on U.S. national security, public health, and humanitarian concerns. Assessing the benefits of U.S. GHG mitigation should also incorporate how those actions may affect mitigation activities by other countries, as those international actions will benefit U.S. citizens and residents. Scientific and economic experts have emphasized reciprocity as support for considering global damages of GHG emissions. Using a global estimate of damages in U.S. analyses allows the U.S. to continue to actively encourage other nations, including emerging major economies, to take significant steps to reduce emissions. The EPA also recommends that TVA remove any language from the Draft EIS indicating that there is "legal uncertainty" around the SC-GHG estimate and not reference ongoing litigation as a rationale for using the outdated estimates from the prior Administration.	Comment noted. First, as to scope of impacts, the social costs of GHG from the previous Administration are based largely on domestic effects while the social costs generated by the IWG for the current Administration are based on global effects. In the DEIS, TVA has used social cost metrics from both the current and previous Administrations. Presenting estimated social costs as a range of values from successive Administrations provides decision-makers and the public with better information in an area fraught with uncertainty. Because the DEIS considers the current Administration's social cost numbers, the global effects were not ignored in TVA's consideration of the social costs. Second, the "legal uncertainty" refers to the fact that the use of SCC by federal agencies has been the subject of litigation and inconsistent rulings and could be the subject of further litigation related to specific agency actions. Moreover, these estimates have changed from administration to administration. Nonetheless, TVA has used the SC-GHG estimates published by the IWG in its analysis, together with other SCC metrics used under previous Administrations to provide a range of potential impacts. Monetizing social costs of GHG is not an exact science and presenting the social costs as a range of values provides decisionmakers and the public with better information for making an informed decision.

5	Finally, the EPA recommends that TVA avoid expressing project-level GHG emissions as a percentage of national or state GHG emissions. Instead, the EPA recommends TVA include a discussion of whether and to what extent the estimated GHG emission reductions from the proposed alternatives are consistent with meeting U.S. commitments, any relevant state or local goals, and TVA's own commitments to be carbon free by 2050.	CEQ's interim guidance on assessing GHG emissions encourages agencies to conduct an emissions analysis for each alternative and to contextualize those emission increases or decreases against climate goals and emission inventories. The proxy emissions analysis that, among other things, expresses emission reductions from alternatives as a percentage of state or national GHG emissions helps provide this context. The DEIS provides additional context by explaining how the reductions from the alternatives help advance climate goals. Along these lines, both action alternatives align with TVA's path to reduce carbon emissions 70 percent by 2030 and 80 percent by 2035, as set out in TVA's Strategic Intent and Guiding Principles (May 2021). TVA also has an aspiration to achieve net-zero carbon emissions by 2050 and the alternatives in the DEIS would advance the agency's aspiration. Moreover, the emission reductions that would result from adoption of the preferred alternative would also help advance the climate goals espoused in several Executive Orders issued by the Biden Administration. These reductions also advance the Nationally Determined Contributions (NDCs) goal for the United States in the Paris Agreement to reduce GHGs by 50-52% below its 2005 level by 2030 (Biden Administration: April 2021) Please see Sections 1.2 and 2.1 for additional details on TVA's carbon emission reduction goals.
6	The EPA recommends providing background documentation including spreadsheets used to estimate life cycle GHG emission for each alternative as well as the net present value (NPV) for both individual basis and system-wide basis. Without this information, it is difficult to verify the accuracy of TVA estimates and inform decisions about the project. The EPA also recommends providing citations including page numbers for the publications used as the basis for the LCA analysis. The EPA also recommends against presenting the SC-GHG as a point estimate at one discount rate, i.e., in Table 3.74, present SC-CO2 in 2028 at 3% discount rate. As emphasized in the IWG Technical Support Document, the discount rate is an important parameter in estimating the SC-GHG and to reflect uncertainty in that parameter, a range of discount rates should be considered. For transparency and to help the public understand the impacts, the EPA recommends that the climate damages be presented for each GHG from 2028-2050 at discount rates of 2.5%, 3.0%, and 5.0%. The EPA is willing to help with calculating the climate damages using the appropriate SC-GHG estimates. The current annual SC-GHG values are in 2020 dollars. The values should not be adjusted for inflation to create a nominal value as has been done in the Draft EIS (adjusted for 2% annual inflation). The EPA is willing to help with adjusting the SC-GHG correctly. Appendix I does not describe the system model used to estimate lifecycle GHG impacts, how it was used, nor the cost assumptions. For transparency and replicability of results, the EPA recommends TVA provide more details on the system-wide modeling and lifecycle modeling. Furthermore, the results of the system-wide LCA modeling are not fully presented. Only the emission-related outputs are presented. The EPA recommends also presenting the distribution of electricity generation in the system-wide model outputs. As it stands, it is not clear if the LCA system-wide model outputs satisfy TVA's commitments towards achieving Net Zero GHG emissions, as well as other policy goals. The EPA recommends presenting the full details about the assumptions of the model and the outputs across the TVA system.	The "Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates Under Executive Order 13990" (SC-GHG TSD) provides the interim SC-CO2, SC-CH4, and SC-N2O estimates in 2020 dollars. Furthermore, Tables 1-3 of this document, and corresponding footnotes, indicate that all values identified in the document are in 2020 dollars. Therefore, these estimates needed to be adjusted to account for inflation as the capacity expansion model relies on nominal inputs. The methodology and assumptions used in the Life Cycle Analyses are described in Appendix I. The basis for the LCAs is NREL publications. The system-wide LCA is based on simulated system-wide generation dispatch. An analysis for the entire TVA-wide power system was performed using industry standard capacity planning and production cost models, Anchor Power Solutions' EnCompass, and Energy Exemplar's Aurora. The capacity planning model develops a least-cost portfolio to meet demand and reserve margin, while the production cost model simulates economic dispatch of the plan. The output includes an estimate of anticipated future emissions across the entire TVA system for each year. The LCA system-wide model outputs do satisfy TVA's commitments towards achieving Net Zero GHG emissions, as well as other policy goals, because the preferred alternative provides reductions in GHGs, which goes towards achieving TVA's plan of reduced carbon of 70% by 2030 and a path towards 80% by 2035 and an aspiration of net zero carbon emissions by 2050. Model results represent TVA's current forecast for electric load, asset performance, and commodity prices, among other things. Differences in any of these forecasts could result in higher or lower anticipated carbon emissions. Future regulatory requirements or incentives would likely result in lower emissions than these estimates, depending on those requirements and TVA's fleet composition at the time. The differences between each alternative are specific to the decision to retire or not retire Kingston Fossil Plant and the associated replacement generation outlined in each alternative. Each alternative has subsequent impacts for other decisions in the future. Given this, there will be variations in simulated dispatch, which will result in differences in emissions, driven by the dynamic nature of power system modeling. All necessary generation data germane to the evaluation of the System-wide LCA analysis and the assessment of climate impacts is provided in the DEIS.

7	The EPA recommends that the Draft EIS include a more robust discussion of whether and to what extent estimated GHG emissions from the proposed alternatives are consistent with achieving science-based national GHG reduction targets, including the Paris Agreement targets, the 2050 goal for net-zero energy emissions, and the goal of achieving a carbon pollution-free electricity sector by 2035. This is particularly critical for projects that may perpetuate reliance on GHG-emitting energy sources beyond the timeframes set by national GHG reduction goals. The Draft EIS should also include more information about the Paris Agreements and the resulting targets, which are referenced without further explanation. Additionally, per 40 CFR 1506.2(d) the Draft EIS should disclose and discuss any inconsistency of the proposed action with State, Tribal, or local plans or laws, including local GHG emissions reduction goals. (https://www.knoxvilletn.gov/government/city_departments_offices/sustainability/climate_change#:~:text=Our%20new%20goal%20to%20reduce,which%20are%20outside%20City%20control).	See response to *Comment #5* above.
8	The Draft EIS should also discuss whether and how the preferred alternative aligns with TVA's goals of TVA's 2019 IRP, which calls for 14,000 MW of solar and 4,200 MW of wind energy by 2038. As noted, the 2019 IRP was developed prior to TVA's subsequent carbon commitments or the significant incentives under the IRA that make many of the alternatives to combustion turbined much more cost effective. The Draft EIS should thus also discuss alignment with subsequent agency GHG reduction goals and policies, including TVA's 2021 Strategic Intent and Guiding Principles document.	The 14,000 MW of solar and 4,200 MW of wind outlined in the 2019 IRP represent the upper end of the range of resource additions included in the Target Power Supply Mix adopted by TVA. See Chapter 2 for more information on the Target Power Supply Mix. The Preferred Alternative is expected to help TVA execute a plan to reduce carbon emissions 70 percent by 2030 with a path to an 80 percent reduction by 2035, and to attain the aspiration of net-zero carbon emissions by 2050 (TVA 2021h).
9	The EPA recommends the Draft EIS provide additional information behind the 2027 timeframe identified in the purpose and need, including whether the timeframes in the 2019 IRP remain consistent given the changes in the energy markets and statutory/regulatory developments, notably the IRA. The EPA recommends greater disclosure around how the 2027 timeframe limited the alternatives and mitigation options considered in the Draft EIS. Increased disclosure about these timing constraints could allow greater insight into whether other reasonable alternatives or mitigation measure may be available to TVA. Although the details of these future regulations are not yet public, the EPA recommends at least including a discussion of their expected impacts, particularly in terms of costs. TVA should be specific about the "recent and anticipated new regulations" that are referenced as a driver for the selection of Alternative A. One of these regulations appears to be EPA's proposed Steam Electric Effluent Limitation Guidelines, 88 Fed Reg 18824; public comments on this proposed rule are open until April 28, 2023. The EPA would prefer that proposed regulations not be referenced as a rationale for selecting an alternative. If the EPA's proposed (not final) regulations are going to be referenced as a reason for selecting Alternative A, it would be helpful to see more explanation about the costs that TVA anticipates would result from compliance with these proposed regulations, as well as an acknowledgment of any uncertainty because these regulations are not finalized.	The DEIS provides a discussion of the "end-of-life" timeframe for the Kingston coal units – end of 2027 - and of the need to replace the retiring generation in a timely manner with 1500MW of firm, dispatchable power. While the IRA will enable faster adoption of renewable resources on the TVA system in the long term, it does not help in the short term to install 1500MW of firm, dispatchable power by 2027 to replace the generation of the retiring Kingston coal units. As to the proposed ELG regulation, TVA took into account the potential cost of a future ELG regulation in the overall analysis that goes into the selection of the preferred alternative. This potential cost as it relates to complying with the 2020 ELG regulations has been added to the DEIS.

10	If TVA intends to install carbon mitigation measures in the future, these costs should be included in their analysis. Carbon capture and hydrogen fuel blending technologies should be considered in the plant design. Utilities similar in size to TVA's Kingston plant are displacing some portion of their natural gas generation with these technologies in a comparable timeframe. For example, the Intermountain Power new natural gas generating units, which will begin operation in 2025, will be designed to utilize 30 percent hydrogen fuel at start-up, transitioning to 100 percent hydrogen fuel by 2045 as technology improves (see https://www.ipautah.com/ipp-renewed/). While smaller in scale, other utilities are displacing a portion of their natural gas use with hydrogen. For example, (https://dailyenergyinsider.com/news/34040-florida-power-light-taps-cummins-for-its-green-hydrogen-facility/). And Competitive Power Ventures is constructing a CC natural gas generation facility using carbon capture technology (https://cpv.com/2022/12/12/cpv-selects-doddridge-county-for-location-of-3-billion-carbon-capture-project-in-west-virginia/) The EPA recommends deleting the sentence regarding comparison of SF6 leaks to combustion emissions, in Section 3.7, as it is not a relevant comparison and is misleading. Given that the life of a switchgear is over 30 years, the EPA suggests that TVA's upgrade of its system and installation of new switchgears represents the ideal time to switch to SF6 free switchgears, which would represent reasonable mitigation, and prevent over 30 years of production of additional SF6 for the TVA system. The EPA can connect TVA with further resources on SF6 free switchgears.	There are many uncertainties around the availability and cost of emerging technologies, such as carbon capture and hydrogen fuel blending. TVA's experience is that these technologies have not been adequately demonstrated to be considered technologically and economically feasible. However, because these technologies are promising, the combined cycle plant under Alternative A would be designed to accommodate future modifications necessary for incorporating CCS and for utilizing hydrogen fuel blending if and when these technologies mature to fruition. TVA is also aware that under EPA's Fall 2022 Unified Regulatory Agenda (published April 22, 2023), the agency expects to propose a GHG reduction rule applicable to new and existing electric generating units in Spring 2023. The construction and operation of any replacement generation would be consistent with the requirements in any such future regulation. The switchgear units that would be utilized for this project are manufactured to meet industry standards. As stated in Section 3.7.2.3.3 of the Final EIS, some older electrical equipment at the Kingston Reservation may contain the GHG sulfur hexafluoride (SF6) gas (e.g., electrical switchgear, circuit breakers), which have the potential for minor leaks, mostly associated with maintenance or long-term equipment degradation. Additionally, where newer equipment has been installed or is proposed, along with more efficient operation and maintenance techniques, and leak detection, these features would minimize the potential for sulfur hexafluoride leaks. The only other market-available switchgear option (vacuum) does not provide interruption to support NERC Protection and TVA reliability standards to provide safe reliable power for the Tennessee Valley. A system-wide review of SF6 switchgear conversion would be outside the scope of this analysis; however, TVA actively monitor evolving technology for future consideration in making system-wide changes. Revisions have been made in Section 3.7 to address EPA's comments here. Additionally, TVA has updated language to acknowledge the impending 111 GHG Rule to Section 2.1.4.2.
11	The EPA recommends that the discussion of climate change and GHGs acknowledge the disproportionate impact that GHG emissions have on already overburdened and vulnerable communities. See, e.g., Climate Change and Social Vulnerability in the United States, the EPA (2021). Similarly, the alternatives discussion should recognize the differences in the GHG emission impacts of each alternative on those vulnerable communities. Also, the environmental justice analysis of non-GHG stressors should include ongoing and projected climate-related impacts, consistent with section 219 of Executive Order 14008. The EPA also recommends that TVA provide details regarding whether there is any potential for rate increases or other costs related to the proposed CC/Aero Plant that could potentially affect consumers and whether those economic impacts could be amplified for low-income populations. The Draft EIS should identify potential impacts to residential properties associated with the pipeline regarding any amplified effects that may be experienced by People of Color and Low-Income populations, including from any potential eminent domain or construction-related activities. Finally, the EPA recommends that TVA provide additional details regarding potential impacts to People of Color and Low-Income populations from pipeline construction and operations related to any subsistence hunting, fishing, and gathering activities; to private drinking water sources; waste disposal sites; noise; and other identified EJ impacts identified in the Draft EIS, including the potential amplification of these impacts to EJ populations.	TVA has assessed the impacts on EJ populations for each resource area in the DEIS, evaluating the potential for any disproportionate impacts on EJ populations. While TVA did not identify any disproportionate impacts, the DEIS recognizes that there could be "amplified" effects on EJ populations due to their greater susceptibility as a result of the long-term history of social discrimination and due to their atypical cultural traditions and norms. TVA recognizes the potential for such "amplified" effects even when EJ and non-EJ communities may be subject to the same potential for harm as a result of project impacts

National Park Service Reviewers

Reviewer Name	Reviewer Initials
Tom Blount	TB
Jeffrey R Duncan	JD
Eric Bilderback	EB
Dusty H Pate	DP
Andrea Stacy	AS

Response Number	Section	Commentor	Comment	Comment Resolution/Updates to the Document
	Front Matter, Acronyms, Table of Contents, Figures and Tables			
1	Cover Sheet	AS	Please specify the number of combustion turbines that will be constructed under each configuration (combined cycle and peaking units). Both the air quality analysis sections and the emissions tables indicate that TVA intends to construct a combined cycle (CC) plant as well as dual-fuel Aeroderivative combustion turbine peaking units at the KIF site. This is not clear based on the language presented here, which could be interpreted to mean that the dual-fuel Aeroderivative CTs are components of the combined cycle plant. Based on information provided in the air quality sections of the analysis, the NPS has interpreted this to mean that TVA proposes to construct both a CC plant and CT peaking units—our comments are prepared accordingly. Please specify whether this understanding is correct.	The Draft EIS has been updated to clarify that TVA proposes under Alternative A to build a single gas-fired combined cycle gas plant and 16 dual-fuel Aeroderivative combustion turbines. Additional details and descriptions are provided in Chapter 2 - description of Alternative A - but are not repeated each time the proposed action is mentioned.
2	Cover Sheet	AS	See comment above regarding recommended clarification of the Alternative A proposal.	See response above.
3	Summary	DP	Awkward construction/repetition. Is this the correct description?	Section revised to improve construction and clarity.
4	Summary	AS	Executive Order (EO) 14008 underscores the urgency of addressing the present climate crisis and EO 14057 sets quantifiable goals for the government in reducing GHG emissions. As the nation's largest government-owned utility, TVA is in a unique position among federal entities to lead by example and dramatically shift the environmental and climate burden of energy production in the United States. If constructed, new natural gas fossil fuel-fired generation will be in place for decades to come, well beyond the time frames addressed in EO 14057 for establishing a carbon-pollution-free electricity sector by 2035. While natural gas-fired electricity generation is cleaner than coal-fired generation, it still emits criteria air pollutants that impact parks and approximately half the amount of carbon dioxide (CO2) on a pound-per-megawatt basis, compared to coal. From a cost perspective, future retrofits with carbon capture and storage may be more costly than investing in renewable energy and storage options from the onset. Therefore, the NPS encourages TVA to move to carbon-free energy sources to the maximum extent possible and employ all available mitigation options to reduce GHG emissions now and in the future. TVA currently has a large systemwide carbon footprint and is considering similar natural gas-fired replacements for other coal-fired units in its power generation system. In the Air Quality Section of the DEIS, TVA states that "Alternative A would help achieve TVA's goal of reducing GHG emissions by 70% by 2030 as set out in TVA's Strategic Intent and Guiding Principles document." The NPS recognizes the significance of these reductions (we note that, based on the IRP, the 70% reduction goal is from a 2005 baseline). However, based on current emissions information, significant additional CO2 emission reductions are still needed in the TVA system. According to information provided in the Environmental Protection Agency's Clean Air Markets Program Data (CAMPD) database, coal, oil, and natural gas-fired units across the TVA system emitted nearly 42.3 million short tons of CO2 in 2021. The Energy Information Administration (EIA) also tracks emissions information by power plant and associated balancing authority. When ranking balancing authorities based on reported 2020 CO2 emissions, the TVA region is ranked seventh among the top ten (out of 66 total) highest carbon dioxide-emitting power balancing authority regions. Comparisons of the EIA balancing authority information with 2020 CAMPD data show that TVA-owned facilities account for approximately 62.6% of the megawatt hours produced and 77.4% of the CO2 emissions in the	Under the Energy Policy Act of 1992, TVA has a statutory obligation to conduct least-cost planning. The target supply mix approved by the TVA Board through the 2019 IRP is the product of the least cost planning process. The decision associated with this EIS is a specific, discrete component of TVA's blended asset strategy and consistent with the recommended target power supply mix in the 2019 IRP see Sections 1.2 and 2.1 for more information on the IRP and Target Power Supply Mix. New gas contributes to TVA's ~80% carbon reduction by 2035 path by enabling the retirement of the remaining coal plants by 2035, while emitting about 65-70% less CO2 than aging coal plants. See Section 3.7.1.1.8.4 for more information on how all action alternatives address executive orders with GHG emissions reductions guidance. While Alternative B would result in greater carbon reductions than Alternative A, it is not feasible by 2027 due to significant transmission work, failing to meet the Purpose and Need. Please refer to the Alternatives Evaluation in Appendix B for more information on assumptions and methodology. TVA has updated all resource costs since the 2019 IRP, using NREL's 2022 Annual Technology Baseline as the source for long-term solar and storage costs. TVA is optimistic that the IRA will enable faster adoption of renewable resources on TVA's system in the long term, but its enactment does not alleviate the transmission-related time constraints described in the Draft EIS for Alternative B that impair the ability of this alternative to fully meet

Response Number	Section	Commentor	Comment	Comment Resolution/Updates to the Document
			TVA balancing authority region. This means that, as of 2021, TVA is responsible for nearly 80% of the CO2 emissions from the seventh highest CO2 emitting balancing authority region in the United States. We urge TVA to use this opportunity to take a hard look at the tradeoffs between the action alternatives. This includes a more in-depth, quantified, site-specific assessment of the costs of constructing fossil fuel-fired generation capacity under Alternative A versus renewable energy options under Alternative B. A growing body of evidence indicates that renewable energy sources are now cost-competitive with even the most economical fossil fuel-fired EGUs (e.g., see IRENA (2021), Renewable Power Generation Costs in 2020, International Renewable Energy Agency, Abu Dhabi. ISBN 978-92-9260-348-9). In their 2022 Annual Energy Outlook, the Energy Information Administration concludes that "[w]ind and solar incentives, along with falling technology costs, support robust competition with natural gas for electricity generation, while the shares of coal and nuclear power decrease in the U.S. electricity mix." We also recommend that TVA take a more-programmatic look at the long-term costs and financial risks of ongoing reliance on fossil fuel energy sources versus renewable energy options. This reflects a June 30, 2022, recommendation by the EPA on the Cumberland EIS that TVA more extensively "consider the long-term financial liabilities" associated with fossil fuel combustion in the alternatives analysis." If TVA were to factor the cost of retrofitting a gas plant with carbon capture and storage and/or future changes in GHG regulation, a new gas plant may have greater risk from a financial perspective than currently assumed.	TVA's purpose and need for firm, dispatchable generation by the end of 2027. As a result, the IRA does not alter TVA's selection of the preferred alternative (Alternative A) nor does it change the least-cost planning analysis that led to TVA's adoption of the target supply mix in the 2019 IRP. There are several market factors, including supply chain limitations, that are affecting both the cost and availability of solar alternatives in the near term. The regulatory initiatives to reduce greenhouse gas emissions have increased solar demand, putting pressure on manufacturers and the transportation industry. Solar panels are primarily produced overseas, and, at this time, the U.S. has little competitive onshore solar manufacturing capability. One example of this is Polysilicon, which is produced in China and the prices of Polysilicon have significantly increased since before the pandemic. Additionally, U.S. tariffs on Chinese imports, recent anti-dumping investigations on Southeast Asian imports, and enforcement process uncertainty with the Uyghur Forced Labor Prevention Act have created supply uncertainty on obtaining solar panels from primarily available sources. Ocean freight costs have also increased, which puts downward pressure on the supply of solar panels sourced from outside of the U.S. Although shipping costs are trending downward, levels remain higher than pre-pandemic. Additional demand and cost for materials, such as steel, for which solar racking and tracking equipment is highly dependent, has also increased significantly. These impacts have led to a reversal of decades-old trend of decreasing solar prices and has led to many solar projects being postponed or canceled. While the IRA incentivizes the transition of the solar supply chain to the U.S., it is projected that it will take 3-5 years for domestic supply chain to mature and ease the current constraints on the supply. Additionally, the tax incentive provisions of the IRA are likely to take more time to implement than is available to TVA for purposes of choosing replacement energy for the KIF Plant. The selected replacement generation must be in place and operational prior to the retirement and demolition of KIF by the end of 2027. The Treasury Department must issue guidance to establish certain qualifications and processes for tax incentive provisions, which could take up to a year, if not longer. TVA takes a more-programmatic look at cost and asset strategy, including detailed review of TVA's target power supply mix in the IRP. IRPs are performed every 4-5 years with the last completed one in 2019. A new IRP cycle will begin this year.

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5	Summary	DP	Referring to Alternative B?	Revised for clarity.
6	Summary	DP.	Here and in the ETNG section below, how can this be true? Did you mean subsurface geologic resources? Unique geologic resources? Section 3.5.1.1.2.6 indicates that "Minor direct effects to potential subsurface geological resources are anticipated," and continues to state that, "the depth to bedrock is anticipated to be less than 78 inches below ground surface for approximately 48 miles of the proposed pipeline route." There are several mitigation measures and remediation methods under the Geologic Hazards heading in the same section that address geologic features.	Moved this language from the TVA Action section into the ETNG Actions section. Additionally, the language was revised here and in Section 3.5.1.1.2.6 to clarify that discussion is about mineral resources only.
7	Summary	DP	See previous comment.	See previous response.
8	Summary	DP	This paragraph does not address pipeline construction and operation.	Deleted discussion of pipeline from this paragraph.
9	Summary	DP	This is more precise. Not all of the Obed River itself is classified as Wild and Scenic, and there are other streams included in the Obed Wild and Scenic River designation.	Accepted revision.
10	Summary	DP	Why? Subsurface installation does not necessarily mean that there would be no visual impact. Pipeline markers and the permanently cleared ROW could be visible for example, and construction may produce its own set of relevant effects from temporary visibility, emissions, noise, vibration, etc.	In December 2021, [ETNG], in consultation with the SHPO, defined the Indirect APE for historic architectural resources along the pipeline corridor. It was determined that the proposed underground facilities along the Pipeline Corridor have a minimal potential to affect historic architectural resources. The pipeline component of the project would be located primarily within an existing ETNG right-of-way, whenever practicable, to minimize impacts to cultural resources, landowners, and the environment. To the extent practicable, ETNG does not plan to directly impact or remove existing historic buildings or historic structures, and upon completion of the project, any impacted landscape features, such as fences, would be restored post-construction; as such, potential for affects to historic architectural resources along the pipeline corridor to be affected are very low.
11	Glossary	DP	Please elaborate/compare to connected action.	Definition removed from Glossary to minimize confusion. A footnote has been added at the first use of "related action" directing the reader to See 40 C.F.R. § 1501.9(e)(1). This is the provision in the regulations that discusses/defines "connected actions".

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12	1.2	DP	Incomplete?	Sentence revised.
13	1.2	AS	The NPS recommends that TVA explore these cost comparisons more comprehensively in the DEIS and that cost information should be specific to the Kingston proposal. We preface this comment by noting that the values cited here and by TVA in the ADEIS are approximate costs based on averages and assumptions provided in EIA's annual Energy reports. We recommend that the ADEIS would benefit from a site-specific, detailed cost discussion in the NEPA document. It is important that the document take a detailed "hard look" at cost trade-offs between the alternatives given TVA's least-cost planning obligations in 16 U.S.C. § 831m-1 and the requirement in Section 15d(f) of the TVA Act to sell power "at rates as low as feasible." With that, we note that the DEIS discussion of EIA's 2022 annual energy outlook may be incomplete. For instance, the Levelized Costs of Electricity (LCOE) cited in this section of the ADEIS (1) do not attempt to quantify the effect of the IRA tax credits on the cost of a PV solar system coupled with battery storage, (2) only compare to the costs of a single CC plant, but do not factor in the costs of the aeroderivative CT peaking units, and incorrectly cites the costs of battery storage (3) do not consider the complete suite of information presented in the EIA report cited, and, (4) do not include a detailed discussion of capital and operation costs for the specific technology types assessed under the action alternatives although the IRP and ADEIS decisions are predicated on these cost assumptions. We believe TVA is quoting information presented in EIA's March 2022 Report titled "Levelized Costs of New Generation Resources in the Annual Energy Outlook 2022" (available at: https://www.eia.gov/outlooks/aeo/pdf/electricity_generation.pdf). Total system LCOEs cited in this table (levelized capital, operating and maintenance, variable and transmission costs) are as follows: Combined cycle (combustion turbine): $37.05/MWh Solar, hybrid (PV system coupled with a four-hour battery storage system): $58.62/MWh Combustion Turbine (simple cycle): $123.84/MWh (Note, based on this table, the LCOE incorrectly cited by TVA as battery storage is the LCOE value for combustion turbines.) Battery storage (arbitrage applications): $124.84/MWh (Note, EIA states this is the cost for energy arbitrage applications, not battery backup for renewable sources.) Footnotes to the EIA table state that solar hybrid technology is assumed to be "photovoltaic (PV) with single-axis tracking system coupled with a four-hour battery storage system. Costs are expressed in terms of net AC (alternating current) power available to the grid for the installed capacity." With reference to the first NPS concern (the DEIS does not attempt to quantify the effect of the IRA tax credits on the cost of a PV solar system coupled with battery storage), we note that the EIA report cited came out prior to enactment of the IRA, as acknowledged by TVA. As such, the EIA LCOE costs cited by TVA assume declining production tax credits and phase down of investment tax credits for utility scale renewable energy projects (see page 2 of the EIA report). We recommend that DEIS address how the renewable energy tax credits under the IRA would apply to TVA system units specifically.	See response to Comment #4. Within the context of the DEIS, the reference to LCOE is used as an example to compare the cost of different resources. Please refer to the Alternatives Evaluation in Appendix B for assumptions and methodology, including all resource costs. The Alternatives Evaluation reflects costs specific to Kingston. The IRA is not expected to affect this analysis over the short term over which this replacement proposal must be implemented to accommodate the retirement of KIF by the end of 2027. Section 1.2 of the KIF Retirement draft EIS discusses the recently enacted Inflation Reduction Act (IRA; Public Law No: 117-169) and the attributes of this act that would improve pricing and availability for renewable and storage resources. While the provisions of the IRA provide substantial incentives for various forms of clean energy, for a number of reasons, those provisions are of limited applicability with respect to the generation choice decisions confronting TVA at Kingston. TVA is optimistic that the IRA will enable faster adoption of renewable resources on TVA's system in the long term, but its enactment does not alleviate the transmission-related time constraints described in the Draft EIS for Alternative B that impair the ability of this alternative to fully meet TVA's purpose and need of firm, dispatchable generation by the end of 2027. The IRA does not alter TVA's selection of the preferred alternative (Alternative A) nor does it change the least-cost planning analysis that led to TVA's adoption of the target supply mix in the 2019 IRP. There are several market factors, including supply chain limitations, that are affecting both the cost and availability of solar alternatives in the near term. The regulatory initiatives to reduce greenhouse gas emissions have increased solar demand, putting pressure on manufacturers and the transportation industry. Solar panels are primarily produced overseas, and, at this time, the U.S. has little competitive onshore solar manufacturing capability. One example of this is Polysilicon, which is produced in China and the prices of Polysilicon have significantly increased since before the pandemic. Additionally, U.S. tariffs on Chinese imports, recent anti-dumping investigations on Southeast Asian imports, and enforcement process uncertainty with the Uyghur Forced Labor Prevention Act have created

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			With reference to the second NPS concern (the DEIS only compares to the costs of a single CC plant but does not factor in the costs of the aeroderivative CT peaking units, and incorrectly cites the costs of battery storage), we note that the EIA LCOE cited by TVA is the LCOE value for combustion turbines, not battery storage. With respect to battery storage costs, we recommend that the EIA LCOE costs for Solar hybrid ($54.71/MWh) systems may be a more appropriate approximation for LCOEs associated with Alternative B. A footnote to the EIA table indicates that the solar hybrid technology "is assumed to be a PV system coupled with a four-hour battery storage system." Page 2 of the EIA report notes that the battery storage costs included in the model ($124.84/MWh in Table 1a) represent "storage in energy arbitrage applications where the storage technology provides energy to the grid during periods of high-cost generation and recharges during periods of lower cost generation, not as providing generation capacity reliability." The capacity weighted LCOEs in Table 1a of EIA's report are $123.84/MWh for a combustion turbine, $37.05/MWh for a combined cycle unit and $58.62 for solar hybrid technology (a PV system coupled with a four-hour battery storage system). This suggests that the LCOE of a solar hybrid system may be lower than cited by TVA and significantly lower than the LCOE of constructing both a CC plant and CT peaking units. With reference to the third NPS concern (the DEIS does not consider the complete suite of information presented in the EIA report cited), we acknowledge that the EIA report also considers the levelized avoided cost of electricity (LACE), the "economic competitiveness between generation technologies a proxy measure for potential revenues from the sale of electricity generated from a candidate project displacing (or the cost of avoiding) another marginal asset." EIA Table 3—Regional variation in levelized avoided cost of electricity (LACE) for new resources entering service in 2027 (2021 dollars per megawatt hour) reports that the average capacity-weighted LACE value of a solar hybrid technology ($50.82/MWh) is potentially less than the individual LACE of a CC plus CT project (the combined LACE would depend on the utilization rate for each turbine configuration but was assessed at $37.45/MWh and $107.82/MWh, respectively). EIA's approach is described at length in their report, Levelized Costs of New Generation Resources in the Annual Energy Outlook 2022 (available at: Levelized Costs of New Generation Resources in the Annual Energy Outlook 2022 (eia.gov)). With reference to the fourth NPS concern (the DEIS does not include an assessment of capital and operation costs for the technology types assessed under the action alternatives), we note that TVA's "least cost determination" is predicated on the IRP systemwide cost analysis and that capital cost assumptions for new generating capacity underpinned part of the IRP analysis. For this reason, the NPS considered the capital cost assumptions presented in the IRP analysis. In this review, we reference another EIA report associated with the 2022 Annual Energy Outlook, the Electricity Market Module (available at: https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf). Table 4 of this EIA document lists the overnight capital costs for various technologies, and estimates a total overnight capital cost as follows: combined cycle combustion turbines: $1,062/kW to $1,201/kW Simple cycle aeroderivative combustion turbines: $1,294/kW Solar PV with battery storage: $1,748/kW Combined-cycle turbine units with 90% carbon capture and storage: $2,845/kW Please note, the capital cost information should be considered in conjunction with the LCOEs, which included annual variable operating costs. The annual variable operating costs are likely much less for renewable energy options. Again, this information suggests that TVA may have underestimated cost of a CC plus peaking CT unit and	supply uncertainty on obtaining solar panels from primarily available sources. Ocean freight costs have also increased, which puts downward pressure on the supply of solar panels sourced from outside of the U.S. Although shipping costs are trending downward, levels remain higher than pre-pandemic. Additional demand and cost for materials, such as steel, for which solar racking and tracking equipment is highly dependent, has also increased significantly. These impacts have led to a reversal of decades-old trend of decreasing solar prices and has led to many solar projects being postponed or canceled. While the IRA incentivizes the transition of the solar supply chain to the U.S., it is projected that it will take 3-5 years for domestic supply chain to mature and ease the current constraints on the supply. Additionally, the tax incentive provisions of the IRA are likely to take more time to implement than is available to TVA for purposes of choosing replacement energy for the KIF Plant. The selected replacement generation must be in place and operational prior to the retirement and demolition of KIF by the end of 2027. The Treasury Department must issue guidance to establish certain qualifications and processes for tax incentive provisions, which could take up to a year, if not longer.

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			overestimated the costs of a PV system with battery backup (see comments on alternative A description). The renewable options considered under Alternative B may be more financially attractive than characterized in the DEIS and IRP, particularly if carbon capture is required in the future.	
It14	1.5	TB	Section 10 also?	Section 10 has been added to Table 1.8-2 in Section 1.8.
15	1.5	TB	Section 10?	Section 10 has been added to Table 1.8-2 in Section 1.8.
16	1.6	DP	Undefined here or above. Here and elsewhere, the pipeline is not described as a connected action. Please explain the rationale/significance of "related action" in this context. CEQ's current NEPA Implementing Regulations do not define "related actions," but use the term "related" when defining connected actions, which are "closely related and therefore should be discussed in the same impact statement." 40 CFR § 1501.9(e)(1) And the pipeline seems to meet all the reasons actions are considered connected per the regs. That is, they: "(i) Automatically trigger other actions that may require environmental impact statements; (ii) Cannot or will not proceed unless other actions are taken previously or simultaneously; or (iii) Are interdependent parts of a larger action and depend on the larger action for their justification." Ibid. "Agencies shall evaluate in a single environmental impact statement proposals or parts of proposals that are related to each other closely enough to be, in effect, a single course of action." 40 CFR § 1502.4(a)	A footnote has been added at the first use of "related action" directing the reader to *See* 40 C.F.R. § 1501.9(e)(1). This is the provision in the regulations that discusses/defines "connected actions".
17	2.1	AS	The NPS has also reviewed TVA's 2019 IRP analysis, which underpins TVA's least-cost determination. We note that additional explanation may be helpful, as TVA's IRP estimates appear to be at odds with more recent economic projections of the costs of renewable energy, as detailed in this comment. However, we recognize that the cost estimates presented are approximations of capital investment and operational costs. None-the-less, they indicate that the cost-competitiveness of renewable energy has improved dramatically in recent years and the DEIS should take a hard look at costs when identifying the "least cost option." According to Appendix A to the IRP, TVA's capital cost estimates (in $/kW) for each technology type included in the cost analysis are based on 2017$. A more recent 2021 Lazard report, "Levelized Cost of Energy, Levelized Cost of Storage, and Levelized Cost of Hydrogen," indicates that TVA may have underestimated the capital costs for a combined cycle plant and overestimated the capital costs for a utility scale photovoltaic (PV) system with backup battery storage. TVA estimated the capital costs of a combined cycle plant would be $560 to $699/kW depending on the plant configuration. TVA's estimates are well below the capital cost range reported by Lazard of $700/kW to $1,300/kW for combined cycle plants and significantly below EIA's estimates of $1,062/kW to $1,201 for combined	Please refer to the Alternatives Evaluation in Appendix B for more information on assumptions and methodology. TVA has updated all resource costs since the 2019 IRP and these costs are represented in 2023 dollars. Please note that the decision to retire and replace Kingston Fossil Plant is one part of TVA's overall diverse asset strategy. The Draft EIS reflects both individual and system-wide LCAs, which include cost summaries. In an IRP, TVA takes a programmatic look at cost and asset strategy, providing a target power supply mix consistent with least cost planning requirements. IRPs are performed every 4-5 years with the last completed one in 2019. A new updated IRP cycle will begin this year.

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			cycle units in their 2022 annual energy outlook. (Capital costs used in the Lazard Report available at: https://www.lazard.com/media/451905/lazards-levelized-cost-of-energy-version-150-vf.pdf. Capital Costs used in the EIA analysis available at: https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf.) TVA's capital cost estimates for utility scale PV systems of $1,203/kW to $1,293/kW are well above the range reported by Lazard of $800-$950/kW. TVA's estimated capital costs for battery storage of $2,824/kW are six to sixteen times higher than the capital cost estimates provided by Lazard, which range from $169 to $460/kW. EIA estimated capital costs for a PV system with battery backup at $1,748/kW, significantly lower than TVA's combined capital cost estimate for PV system plus battery back-up (approximately $4,000/kW). Lazard notes that the levelized costs of energy (LCOEs) of "renewable energy technologies continue to decline globally, albeit at a slowing pace, reflecting reductions in capital costs, increased competition as the sector continues to mature and continued improvements in scale and technology." The Lazard report is not the only recent economic information indicating that the LCOE (in $/MWh) for renewable energy sources has decreased dramatically between 2010 and 2020. Renewable energy sources are now cost-competitive with even the most economical fossil fuel-fired EGUs. This is significant considering TVA's "core statutory objectives to provide the people of the Tennessee Valley with low-cost and reliable electricity, environmental stewardship, and a prosperous economy." (16 U.S.C. §§ 831 et seq.) TVA's systemwide cost assessment provided in the 2019 TVA IRP indicates that the system-average cost for strategy E (promoting renewables) is cost-competitive with the other strategies analyzed by TVA at $70-$76/MWh. However, we note that this is a systemwide analysis, which includes TVA's hydro, nuclear, coal, gas, and oil-fired assets. LCOEs for solar energy sources alone are significantly lower than TVA's systemwide projections (with a maximum of $42/MWh and an average of $34/MWh across the U.S.). The Lazard report suggests these LCOEs reflect "unsubsidized" costs for utility scale solar projects. Additional tax incentives and subsidies under the Inflation Reduction Act may shift the balance of costs for renewable energy sources more in their favor. In terms of reliability, storage, and dispatch concerns for renewable energy, the EIA found that electricity storage capacity has grown rapidly since 2020 and that growth is expected to continue. (These comments focus on solar because TVA only analyzed solar in the FEIS. However, we note that a mixed renewable strategy may be a cost-effective option that increases reliability of the renewable energy system.) Finally, capital costs and LCOE figures from the Reports cited above only reflect costs for infrastructure investments, not the social costs of GHGs. TVA's analyses show that Alternative A is associated with $6.7 billion in nominal dollars for total life cycle social cost of CO2 emissions using the current administration's values for the cost of GHGs. (We note that based on Table 3.7 4, it appears TVA is using a SCC value of approximately $70/metric ton. EPA is currently considering raising this cost to as much as $190/metric ton). We recommend that the TVA analysis more fully address this information in the DEIS and take a comprehensive look at the long-term costs and financial risks of ongoing reliance on fossil fuel energy sources versus renewable energy options.	
18	2.1.3.2.1	DP	It seems like it'd be more correct to focus on the greenfield disturbance needed with this statement.	Accepted recommended revision to focus on the reduction in impacts to greenfield properties.

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19	2.1.3.2.1	DP	Restatement of part of previous bullet.	Revised to avoid redundancy.
20	2.1.3.2.1	DP	The KIF Reservation?	Sentence revised: The Kingston Reservation has favorable air permitting prospects for a new CC paired with dual-fuel Aero CT units, since it would be replacing the existing higher GHG emitting coal units.
21	2.1.3.2.2	AS	Please specify the number of combustion turbines that will be constructed under each configuration (combined cycle and peaking units). Both the air quality analysis sections and the emissions tables indicate that TVA intends to construct a combined cycle (CC) plant as well as dual-fuel Aeroderivative combustion turbine peaking units at the KIF site. This is not clear based on the language presented here, which could be interpreted to mean that the dual-fuel Aeroderivative CTs are components of the combined cycle plant. Based on information provided in the air quality sections of the analysis, the NPS has interpreted this to mean that TVA proposes to construct both a CC plant and CT peaking units—our comments are prepared accordingly. Please specify whether this understanding is correct.	See responses to Comments #1 and #20.
22	2.1.3.5.2	DP	East Survey Area transmission lines run near portions of Manhattan Project National Historical Park. West Survey Area transmission lines cross the Obed River upstream of its WSR section.	Section figures and text have been revised to identify and discuss the Manhattan Project National Historical Park and the Obed River Wild and Scenic River.
23	2.1.3.6	DP	ETNG submitted a request for pre-filing to FERC on May 6, 2022, and submitted draft resource reports in June and December 2022. There are additional specific references to ETNG's December 9, 2022, draft resource report filing below that would benefit from improved context here. NPS understands that ETNG anticipates filing their application with FERC in July 2023.	Revised text to state that ENTG submitted draft Resource Reports to FERC under Docket No. PF22 in June 2022 followed by revised Resource Reports in December 2022.
24	2.1.5	DP	…but was not selected due to…	Updated text to state the conversion of the existing coal units to natural gas fuel was also considered as an alternative to the retirement of the existing KIF, but was eliminated from detailed review. Although this alternative would have utilized the existing plant boilers of the current KIF coal plant, the generating plant would have been approximately 30 percent less efficient than the proposed CC and would be expected to have shorter lifespan. This, in addition to the potential for continued material condition issues and the O&M of an older, larger plant, lead to this alternative being dismissed from more detailed consideration.
eli25	2.1.5.1	DP	NPS understands that these alternatives are ETNG's, but what about ETNG's Line 3200-1 system?	No change. Not provided in draft resource reports because The Line 3200-1 system was not included in ETNG's draft resource reports because it was ruled out early on due to substantially higher cost.

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27	3.5.1.1.1.3	DP	From NPS Geomorphologist EB: The faults are ancient but have been reactivated to release stress accumulated through much of the eastern North American Plate. Earthquakes in the early 1800s are not ancient. Also, the term “deep-seated” is not useful when describing a fault without context. Locked faults don’t move between large earthquakes, so GPS readings a not incredibly useful for predicting future earthquakes. For example, there was no easily recordable deformation in the Canterbury Plains of the South Island of NZ before the 2010 Mw 7.1 earthquake. This was a preexisting intraplate fault formed there during a much different tectonic regime, but still able to release stress.	Removed text regarding ancient faults and land movements measured by GPS.
28	3.5.1.1.2.4	DP	From NPS Geomorphologist EB: Because steeper slopes in this part of the country are more likely to be forested, this is somewhat misleading. Vegetation can reduce landslide frequency by affecting hydrologic conditions, but steeper slopes are more prone to landslides than less steep slopes with or without vegetation.	Removed text regarding decreased vegetation on steeper slopes. Revised to state that “Landslides have a higher likelihood in areas with steeper slopes.”
29	3.5.1.1.2.4	DP	From NPS Geomorphologist EB: Earthquake shaking that is described as strong, very strong, or more violent using the Modified Mercalli Intensity (MMI) (VI and greater) has caused significant slope failures during past seismic events. Using relationships between MMI, peak ground acceleration (PGA) and peak ground velocity (PGV) (Worden et al., 2012), a MMI of VI and higher translates into an unstable slope triggering PGA of 0.12-0.22 g (12-22% of gravity) and greater or a PGV of 9.6-20 cm/s (3.8-7.9 in./s) or greater. For example, Mackey and Quigley (2014) and Massey et al. (2014) documented that rock cliffs subjected to PGA and PGV in this range experienced rockfall. The lower limit for any seismic triggering of landslides may be as low as 0.02-0.08 g (Jibson & Harp, 2016) so some discretion about whether one is interested in isolated landslides on very susceptible slopes or significant / concentrated land sliding on most susceptible slopes is warranted.	Accepted text suggestion.
30	3.5.1.1.2.4	DP	From NPS Geomorphologist EB, here and elsewhere: “Unlikely to occur” and “low probability” are not necessarily the same thing unless “unlikely to occur” is specifically defined.	Revised to clarify that earthquakes are unlikely to occur in the vicinity of the Study Area and, as such, the potential for soil liquefaction to occur in the Study Area is low.
31	3.5.1.2.2.6	DP	See previous comment from NPS Geomorphologist EB.	See response to Comment #30 above.
32	3.5.1.2.2.6	DP	From NPS Geomorphologist EB: See previous comment about site specific steep slopes. The USGS landslide incidence and susceptibility mapping is not intended to replace site specific evaluations in area of steep slope.	Sentence deleted to avoid confusion.

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33	3.5.1.2.2.7	DP	See comment regarding the same statement in the Intro through Section 2 doc.	Revised to state: "No mineral resources identified within 0.25-mile of the pipeline workspaces would be impacted."
34	3.5.1.2.3.1	EB	Same comment as above: Because steeper slopes in this part of the country are more likely to be forested, this is somewhat misleading. Vegetation can reduce landslide frequency by affecting hydrologic conditions, but steeper slopes are more prone to landslides than less steep slopes with or without vegetation.	See response to Comment #28 above.
35	3.6.2.1.1.2	JD	Wild and Scenic River are protected by more than just Section 7(a). For example, Section 10 provides an antidegradation requirement. Maybe just say they are protected subject to the Wild and Scenic River Act.	Recommended revision accepted.
38	3.7.1.1	AS	This statement is misleading and should be revised. It is well established that pollutants from power plants and other industrial sources can undergo long-range transport, contributing to air quality issues in areas far downwind of the source.	Revised by adding a qualifying statement with comparison of coal/oil vs. natural gas combustion.
39	3.7.1.1.8.4	AS	The NPS agrees with this conclusion and as noted elsewhere in our comments, we recommend that TVA take a more detailed look at the cost comparisons between Alternatives A and B based on more-recent information.	The text was revised as follows: All action alternatives significantly reduce system carbon intensity, compared to the No Action Alternative. The highly efficient advanced-class CC and Aero CTs in Alternative A reduce system carbon emissions by offsetting coal generation and by improving the combined fuel efficiency of the entire TVA gas fleet. Solar facilities in Alternative B reduce system carbon emissions by offsetting coal and gas generation, and while existing fossil units increase generation for battery charging or when solar is not available, this Alternative has the lowest system carbon rate (see Appendix B, Appendix H, and Appendix I for details on the carbon rate analysis). Although Alternatives A and B would help achieve the Administration's goal of reducing emissions from overall federal operations, Alternative B likely would go further in achieving the goals outlined in EO 14057 and 14082, the targets agreed to in the Paris Agreement, and National net zero policy. The Alternatives Evaluation includes a carbon rate comparison and the LCA goes into more detail. TVA remains committed to achieving the goals under these Executive Orders to the extent these goals can be achieved consistent with other statutory mandates applicable to TVA under the TVA Act, such as the TVA Act's least-cost planning requirements and the requirement to provide power at rates as low as feasible. GHG mitigation measures and their impacts are further discussed in the Environmental Consequences section of this EIS. For more information on solar cost and supply chain issues please see response to #13.

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40	3.7.2.1	AS	Recent information indicates that existing renewable energy sources are already cost-competitive with coal. For instance, a recent report produced by the non-partisan energy and climate policy think tank, Energy Innovation Policy & Technology LLC found that "99 percent of all coal-fired power plants in the U.S. are more expensive to operate on a forward- looking basis than the all-in cost of replacement renewable energy projects, and 97 percent are more expensive than renewable energy projects sited within 45 kilometers (approximately 30 miles), a significant acceleration from our two previous analyses. For more than three quarters of U.S. coal capacity, the all-in cost per MWh of the cheapest renewable option is at least a third cheaper than the going-forward costs for the coal it would replace." (See Coal Cost Crossover 3.0: Local Renewables Plus Storage Create New Opportunities for Customer Savings and Community Reinvestment, available at: https://energyinnovation.org/publication/coal-cost-crossover-3-0-local-renewables-plus-storage-create-new-opportunities-for-customer-savings-and-community-reinvestment/)	Comment noted.
41	3.7.2.3.1.4	AS	We appreciate that TVA included an Estimated Life Cycle GHG Emissions and Associated Social Costs assessment in the ADEIS and also presented the social costs for each individual KIF alternative rather than on a TVA systemwide basis. The life cycle assessment for each alternative improves transparency by considering the indirect effects of GHG emissions from upstream and midstream natural gas well drilling, production, and transport associated with Alternative A. It also provides a more meaningful method for comparison among alternatives by addressing the "cradle-to-grave" impact of natural gas combustion. TVA's analysis shows that, the preferred alternative, Alternative A, has the highest estimated GHG lifecycle emissions and associated future social cost of any of the action alternatives. As a federal agency, TVA has an opportunity to "lead by example" and replace the KIF coal-fired generation with renewable sources, measures that are necessary to implement the goals of EO 14057 to "achieve a carbon pollution-free electricity sector by 2035 and net-zero emissions economy-wide by no later than 2050." While natural gas-fired electricity generation is cleaner than coal-fired generation, it still emits criteria air pollutants that impact parks and approximately half the amount of carbon dioxide (CO_2) on a pound-per-megawatt basis, compared to coal (see emission summaries). It is anticipated that the natural gas plants constructed under Alternative A would require retrofits with carbon capture and storage to achieve a carbon-free electricity sector by 2035. Given this, it may be more cost-effective over the life of the plant to consider greater renewable replacement generation from the outset.	Comment noted.
42	3.7.2.3.1.4	AS	Again, natural gas-fired electricity generation is cleaner than coal-fired generation, but still emits approximately half the amount of carbon dioxide (CO_2) on a pound-per-megawatt basis, compared to coal (see emission summaries). In order to meet the goals of EO 14057, it is anticipated that the natural gas plants constructed under Alternative A would require retrofits with carbon capture and storage to achieve a carbon-free electricity sector by 2035. Given this, it may be more cost-effective over the life of the plant to consider greater renewable replacement generation from the outset.	Comment noted. TVA has committed to ensuring that the design of the Alternative A CC/Aero CT plant would enable and accommodate potential future modifications for carbon capture and the combustion of hydrogen (CC units only) as a replacement or supplemental fuel for natural gas when these technologies mature to scale. The proposed CC units under Alternative A would be designed to be 5 percent hydrogen capable at commissioning by adding balance of plant equipment that includes areas for future hydrogen storage, appropriately sized piping, and a blending station during the original construction. TVA would also purchase a CC unit capable of burning at least 30 percent hydrogen, by volume, with modifications to the balance of plant once a hydrogen source is available. TVA would only consider burning hydrogen as a part

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				of test burns or normal operations when it is commercially available at an acceptable chemical content that would reduce carbon emissions and be price competitive in the market at that time. It is important to note that once a viable option for future mitigation projects is identified, TVA would conduct additional analyses to determine proposed pipeline routes, costs, storage requirements, or other needs with hydrogen fuel incorporation. TVA would analyze the site- specific impacts associated with any future mitigation that is planned as additional details become available. TVA has considered the USEPA's draft whitepaper on reducing GHG emissions from CTs (USEPA 2022b) and anticipates the efficiency, effectiveness, scalability, and economics of these systems to improve in the next several years, allowing for more informed decisions in the future when adequate storage locations or pipelines are identified for both the delivery of hydrogen and the storage or use of captured CO_2. TVA is exploring partnerships with federal agencies and peer utilities to advance the research and development of both alternative fuels and CCS technology, which could enable their use at existing or future TVA facilities. In addition to the current cost and maturity challenges with CCS, the potential geological features (i.e., karst instability and tendency to develop sinkholes) of the Kingston Reservation pose further challenges to the consideration of CCS at this site.
43	3.7.2.3.7	AS	The NPS appreciates that TVA intends to factor future retrofits of carbon capture and storage into the design of the proposed combined cycle plant. We recommend that TVA incorporate the costs of such future retrofits into their cost analyses and financial risk assessment. It is possible that the LCOE of carbon capture and storage retrofits may prove to be more costly (on a $/MWh basis) than developing renewables from the outset and this should be addressed in the DEIS.	There are many uncertainties around the availability and cost of carbon capture technology. The combined cycle plant in Alternative A is designed to support potential implementation but given this technology is not deployable today, it is not part of the Alternatives Evaluation. See Response to comment #42 and Section 2.1.4.2 in the DEIS.
44	3.7.2.4.1.2	AS	Table 3.7 8 reflects an estimated 9.8 million tons of total life cycle CO_2 emissions are associated with Alternative B. However, as noted here, there are no operational emissions associated with Alternative B. The document does not disclose what solar-related activities these emissions are associated with (i.e., are they one-time construction emissions or associated with upstream or down-stream activities) or what emission factors were used to derive these estimates. We recommend that TVA disclose this information in the DEIS.	The total life cycle CO_2 emissions associated with Alternative B come from upstream and downstream activities which include raw material extraction/acquisition, product manufacturing and transport, site construction, and future deconstruction/demolition and disposal. This is explained in the DEIS section 3.7.2.4.1.4 entitled GHG Effects from Direct and Indirect Emissions – Life Cycle Analyses for Alternative B and in the referenced Appendix I which contains details on the individual resource GHG LCAs.
45	3.7.2.4.1.4	AS	Please clarify what activities/emission sources the lifecycle CO_2e emissions estimates of 9.8 million tons associated with Alternative B are attributed to. This is unclear because as noted in Section 3.7.2.4.1.2, "Operation of the solar and storage facilities are not expected to produce any emissions."	See response to Comment #44. Note that the statement referenced in this comment refers only to Alternative B emissions that occur during its operation. As noted in response to Comment #44, the lifecycle estimates for Alternative B include upstream and downstream activities, not just operation of the solar and storage facilities.

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46	3.7.2.4.1.4	AS	Please clarify what activities/emission sources the lifecycle CO2e emissions associated with Alternative B are attributed to.	See response to Comment #44.
47	3.9.1	AS	Recommend that this analysis/section is expanded to include areas of national significance within the KIF vicinity, including Great Smoky Mountains National Park, which is located approximately 60 km southeast of the KIF facility and Obed Wild and Scenic River, which is located approximately 23 km northwest of the KIF facility. Great Smoky Mountains is America's most visited national park. In 2022, nearly 13 million visitors came to experience the park's world-renowned biological diversity, scenic beauty, mountain landscapes, and Southern Appalachian Mountain culture. (See: https://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/Park%20YTD%20Version%201?Park=GRSM) Emissions from TVA facilities have had a direct impact on the air quality in National Park System units across the Southeastern U.S. for nearly fifty years. Research and monitoring conducted in Great Smoky Mountains, Mammoth Cave, and Shenandoah National Parks over the past forty years has shown that these airborne pollutants are degrading park resources which can impact visitor enjoyment. The burning of fossil fuels (coal and natural gas) causes most of the air pollution affecting these parks. Including a description of NPS units impacted by the no action and action alternatives explicitly highlights the national prominence and importance of these parks to the American public.	Section 3.9.1 updated with regional climate section that discusses GSMNP and Obed Wild and Scenic River.