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BROWNS FERRY NUCLEAR PLANT SUBSEQUENT LICENSE RENEWAL PROJECT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

Limestone County, Alabama

Prepared for:
TENNESSEE VALLEY AUTHORITY
Athens, AL 35611

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COVER SHEET

Browns Ferry Nuclear Plant Subsequent License Renewal

Proposed action: The current operating licenses for Browns Ferry Nuclear Plant (BFN) expire on December 20, 2033, for Unit 1, June 28, 2034, for Unit 2, and July 2, 2036, for Unit 3. The purpose of the proposed action is to help provide continued generation of baseload power from the BFN site between 2033 and 2056 by obtaining subsequent license renewals from the Nuclear Regulatory Commission (NRC) to operate all three BFN units.

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Abstract: TVA proposes to submit a subsequent license renewal (SLR) application to the NRC for Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3, in Limestone County, Alabama. SLR would permit operation for an additional 20 years past the current operating license terms that expire in 2033, 2034, and 2036 for Units 1, 2, and 3 respectively. SLR would involve continuation of normal operations, maintenance, and refueling. The SLR program would not require major new construction, alternations, or refurbishment to BFN to maintain consistency with the current licensing basis. The purpose of the proposed action is to continue to generate baseload power at the BFN site between 2033 and 2056. BFN's current baseload generation supports future forecasted baseload power needs, as outlined in the TVA's 2019 Integrated Resource Plan (IRP), by helping to maintain grid stability and generating capacity for TVA's generation portfolio mix. In addition to continuing to operate BFN, TVA evaluated alternative methods for supplying electrical power. Relative to BFN, the No Action Alternative would involve ceasing operation of BFN when the current operating licenses expire and using other methods to provide necessary capacity and energy. Feasible alternatives evaluated in more detail include natural gas, solar, storage, and nuclear SMRs. TVA has prepared this supplemental environmental impact statement to inform decision makers and the public about the potential environmental impacts that would result from renewing BFN operating licenses. This document supplements the original 1972 *Final Environmental Statement, BFN Units 1, 2, and 3* and the 2002 *Final Environmental Impact Statement for Operating License Renewal of the BFN in Athens, Alabama* that TVA prepared to evaluate the impacts from license renewal. TVA will use this information in addition to input provided by reviewing agencies, tribes, and the public to make an informed decision about renewing BFN operating licenses.

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SUMMARY

Purpose and Need for Action

The current operating licenses for Browns Ferry Nuclear Plant (BFN) expire on December 20, 2033, for Unit 1, June 28, 2034, for Unit 2, and July 2, 2036, for Unit 3. The Tennessee Valley Authority (TVA) must decide whether to submit a subsequent license renewal (SLR) application (SLRA) to the Nuclear Regulatory Commission (NRC) to renew the operating licenses of the three BFN units for an additional 20 years beyond their current license expiration dates.

As an integral part of TVA's current generation portfolio, in 2020, BFN produced approximately 20 percent of TVA's average generation capacity. Renewal of the current operating licenses would allow BFN to continue supplying approximately 3,900 megawatts electric (MWe) capacity of safe, clean, reliable, and cost-effective baseload power for an additional 20 years. BFN has two onsite independent spent fuel storage installations (ISFSIs) using dry cask storage. Expansion of the onsite ISFSI capacity will be required by 2036 to support BFN operations during the period of SLR if the U.S. Department of Energy (DOE) does not provide for permanent storage and disposal of the onsite spent fuel as planned. Otherwise, the SLR program would not require major new construction, alterations, or refurbishment to BFN to maintain consistency with the current licensing basis. Furthermore, BFN SLR is a key component of meeting TVA's goal of a net-zero carbon emissions generating system by 2050.

The purpose of the proposed action is to continue to generate baseload power at the BFN site between 2033 and 2056 through obtaining SLRs from the NRC to continue operation of all three BFN units. BFN's current baseload generation supports future forecasted baseload power needs, as outlined in the TVA's 2019 Integrated Resource Plan (IRP), by helping to maintain grid stability and generating capacity for TVA's generation portfolio mix.

TVA operates BFN Units 1, 2, and 3 in Limestone County, Alabama. Unit 1 began commercial operation in 1974, Unit 2 in 1975, and Unit 3 in 1977. The BFN site is located on an approximately 880-acre tract on the north shore of Wheeler Reservoir at Tennessee River Mile 294, approximately 30 miles west of Huntsville, Alabama, 10 miles northwest of Decatur, Alabama, and 10 miles southwest of Athens, Alabama.

This Supplemental Environmental Impact Statement (SEIS) supplements the original *Final Environmental Statement, BFN Units 1, 2, and 3* that TVA prepared in 1972 to evaluate the impacts of constructing and operating BFN and the *Final Environmental Impact Statement for Operating License Renewal of the BFN in Athens, Alabama* that TVA prepared to evaluate the impacts from license renewal. Information from the 1974 final environmental statement and final environmental impact statement (EIS) was analyzed and updated where needed to develop this SEIS. Additionally, information from other related environmental reviews was used to facilitate the development of this SEIS. This SEIS also updates the need for power analysis based upon the current TVA power system, TVA forecasted economic conditions, costs of fuel and technology, and other contributing factors. In TVA's IRP released in June 2019, the analysis included existing nuclear power plants such as BFN to be a main component of TVA's power supply in the future. This SEIS uses information and analyses from the IRP EIS process, particularly for load forecasting and evaluation of energy generation portfolios designed to meet forecasted needs.

Alternatives

Alternatives were analyzed in addition to the continuing operation of BFN by SLR and the proposed subsequent period of extended operation. TVA considered alternatives for the generating capacity and energy needed to provide approximately 3,900 MWe of baseload power between 2033 and 2056. TVA's IRP identified potential options for meeting TVA's purpose and need, including the range of supply-side and demand-side actions. TVA reviewed combinations of options that would, and would not require new generating capacity.

The Action Alternative for BFN is to continue operation by completing SLR. Taking no action to renew the BFN operating licenses would result in ceasing operation of BFN Unit 1 in 2033, Unit 2 in 2034, and Unit 3 in 2036. Subsequently, TVA would need to rely on alternate means to meet the demand for power that BFN provides. Therefore, in this SEIS, implementing an alternate way to provide the capacity and energy otherwise generated at BFN is described as part of the No Action Alternative.

Eventual decommissioning of BFN would be necessary regardless of TVA's decision to pursue SLR. BFN would undergo decommissioning at the end of the current licenses, or at the end of the proposed subsequent period of extended operation. BFN would be placed in a safe condition and all fuel removed from the reactor. Decommissioning activities would begin after the permanent and safe shutdown of the units is achieved and after the formal decommissioning plans are approved by the NRC.

Safe storage of spent fuel would also be necessary whether the BFN operating licenses are renewed or not. BFN has two ISFSI used to safely store spent fuel in licensed and approved dry cask storage containers on site. These ISFSI are licensed separately from the BFN operating units and would remain in place until the DOE takes possession of the spent fuel and removes it from the site for permanent disposal or processing.

In-scope transmission lines potentially affected by the proposed action include those lines connecting BFN to the onsite switchyards. All in-scope transmission lines are located completely within the BFN site boundary. Each BFN unit is connected into the existing TVA 500-kilovolt (kV) transmission system by three 500-kV transmission lines via an onsite 500-kV switchyard. BFN is also connected to the 161-kV switchyard through two 161-kV transmission lines. Transmission lines connecting the BFN switchyard to the electric power grid would be operated whether BFN is operated or shut down. Operation and maintenance of these transmission lines connecting the switchyard to the grid does not depend upon the decision to renew BFN operating licenses; proposed maintenance would be identical regardless of the decision to pursue SLR~~.~~ Therefore, operation of out-of-scope transmission lines and maintenance of rights-of-way are not addressed in this SEIS.

Alternative A – BFN Units 1, 2, and 3 Shutdown - No Action Alternative

If no action were taken by TVA, the operating licenses for BFN would expire on December 20, 2033 for Unit 1, June 28, 2034 for Unit 2, and July 2, 2036 for Unit 3. If the operating licenses expire, BFN would shut down and enter decommissioning. The TVA power service area would be shorted approximately 3,900 MWe of reliable base load generation and electric service could be disrupted during periods of peak demand on the TVA system if alternate generations sources were not available.

Therefore, if BFN were shut down at the end of the current license period, TVA would need to rely on alternate means to provide adequate capacity and energy in the absence of BFN. Alternatives sufficient to meet the project purpose and need include the construction of a combination of new generating capacity (i.e., natural gas-fired combined cycle generation, natural gas-fired combustion turbine generation, solar generation, energy storage, and nuclear-powered generation in the form of small modular reactors).

Alternative B – BFN Units 1, 2, and 3 Subsequent License Renewal – Proposed Action
The proposed action is for TVA to submit a SLR application to extend the expiration dates for BFN's operating licenses. Subsequent renewal of the current operating licenses would permit operation for an additional 20 years past the current operating license terms that expire on December 20, 2033, for Unit 1, June 28, 2034, for Unit 2, and July 2, 2036, for Unit 3. The NRC would evaluate TVA's SLRA and the potential environmental impacts of granting SLRs. If SLR is granted, BFN would be available as a base load generation plant until 2053 for Unit 1, 2054 for Unit 2, and 2056 for Unit 3.

The proposed subsequent period of extended operation would not require major new construction, alterations, or refurbishment to BFN to maintain consistency with the current licensing base. Nor would it require changes to the programs, processes, or procedures currently in use. No changes to operational limits or permit requirements would be necessary to comply with current regulations. Other than the continued normal operations, refueling, and maintenance for an additional 20 years, no refurbishments or plant modifications would be needed during the proposed subsequent period of extended operation to continue current operation of BFN Units 1, 2, and 3. Expansion of the onsite ISFSI capacity will be required by 2036 to support BFN operations during the proposed subsequent period of extended operation if the DOE does not provide for permanent storage and disposal of the onsite spent fuel as planned. The current ISFSI storage pads are projected to be filled on or before year 2036. Under the existing licenses, and assuming decommissioning at the end of the current license periods, additional dry fuel storage cask will be needed to support operations and decommissioning. The addition of a third ISFSI storage pad to further increase storage capacity needed for the proposed subsequent period of extended operation is under consideration, but plans are in the conceptual stage and no installation schedule has been established. The BFN site has adequate space onsite to accommodate the construction of an additional ISFSI pad if necessary. Should this be necessary, the impacts associated with this expansion would be assessed under a licensing process separate from that of BFN Units 1, 2, and 3 Renewed Facility Operating Licenses, consequently it would also be reviewed under a separate NEPA evaluation.

<u>Summary of Environmental Consequences</u>
Potential environmental impacts of the proposed project and the power generation alternatives are briefly summarized in Table S-1.

Preferred Alternative
Based upon the evaluations presented in this SEIS, and considering environmental impacts, costs, electrical generation needs of the TVA system, and TVA goals and policies, TVA has identified Alternative B – BFN Units 1, 2, and 3 SLR as the preferred alternative. Implementing the preferred alternative would provide the Tennessee Valley with an additional 20 years of reliable base load power while promoting TVA's efforts to reduce carbon emissions, make beneficial use of existing assets, and deliver power at the lowest feasible cost.

<u>Public Review of the Draft SEIS</u>
On June 1, 2021, TVA published a Notice of Intent (NOI) in the Federal Register announcing plans to prepare a SEIS to address the potential environmental effects associated with extending the operation of BFN Units 1, 2, and 3 for an additional 20 years. The NOI initiated a

30-day public scoping period, which concluded on July 1, 2021. In addition to the NOI in the Federal Register, TVA published notices regarding this effort in two local newspapers: The Decatur Daily which serves the Decatur and the Tennessee Valley in northern Alabama and the News Courier which serves Limestone County. TVA also issued a news release to media and posted the news release on the TVA Web site.

TVA also created a virtual meeting room that remains available for the duration of the NEPA analysis. The URL link to the virtual meeting room was included in the NOI and can be accessed through TVA's website (https://www.tva.com/environment/environmental-stewardship/environmental-reviews/nepa-detail/browns-ferry-nuclear-plant-subsequent-license-renewal). The virtual scoping meeting room contains information on the NEPA process and the proposed action, as well as links to TVA and NRC websites related to the project.

A draft of the SEIS was released for public review and comment on February 10, 2023. The availability of the Draft SEIS and request for comments was announced in newspapers that serve the Limestone County area, and the Draft SEIS was posted on TVA's website. TVA's agency involvement included notification of the availability of the Draft SEIS to local, state, and federal agencies and federally recognized tribes. Comments were accepted through March 14, 2023, via TVA's website, mail, and e-mail.

TVA received two comment letters from members of the public via TVA's website and one comment letter from the U.S. Environmental Protection Agency (USEPA). TVA carefully reviewed all the comments. Comments raised during the comment period are summarized by topic along with TVA's responses to each comment in Appendix B. A copy of each of the comment letters is included at the end of the appendix.

The completed final SEIS will be transmitted to the USEPA, which will publish another notice of availability (NOA) in the Federal Register. TVA will make a decision on the proposed action no sooner than 30 days after the USEPA's NOA of the final SEIS is published in the Federal Register. This decision will be based on the project purpose and need, anticipated environmental impacts as documented in the final SEIS, and cost, schedule, technological, and other considerations. To document the decision, TVA will issue a formal record of decision (ROD).

Table S-1. Summary of the Environmental Impacts of the No Action and Action Alternatives

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Land Use	Changes in land use, land acquisition, or land conversion.	*Impacts of BFN shutdown:* No changes in onsite land use patterns. Potential decrease in offsite land-use impacts from decreased uranium mining demand. *Impacts due to new generation assets:* Alternative sources for energy include a combination of natural gas-fired combined cycle (CC) generation, natural gas combustion turbine (CT) generation, solar photovoltaic (PV) facilities, energy storage facilities, and small modular reactors (SMRs). Some of these alternative sources could be sited on the nearly 880-acre BFN site and some would be sited offsite. Impacts to land use associated with construction of these new sources for energy would be small to moderate.	No changes to offsite or onsite land use Impacts associated with expansion of ISFSI would be assessed under a licensing process separate from that of the BFN SLR. Incremental contribution to cumulative impacts to land uses would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Geology and Soils	Seismic adequacy	*Impacts of BFN shutdown:* No impacts from potential minor seismic event(s) would be expected during shutdown activities. *Impacts due new generation assets:* The site chosen for any replacement generation facility would be evaluated for geologic conditions and potential seismic impacts during the site-selection process Impacts would largely be associated with ground-disturbing activities associated with the new construction and would be expected to be small.	No changes or new impacts.
	Changes or use of geological resources	*Impacts of BFN shutdown:* Anticipated impacts to soils from decommissioning would be small. *Impacts due new generation assets:* Potential effects from construction could include excavation, grading, and blasting. Impacts could range from small to moderate and would depend on the type and extent of soil disturbance activities.	No changes or new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Surface Water	Surface water hydrology and water quality.	*Impacts of BFN shutdown:* Impacts to surface water quality would be small, and potentially beneficial. *Impacts due to new generation assets:* The characteristics of the surface water impacts would be expected to be small because they would be controlled under an NPDES permit that would be regulated by the state in which the plant(s) is located. There is a potential that some erosion and sedimentation may occur during construction; however, construction would be temporary, and the implementation of best management practices (BMP) should limit any potential impacts to surface water quality. Depending on the water source, the impacts on water quality caused by plant discharge could have noticeable impacts. The plant would have to maintain compliance with the plant's NPDES permit. Impacts would be expected to be small.	All releases to surface water would be controlled as per NPDES permits and impacts would remain small. BFN complies with current NRC regulations. No change is anticipated regarding potential impacts from the current level of small impacts anticipated.
	Surface water use and trends.	*Impacts of BFN shutdown:* Impacts to surface water use would be small, and potentially beneficial. *Impacts due new generation assets:* Surface water use impacts would depend on the volume of water withdrawn for makeup water for each new generation source relative to the amount available from the intake source and the characteristics of the surface water. The overall impacts could be small for water use impacts during normal flows and possibly large impacts during extreme low-flow conditions. Potential impacts can be mitigated by derating (reducing the thermal output of the plant by reducing its electrical power rating) during periods of thermal sensitivity.	Direct, indirect, and cumulative effects of chemical and thermal discharges would be small. No changes in current level of small impacts to water supply. No cumulative effects to water supply are expected.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Surface Water (continued)	Hydrothermal effects of plant operation.	*Impacts of BFN shutdown:* Impacts would be small, and potentially beneficial. *Impacts due new generation assets:* Hydrothermal impacts on surface water from an SMR or gas-fired plant would be site specific, and dependent on the volume and temperature of water discharged. The use of cooling towers and compliance with the NPDES permit should minimize impacts which could range from small to large.	BFN would continue to operate within the thermal limits set by BFN's NPDES permit and without measurable adverse impact. BFN is in compliance with current NRC and ADEM regulations related to thermal discharge evaluation requirements; therefore, no change regarding any potential impact from the current level of small impact would be anticipated, including to cumulative impacts.
	Chemical additives for plant operation.	*Impacts from BFN shutdown:* The use of chemical additives would decrease and eventually end resulting in small and potentially beneficial impacts. *Impacts due new generation assets:* Plant discharges would be regulated by the state in which the plant is located. An NPDES permit would be required, and the plant would comply with applicable water quality standards and criteria. Therefore, when the new generation source commences operation, the direct, indirect, and cumulative effects of chemical discharges would be expected to be small.	Current use and discharge of chemical additives is expected to remain the same during the proposed subsequent period of extended operation. There would be no change in impact from the current level of small impact.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Groundwater	Chemical and radiological impacts to groundwater. Groundwater use.	*Impacts from BFN shutdown:* No effects to the groundwater hydrology, groundwater use, or groundwater quality. *Impacts due new generation assets:* Groundwater impacts for new generation resources would depend on the use of groundwater and construction activities required to build the plant, aquifer conditions, and other withdrawals and on the type of plant constructed. With compliance with all permits and regulations and use of BMPs, chemical and radiological impacts to groundwater would be anticipated to be small. Although it is unlikely that groundwater would be used for makeup and/or cooling water, it would depend on site-specific conditions and therefore the impacts could be moderate to large.	No change from current level of small impact. No groundwater use at BFN. No impact anticipated.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Floodplains and Flood Risk	Construction or modification of the floodplain.	*Impacts from BFN shutdown:* No impact is anticipated on any floodplain or flood risk since a majority of the site is located outside of the floodplain. Negligible beneficial impacts would occur if facilities within the 100-year floodplain were removed upon shutdown. *Impacts due to new generation assets:* Construction and operation of a new plant(s) would introduce construction impacts and new incremental operational impacts. All proposed construction would be evaluated to ensure consistency with EO 11988. Proper standard erosion-control measures would be followed to minimize the potential for adverse impacts on floodplains. Therefore, impacts would be anticipated to be small.	No increase in flood risk and no new impacts to floodplains in the Wheeler Reservoir watershed.
Wetlands	Destruction of wetlands or degradation of wetland functions.	*Impacts from BFN shutdown:* No impacts to wetland resources on or in the vicinity of BFN would be anticipated. *Impacts due to new generation assets:* Construction of new generating sources for energy would result in small to large impacts depending on the physical location of the plant structures and footprint.	Impacts would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat.	*Impacts due to BFN shutdown:* Elimination of impingement and entrainment, thermal effects, non-cooling water discharge, maintenance dredging, and other operational effects generally would be expected to be small and beneficial for aquatic resources. *Impacts due to new generation assets:* Construction and operation of new SMR plant(s) could range from small to large depending on plant design, organisms present, source water, and receiving water. Construction and operation of other generating sources would range from small to large depending on location of the plant and supporting structures. Impacts would be mitigated through use of BMPs and adherence to permit and regulatory requirements.	Impacts from impingement and entrainment, thermal effects, non-cooling water discharge, maintenance dredging, and other operational effects would be small.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife.	*Impacts due to BFN shutdown:* The elimination of operational effects would be expected to be small and beneficial for terrestrial resources. *Impacts due to new generation assets:* In association with construction of a new generation facility, impacts would occur to terrestrial plants cleared to accommodate the new plant site. Wildlife in the vicinity may be able to relocate and would have lesser impacts due to displacement, habitat loss, and fragmentation. Direct and indirect impacts from construction of these new sources for energy would range from small to moderate. Small cumulative impacts to terrestrial vegetation and wildlife.	No change from current BFN operations and impacts would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species including impacts to their critical habitat.	*Impacts due to BFN shutdown:* The elimination of operational effects would be expected to be small and beneficial for threatened and endangered species. *Impacts due to new generation assets:* Possible alternative sources could be sited onsite or offsite. Small to large indirect and direct impacts from alterations in land use patterns and human population density and growth rates that could alter habitats. Construction of generating sources could have small to large cumulative impacts from potential habitat loss, habitat fragmentation, and loss of biodiversity.	No effect on the gray bat, Indiana bat, northern long-eared bat, and tricolored bat. BFN operations that could result in tree removal would be assessed in separate environmental reviews and Section 7 Consultation would occur as appropriate to address potential impacts. Small impacts on monarch populations, bald eagles, migratory birds, aquatic species.
Managed and Natural Areas	Degradation of the value or quality of natural areas.	*Impacts due to BFN shutdown:* No impacts to managed and natural areas in the vicinity would be expected. *Impacts due to new generation assets:* Avoidance planning would likely place any potential new generation plants at a safe distance from most natural areas, therefore impacts would be small. However, over time there could be small to large cumulative impacts resulting from additional development.	Impacts would remain small. Cumulative impacts would be small.
Recreation	Degradation or elimination of recreational facilities or opportunities.	*Impacts due to BFN shutdown:* No impacts are anticipated. *Impacts due to new generation assets:* Alternative generation facility locations would be assessed for potential adverse impacts. If a potential facility were sited near a recreational, scenic, or culturally significant area, then noise, dust, viewshed, and watershed impacts could range from small to moderate.	No impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Meteorology, Air Quality, Climate Change and Greenhouse Gasses	Local meteorology and meteorological conditions.	*Impacts due to BFN shutdown:* No impact to meteorology and impact to air quality would be slightly beneficial. *Impacts due to new generation assets:* Prior to construction of a new generating plant, local meteorological conditions would be evaluated to model dispersion characteristics as well as the potential impact on the local air quality from the operation of the new facility.	No impact.
	Emissions resulting in increases of air pollutants.	*Impacts due to BFN shutdown:* Once the destruction and recycling of site structures and facilities began, there would be a brief period of increased pollutant emissions from construction-type activities resulting in temporary adverse air quality impacts. These would be minimized through use of BMPs and adherence to all applicable regulations. *Impacts due to new generation assets:* Construction of alternative generation sources would result in a temporary increase in fugitive dust emissions, vehicular traffic emissions, heavy equipment emissions, and concrete batch plant emissions. BMPs would be used to control the sources of emissions, and the impacts would be small and of short duration. Depending on alternative power generation methods, adverse operational impacts to air quality would be small to moderate.	BFN is not a significant source of pollutants, and the impact of operation for an additional 20-year period would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Air Quality, Climate Change and Greenhouse Gasses (continued)	Climatology and effects due to climate change.	*Impacts due to BFN shutdown:* Small impacts on GHGs as a result of emissions during decommissioning. These impacts would be temporary and would not be expected to contribute to climate change. *Impacts due to new generation assets:* Small impacts on GHGs from the construction of alternative generation sources. These impacts would be temporary and would not be expected to contribute to climate change. Operation of a new SMR or solar plant(s) would not create a significant source of pollutants including GHG, because those facilities produce considerably less air pollutants when compared to fossil-fueled generation sources. Therefore, the environmental impact of a new SMR or solar plant(s) would be small. Operation of a new natural gas-fired turbine plant would increase some GHGs and impacts would be small to moderate.	The impacts of BFN on air quality, GHGs, and global climate change would be expected to be small.
	Gasoline and diesel emissions from vehicles and equipment.	*Impacts due to BFN shutdown:* Vehicle and equipment emissions would initially increase during decommissioning of BFN which would result in small temporary impacts on GHG emissions. *Impacts due to new generation assets:* Vehicle and equipment emissions would initially increase during construction of any alternative generation resources which would result in small temporary impacts on GHG emissions.	No changes or new impacts would occur.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Transportation	Elevated levels of traffic from construction work force and deliveries.	*Impacts due to BFN shutdown:* Any decline in traffic due to plant closure would likely be partially offset by future development. *Impacts due to new generation assets:* Construction and operation of a new generation facility would potentially impact the transportation infrastructure and traffic load on the roadways associated with a site. Mitigation of potential transportation impacts due to the location of a facility may be necessary because of expected increases in construction and operation traffic. Therefore, impacts could range from small to moderate.	No changes or new impacts expected.
Visual Resources	Effects on scenic quality, degradation of visual resources.	*Impacts due to BFN shutdown:* No adverse impacts. *Impacts due to new generation assets:* The impact on the visual resources of an area would be dependent upon the physical, biological, and cultural characteristics of the potential new generation site. The level of impact anticipated during construction and operation would range from small to moderate and vary depending upon viewer distance from the site, the abundance of trees, hilly terrain, and mitigation measures used, such as utilizing landscape materials on site, and painting techniques applied to facility structures.	No new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Noise and Vibration	Generation of noise at levels causing a nuisance to the community.	*Impacts due to BFN shutdown:* A drop in industrial noise would result in a small beneficial impact long-term. *Impacts due to new generation assets:* Noise impacts for a new generation facility and transmission systems are dependent on the distance to the nearest critical receptor. Noise for the construction of a new generation plant is expected to be small to moderate (depending on location and type of sensitive receptor) because most noise-producing construction activities are of short duration and the construction is temporary, and there are numerous mitigation methods that can be implemented to limit the impact of noise. Operational noise would also be anticipated to be small.	Impacts would be small. No change from the current condition.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Socioeconomics	Changes in local populations, employment, and incomes.	*Impacts due to BFN shutdown:* Impacts related to loss of jobs and income would be short-term and small. *Impacts due to new generation assets:* Potential effects from construction and operation of new assets could help offset the loss of jobs from BFN shutdown, it could also result in a small shift in population both during construction and operation. Therefore, impacts could range from small to moderate, depending on site specific site conditions.	No changes in operating employment levels. No new impacts to population, local employment, or income.
	Changes in availability of housing.	*Impacts due to BFN shutdown:* May cause housing costs to slightly decrease which would result in short-term and small impacts. *Impacts due to new generation assets:* Population shifts related to construction of new generation sources could place pressures on the housing market during both construction and operations. impacts could range from small to large depending on available housing surrounding the potential site areas.	No changes or new impacts.
	Local government revenues.	*Impacts due to BFN shutdown:* Small impact on local government revenues as a result in potential changes in TVA's payment in lieu of taxes. *Impacts due to new generation assets:* Construction and operation of replacement generation sources would result in a beneficial impact if the total amount of TVA-managed land in any individual county increased. Revenue increases would be proportionally small. Impacts from construction and operation would be beneficial.	No changes or new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Socioeconomics (continued)	Police, fire, and medical services.	*Impacts due to BFN shutdown:* Phased reduction in the need for public safety services and emergency personnel. These changes would likely be offset by continued growth in the counties in the vicinity of BFN. *Impacts due to new generation assets:* Depending on the proximity to population centers and the availability of emergency services in the vicinity of these generation resources, the influx of construction workers could impact the ability of an area's police, fire, and medical facilities to provide support requiring additional resources. The expansion of public safety services would support incoming operational staff and families expected to permanently move to the area, as well as other further county population growth. Therefore, impacts could range from small to moderate.	No changes or new impacts.
	Schools and education.	*Impacts due to BFN shutdown:* The loss of operational jobs could result in a loss of population and result in reduced school enrollment. Impacts would likely be small. *Impacts due to new generation assets:* The arrival of workers and the facility would bring new monies to a region through direct and indirect spending, and in the long run, the costs of providing education for additional students should be offset by the increase in tax revenues and plant equivalent payments, therefore impacts should be small.	No changes or new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Environmental Justice	Disproportionate effects on low-income and/or minority populations.	*Impacts due to BFN shutdown:* impact is expected to be short-term and small with no disproportionate impacts to potential environmental justice communities of concern. *Impacts due to new generation assets:* Environmental justice issues would depend on the proposed location of the new generation assets and impacts could range from small to moderate based on pressure on food and housing process, or increases in road congestion or noise near residential communities	No disproportionate effects on low-income or minority populations. No incremental contribution of the continued operation of BFN to the cumulative environmental justice conditions in the region during the proposed subsequent period of extended operation

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Archaeological and Historic Resources	Damage to archaeological sites or historic structures.	*Impacts due to BFN shutdown:* Any decommissioning activities, including but not limited to demolition could result in adverse effects to the National Register of Historic Places-eligible BFN historic district and contributing structures Should any activity related to decommissioning be proposed that would modify BFN or affect any of the potentially-eligible archaeological sites, TVA will follow the steps of §800.5 for assessing adverse effects and, if required, the steps of §800.6 for resolving adverse effects. *Impacts due to new generation assets:* All lands involved in the undertaking would likely need an inventory and evaluation of cultural resources to identify historic properties and may require avoidance plans or other actions to mitigate adverse effects from proposed ground-disturbing actions and/or visual effects related to physical activities at the proposed site. The effects on cultural resources could, depending on the site, range from small to large. The anticipated NHPA Section 106 process would ensure that any historic properties would be properly identified and managed and that potential impacts would be considered and mitigation developed as appropriate.	No effect to archaeological and historic resources within BFN site or vicinity are expected. Should any activity related to SLR be proposed that would modify BFN or affect any of the potentially-eligible archaeological sites, TVA will follow the steps of §800.5 for assessing adverse effects and, if required, the steps of §800.6 for resolving adverse effects.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Hazardous, Solid, and Low-Level Radioactive Wastes	Generation and disposal of hazardous, sold, and low-level radioactive wastes.	*Impacts due to BFN shutdown:* Impact on the environment from waste generated during the period of decommissioning would be small. *Impacts due to new generation assets:* The quantities and types of solid waste generated by the construction and operation of replacement generation resources would be determined primarily by the number of acres, the initial condition of the selected site(s), and the location and type of technology chosen. Any construction and demolition wastes generated during the building and renovation process would be managed through the TVA waste disposal contracts to access the permitted disposal capacity or recycling facilities, as needed. Construction of new transmission lines has a potential to produce large volumes of solid waste. TVA-established management practices would ensure impacts to the public and the environment are small.	Waste would continue to be handled according to TVA approves procedures and federal regulations. Impacts would continue to be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Radiological Effects of Normal Operations	Effects to humans and nonhuman biota from normal radiological releases.	*Impacts due to BFN shutdown:* Decommissioning effluent releases would be small. *Impacts due to new generation assets:* There would be no radioactive effects during the construction of a new SMR plant(s) unless the construction takes place at the location of another operating nuclear plant, or there are multiple units being built and one unit becomes operational before the other(s). The radiological impacts from the construction of a new nuclear plant would be of minor significance to the construction workers. There would be no expected observable impacts from radioactive liquid or gaseous releases from a new SMR plant(s) during normal operations. The REMP would be set up for the new SMR plant(s) to ensure there are no measurable indirect or cumulative effects to the environment offsite of the new location or to the public. There would be no radioactive impacts from the construction and operation of other potential generation resources.	Annual doses to the public are well within regulatory limits; no observable health impacts are expected. No changes or new impacts are expected. Doses to nonhuman biota would be well below regulatory limits; no noticeable effects are expected and impacts are expected to remain small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Uranium Fuel Cycle Effects	Radioactive waste volumes and disposal.	*Impacts due to BFN shutdown:* Impacts associated with radioactive waste handling, storage, and transportation for decommissioning activities would be expected to be small. *Impacts due to new generation assets:* If new SMR generation were selected, the approved design would be subject to the same requirements for handling and processing radioactive waste at BFN. Similar to BFN, the environmental impacts associated with radioactive waste handling, storage, and transportation would be expected to be small and potentially less than BFN. There would be no environmental impact related to radioactive waste during the construction or operation of any non-nuclear power generation facility.	Impacts to the public and the environment resulting from processing, storage, and transportation of solid radwaste, including cumulative effects of waste storage from BFN would remain small. During decommissioning, the plant would ship all stored radioactive material to be processed or to its final disposal. Transportation impacts of all types of radioactive waste would be expected to be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Uranium Fuel Cycle Effect (continued)	Radioactive waste transportation.	*Impacts due to BFN shutdown:* Generation of routine operational radioactive waste would cease. However, decommissioning of active components would generate waste and result in in small impacts. *Impacts due to new generation assets:* Impacts associated with radioactive material transportation at any new SMR facility would be small.	The impact to members of the public resulting from processing, storage, and transportation of solid low-level radioactive waste would be small.
	Spent fuel.	*Impacts due to BFN shutdown:* No additional spend fuel would be generated after BFN is shutdown. Small impacts as it is operated under a separate license. *Impacts due to new generation assets:* Impacts associated with spent fuel storage at any new SMR generation facility would be expected to be small. There would be no environmental impact related to spent nuclear fuel during construction or operation of any non-nuclear power generation facility. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses	Small impacts from the operation of the ISFSI, as it is operated in accordance with all applicable regulations. Additional ISFSI storage capacity would be required before 2036 if DOE does not take possession of spent fuel. Impacts from the construction and operation of an additional storage pad would be assessed in a separate evaluation and would be expected to have small cumulative impacts including small direct impacts from radiation doses from the ISFSI for onsite workers and people in the surrounding area.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Nuclear Plant Safety and Security	Postulated design-basis accidents.	*Impacts due to BFN shutdown:* All equipment and facilities would be properly maintained to ensure high integrity and safety of all systems through the end of operation and decommissioning. *Impacts due to new generation assets:* Impacts at any new SMR facility would be expected to be small. For any non-nuclear electrical power generation facility, there would be no applicable environmental impact related to DBAs.	In all cases, the doses to an assumed individual at the exclusion area boundary and low population zone are a fraction of the regulatory dose limits. Environmental risks due to postulated radiological accidents are small.
	Severe accidents.	*Impacts due to BFN shutdown:* Impacts would no longer be applicable. *Impacts due to new generation assets:* Impacts at any new SMR facility would be expected to be small and of no significance. For any non-nuclear electrical power generation facility, there would be no applicable environmental impact related to severe radiological accidents.	Severe accident analysis indicates that the risk is small and meets all safety goals.
	Plant security.	*Impacts due to BFN shutdown:* Small impacts and bound by the server accident scenarios. *Impacts due to new generation assets:* Impacts for an SMR facility would be bound by the severe accident scenarios and would be expected to remain small. For any non-nuclear electrical power generation facility, nuclear plant security regulations are not applicable.	TVA is in compliance with all regulations on plant security and plant security related impacts would remain small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Nonradiological Public Health and Safety	Electric shock and microbiological hazards.	*Impacts from BFN shutdown:* Electric shock hazards from in-scope transmission lines would be nullified. Impacts to public health would be small and beneficial from the reduced heating of waters for thermophilic organisms. *Impacts due to new generation assets:* Potential effects from construction and operation of new generation assets would be evaluated in separate analyses and impacts could range from small to moderate.	The public is precluded from accessing the site and from direct contact with transmission lines, therefore, possible shock hazard is small. No new impacts to public health from thermophilic organisms are anticipated.
Decommissioning	Environmental, cultural, and socioeconomic impacts.	Impacts would be similar to Alternative B and small.	Delaying decommissioning of the BFN reactors as a result of SLR would have small beneficial and negative impacts.

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Symbols, Acronyms, Abbreviations, and Glossary of Terms

°C	degrees Celsius
°F	degrees Fahrenheit
ADEM	Alabama Department of Environmental Management
ADPH	Alabama Department of Public Health
Aero	Aeroderivative
Ag	silver
ALARA	as low as reasonably achievable
APE	area of potential effects
AREOR	Annual Radiological Environmental Operating Report
BCC	birds of conservation concern
BESS	battery energy storage systems
BFARF	Browns Ferry Aquatic Research Facility
BFN	Browns Ferry Nuclear Plant
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practices
BTA	best technology available
BWR	Boiling Water Reactor
C&D	construction and demolition
CAA	Clean Air Act
CAES	compressed air energy storage
CAGR	Compound Annual Growth Rate
CC	combined cycle
CCW	condenser circulating water
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
CH_4	methane
Ci	curies
Co	cobalt
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalents
CPUE	catch per unit effort
CRP	Cummings Research Park
Cs	cesium
CST	condensate storage tank
CSX	CSX Transportation, Inc
CT	combustion turbine
CWA	Clean Water Act
CWIS	cooling water intake structure
DAW	dry active waste
dB	decibels
dBA	decibels in A-weighted scale
DBAs	Design Bias Accidents
DDT	dichlorodiphenyltrichloroethane
DNL	day/night sound level

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DR	demand response
EA	Environmental Assessment
EAB	Exclusion Area Boundary
EE	energy efficiency
EECW	emergency equipment cooling water
EFH	essential fish habitat
EIA	Energy Information Administration
EIS	Environmental Impact Statement
EO	Executive Order
EPRI	Electric Power Research Institute
EPU	extended power uprate
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FICON	Federal Interagency Committee on Noise
FONSI	Finding of No Significant Impact
fps	feet per second
FR	Federal Register
FRP	Flood Risk Profile
FY	Fiscal Year
GEIS	Generic Environmental Impact Statement
GHG	greenhouse gas
GIS	geographic information system
gpm	gallons per minute
HAP	hazardous air pollutant
I&I	irreversible and irretrievable
IGCC	integrated gasification combined cycle
IPaC	Information for Planning and Consultation
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
ISFSI	independent spent fuel storage installation
kV	kilovolt
LLRW	Low level radioactive waste
MBTA	Migratory Bird Treaty Act
MGD	million gallons per day
Mn	manganese
Mph	miles per hour
mrad	millirad
mrem	millirem
mrem/yr	millirem per year
msl	mean sea level
MW	megawatt
MWd/MTU	megawatt day/metric tons of uranium
MWe	megawatts electric
MWh	megawatt hour

MWt	megawatt thermal
NAAQS	National Ambient Air Quality Standards
NAVD 88	North American Vertical Datum of 1988
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC	National Electric Safety Code
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
N_2O	nitrous oxide
NOA	Notice of Availability
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRC	Nuclear Regulatory Commission
NREL	National Renewable Energy Laboratory
NRHP	National Register of Historic Places
NWI	National Wetland Inventory
ODCM	Off-site Dose Calculation Manual
OLTP	operating license thermal power
PAM	primary amoebic meningoencephalitis
PCB	polychlorinated biphenyl
pCi/L	picocurie per liter
PFOS	perfluorooctane sulfonate
PM10	particulate matter with aerodynamic diameters of 10 microns or less
PM2.5	particulate matter with aerodynamic diameters of 2.5 microns or less
PPA	Power Purchase Agreement
PV	photovoltaic
RCRA	Resource Conservation and Recovery Act
REMP	Radiological Environmental Monitoring Program
RFAI	Reservoir Fish Assemblage Index
RHA	Rivers and Harbors Act
RHR	residual heat removal
ROD	Record of Decision
ROI	Region of Interest
ROW	right-of-way
RV	recreational vehicle
SCPC	supercritical pulverized coal
SEIS	Supplemental Environmental Impact Statement
SF_6	sulfur hexafluoride
SHPO	state historic preservation officer
SLR	subsequent license renewal
SLRA	subsequent license renewal application
SMR	small modular reactor
SND	summer net dependable capacity
SPCC	spill prevention, containment, and countermeasure
spp	species (plural)
TMDL	total maximum daily load
tpy	tons per year

TRM	Tennessee River Mile
TVA	Tennessee Valley Authority
TVARAM	Tennessee valley Authority Rapid Assessment Method
TWH	terawatt hours
UFC	uranium fuel cycle
UILT	upper incipient lethal temperatures
USACE	US Army Corps of Engineers
USCB	US Census Bureau
USDA	US Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	US Fish and Wildlife Service
USGS	United States Geological Survey
WMA	Wildlife Management Area
Zn	zinc

CHAPTER 1 – PURPOSE AND NEED FOR THE PROPOSED ACTION

The current Nuclear Regulatory Commission (NRC) operating licenses for Browns Ferry Nuclear Plant (BFN) expire on December 20, 2033, for Unit 1, June 28, 2034, for Unit 2, and July 2, 2036, for Unit 3. The purpose of the proposed action is to continue to generate baseload power at the BFN site between 2033 and 2056 through obtaining subsequent license renewals (SLRs) from the NRC to continue operation of all three BFN units. BFN's current baseload generation supports future forecasted baseload power needs, as outlined in the Tennessee Valley Authority's (TVA) 2019 Integrated Resource Plan (IRP), by helping to maintain grid stability and generating capacity for TVA's generation portfolio mix. As an integral part of TVA's current generation portfolio, in 2020, BFN produced approximately 20 percent of TVA's average generation capacity. Renewal of the current operating licenses would allow BFN to continue supplying approximately 3,900 Megawatts electric (MWe) capacity of safe, clean, reliable, and cost-effective baseload power for an additional 20 years. The BFN SLR is a key component of meeting TVA's goal of a net-zero carbon emissions generating system by 2050.

TVA is the largest producer of public power in the United States. TVA provides wholesale power to 154 local power companies and directly sells power to 58 industrial and federal customers. TVA's power system serves nearly 10 million people in a seven-state, 80,000-square-mile region (Figure 1.1-1). 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 (TVA 2019a).

According to forecasting and power system planning models, TVA expects annual peak load and net system power requirements to increase at a 0.3 percent compound annual growth rate (CAGR) through 2029 (TVA 2019a). TVA has a legal obligation to meet this demand while maintaining low-cost, reliable power for consumers in the power service area. Consistent with its 2020 Environmental Policy, TVA also plans to use cleaner energy options and energy efficiency initiatives to reduce the intensity of carbon emissions from its power system.

Subsequent renewal of the BFN operating licenses would involve continuation of normal operations, maintenance, and refueling. These activities would continue to be managed in accordance with TVA programs and procedures. No refurbishments are expected to occur during the proposed subsequent period of extended operation, as described in Sections 2.1.2 and generically discussed in Chapter 4 of federal guidelines, Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Power Plants (2013 GEIS).

BFN has two onsite independent spent fuel storage installations (ISFSIs) using dry cask storage. Expansion of the onsite ISFSI capacity will be required by 2036 to support BFN operations during the proposed subsequent period of extended operation if the U.S. Department of Energy (DOE) does not provide for permanent storage and disposal of the onsite spent fuel as planned. This expansion would require the construction of an additional concrete storage pad similar to the ones used for the current ISFSIs; however, construction of an ISFSI pad, if needed, would be addressed in a separate environmental review in compliance with the National Environmental Policy Act (NEPA; 42 United States Code [U.S.C.] 4321 et seq.), associated Council on Environmental Quality (CEQ) regulations (40 CFR Part 1500), and TVA's NEPA Procedures (18 CFR 1318). Regardless, existing equipment and procedures would continue to be used to store the spent fuel at BFN until DOE provides a permanent long-term storage location.

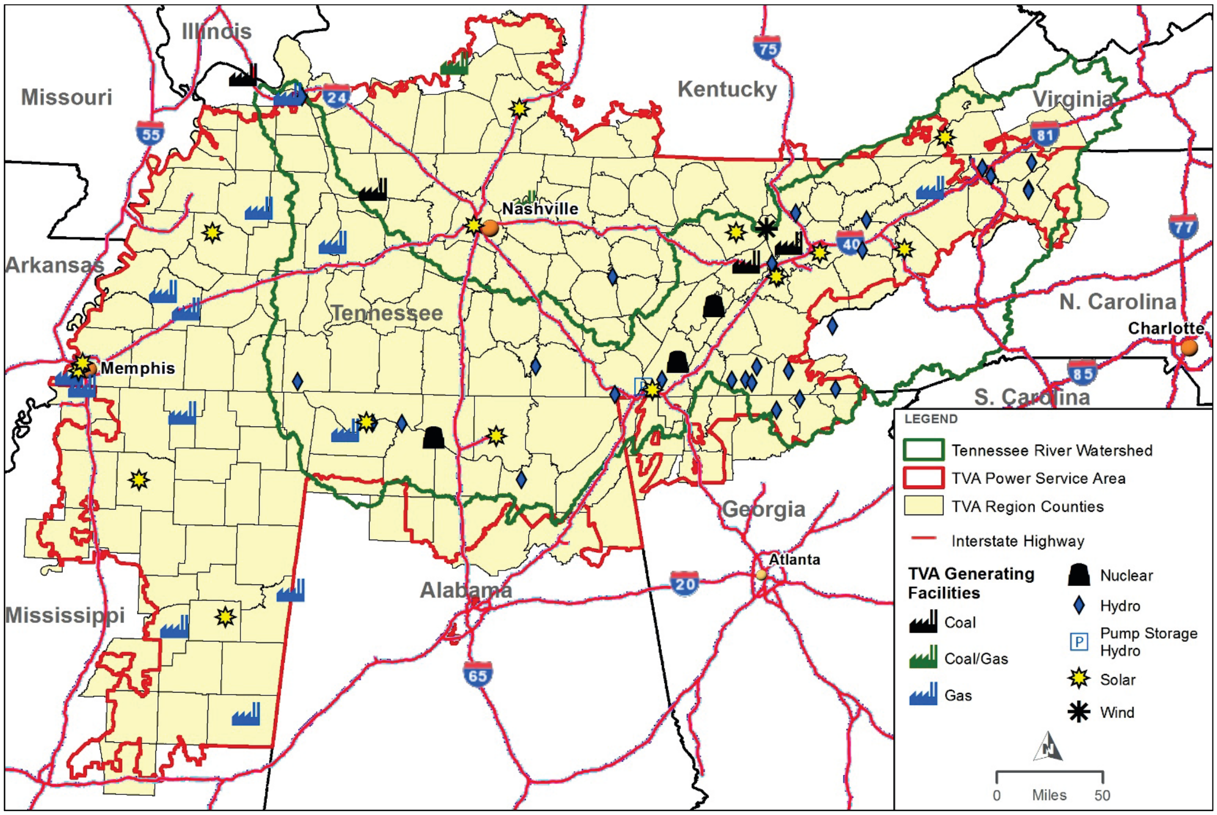


Figure 1.1-1. Power Service Area and Tennessee River Watershed in the TVA Region

1.1. Decision to be Made

TVA must decide whether to submit a subsequent license renewal application (SLRA) to the NRC to renew the operating licenses of the three BFN units for an additional 20 years beyond their current license expiration dates. Therefore, TVA has prepared this Supplemental Environmental Impact Statement (SEIS) to inform TVA decision-makers, agencies, and the public about the potential environmental impacts associated with the proposed action.

In accordance with NRC NEPA procedures, the NRC would evaluate TVA's SLRA and conduct its own environmental review to evaluate the potential environmental impacts of granting renewed operating licenses for BFN Units 1-3. As part of the SLRA, TVA would submit an environmental report to the NRC that describes the potential environmental impacts of renewing BFN's operating licenses.

1.2. Background

TVA operates BFN Units 1, 2, and 3 in Limestone County, Alabama. Unit 1 began commercial operation in 1974, Unit 2 in 1975, and Unit 3 in 1977. The BFN site is located on an approximately 880-acre tract on the north shore of Wheeler Reservoir at Tennessee River Mile (TRM) 294, approximately 30 miles west of Huntsville, Alabama, 10 miles northwest of Decatur, Alabama, and 10 miles southwest of Athens, Alabama. Figure 1.2-1 shows the 50-mile region surrounding BFN for locational context. Figure 1.2-2 shows the 6-mile vicinity around BFN which is the primary area of focus for this analysis.

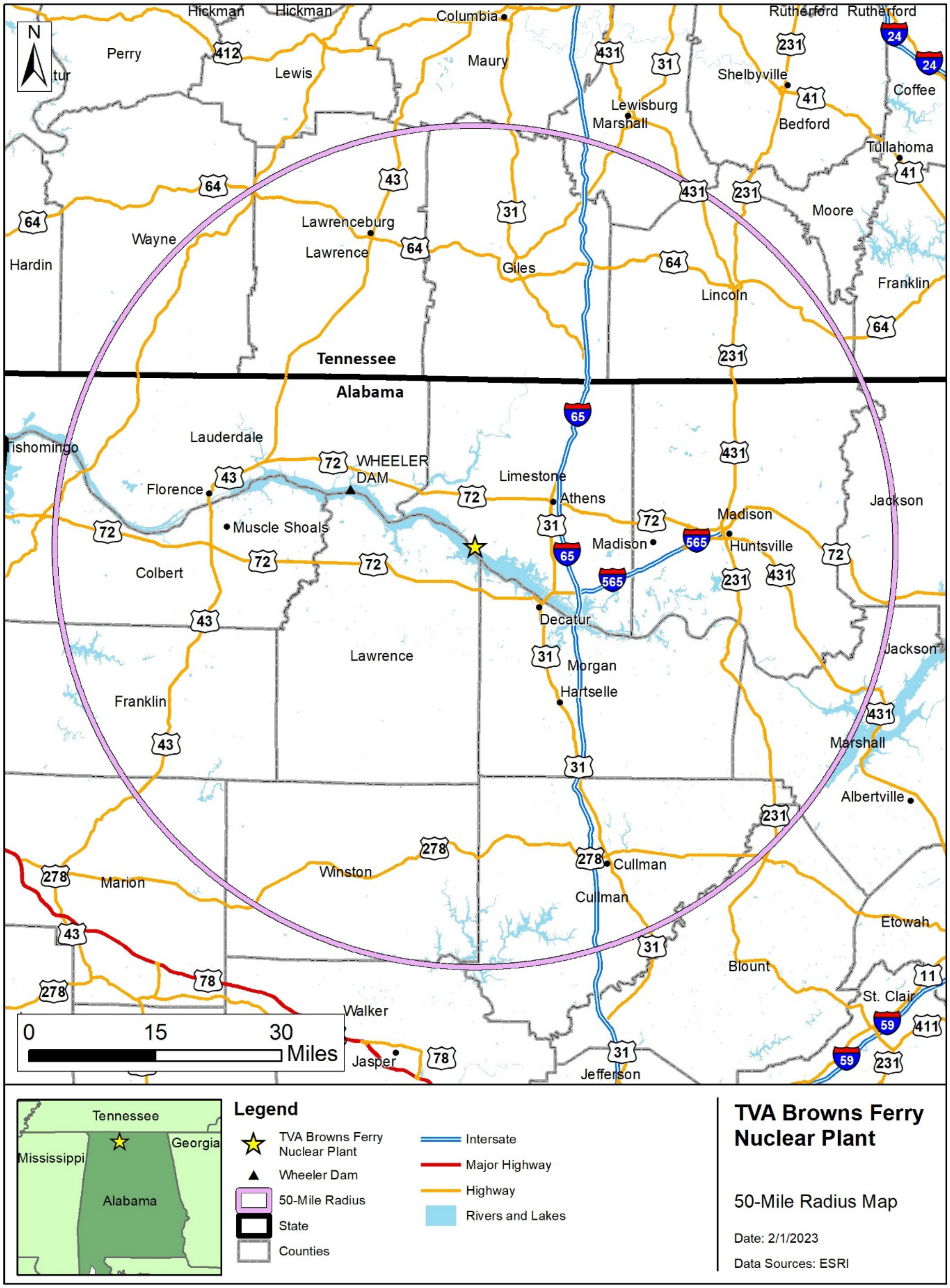


Figure 1.2-1. Regional Location Map for Browns Ferry Nuclear Plant

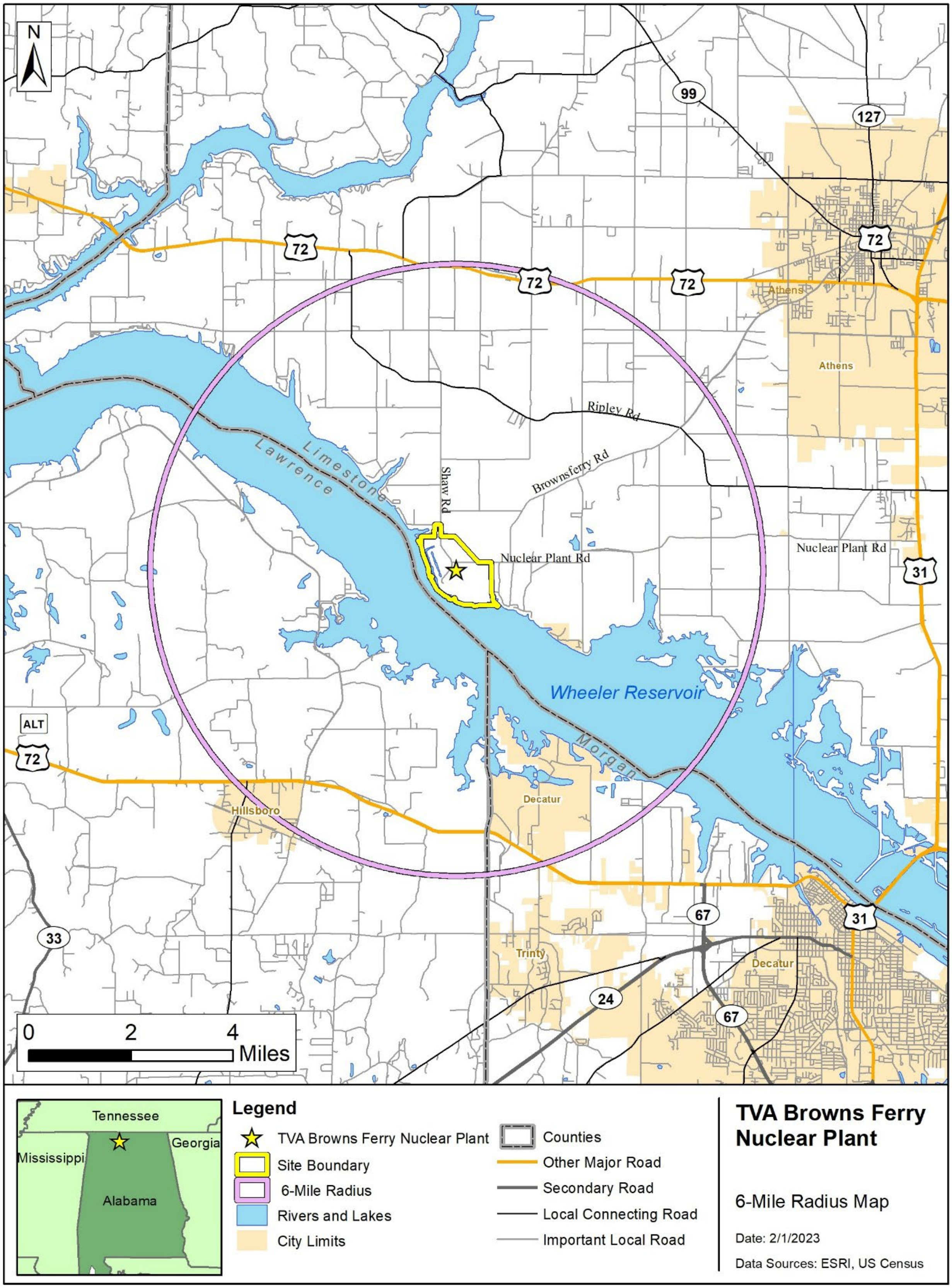


Figure 1.2-2. 6-Mile Vicinity Map for Browns Ferry Nuclear Plant

1.2.1. General Plant Information

The BFN facility consists of a reactor building, a turbine building, a service building, a maintenance building, two diesel generator buildings (one for Units 1 and 2 and one for Unit 3), a radioactive waste building, administration buildings, an intake pumping station, a 161-kilovolt (kV) switchyard and a 161-kV capacitor yard, a 500-kV switchyard, seven helper cooling towers, an off-gas stack, hot water and cold water discharge channels, and a meteorological tower. Additional facilities include a training center, materials and procurement complex, low -level radioactive waste and hazardous waste storage areas, wastewater lagoons, a Diverse and Flexible Coping Strategies (FLEX) equipment storage building, and ISFSI pads. Figure 1.2-3 shows the general features of the facility and the site boundary. Five of the original six helper cooling towers that serve BFN (Cooling Towers 1 and 3-6) have been replaced, Cooling Tower 2 is scheduled for replacement by 2027, and Cooling Tower 7 was constructed in May 2012 (TVA 2020a).

BFN consists of three General Electric Type 4 boiling water reactors (BWR/4) and associated turbine generators that collectively supply approximately 3,900 MWe to the TVA transmission and distribution system. Each of BFN's three nuclear reactors is connected to its own dedicated generator. BFN uses a once-through (open cycle) condenser circulating water system with seven helper cooling towers which can be used to dissipate waste heat and reduce cooling water temperature as necessary to comply with a National Pollutant Discharge Elimination System (NPDES) permit issued by the state of Alabama before cooling water is discharged back to Wheeler Reservoir.

1.2.2. Reactor and Containment System

The BWR/4 reactor systems at BFN are characterized by a reactor vessel housing a reactor core where nuclear fission within the uranium dioxide fuel pellets creates heat; thus, causing the coolant water to boil. The resultant steam and water droplets are separated by steam separators and steam dryers. The dried steam is directed to the turbine generators, which rotate and generate electricity. After exiting the turbine, steam is cooled back to coolant water in the condenser and then returned to the reactor core. Off-gases are treated through the off-gas treatment system and then released through the BFN main stack.

The primary containment system for each unit at BFN is a Mark I pressure suppression system consisting of a drywell, pressure suppression chamber, vent system, isolation valves, containment cooling system, and other service equipment.

Designed to withstand an internal pressure of 62 pounds per square inch above atmospheric pressure and coupled with its engineered safety features, each Mark I containment is designed to provide adequate radiation protection for both normal operation and postulated design-basis events, such as earthquakes or loss of coolant.

The reactor building acts as a secondary containment system by surrounding the primary containments, which, in turn, surround the reactor vessels. In addition, the reactor building houses refueling and reactor servicing equipment, new and spent fuel pools, and other reactor safety and auxiliary systems.

The containment systems and their engineered safeguards are designed to ensure that offsite doses resulting from postulated design-basis events are well below the guidelines in 10 Code of Federal Regulations (CFR) 50.67.

Figure 1.2-3. Browns Ferry Nuclear Plant Site Map

1.2.3. Fuel Enrichment, Burn-Up, and Independent Spent Fuel Storage

BFN Units 1, 2, and 3 are licensed to operate using fuel composed of uranium-dioxide pellets enriched at 2 to 5 percent by weight of uranium-235 and contained in sealed zircaloy fuel rod tubes which are assembled into individual fuel bundles. Average peak rod fuel burn-up for each unit will not exceed 62,000-megawatt day/metric tons of uranium (MWd/MTU).

Refueling of one-third of the fuel in each unit is performed approximately every 24 months. Refueling outages occur for approximately 28-45 days. The spent fuel pools for Units 1, 2, and 3 are available for storage of new fuel and spent fuel assemblies. The inventory of fuel assemblies in each pool is maintained such that enough locations are open to accommodate a full core offload at any time. However, the number of spent fuel assemblies in each fuel pool varies due to cycle-specific variations in the number of fuel assemblies discharged at the end of each cycle and the number of spent fuel assemblies removed and transferred to dry storage casks during dry cask storage campaigns.

Spent nuclear fuel from Units 1, 2, and 3 is also stored onsite in dry casks in the ISFSI. The ISFSI complies with the General License issued under 10 CFR Part 72, Subpart K (General License for Storage of Spent Fuel at Power Reactor Sites) and the conditions contained in the Certificate of Compliance for the cask system. Implementation of the ISFSI was reviewed as part of the TVA Final SEIS for operating license renewal of the three units and restart of Unit 1 at BFN (TVA 2002) and does not need to be analyzed herein.

1.2.4. Cooling and Auxiliary Water Systems

This section describes BFN's condenser circulating water (CCW) system and residual heat removal (RHR) service water system.

1.2.4.1. Condenser Circulating Water System

BFN units operate utilizing a once-though (open cycle) CCW system. The condensers are normally cooled by pumping water from Wheeler Reservoir into the turbine-generator condensers and discharging it back to Wheeler Reservoir via three submerged diffuser pipes. The diffuser pipes are perforated to maximize uniform mixing of BFN thermal effluent into the flow stream. This straight-through flow path is known as "open cycle" or "open mode" operation. The water is withdrawn from Wheeler Reservoir by an intake structure located at about TRM 294.3. The CCW system is designed to provide a flow of approximately 675,000 gallons per minute (gpm) to the condenser during open cycle operation, and a flow of approximately 25,000 gpm to the raw cooling water system of each unit. In addition to flow through the CCW pumps and the raw cooling water system, the plant total intake also includes water for the emergency equipment cooling water system (EECW), the RHR service water system, the fire protection system, the intake screen wash system, and the raw service water system.

BFN returns nearly all of the water it withdraws back to Wheeler Reservoir, albeit at a higher temperature, through three submerged diffuser pipes (see Section 3.3.2). The diffuser pipes (17 feet, 19 feet, and 20 feet 6 inches in diameter) extend across the reservoir channel. Each has the last 600 feet perforated on the downstream side with more than 7,000 two-inch-diameter holes. Thus, approximately 22,000 holes spaced 6 inches on centers in both directions distribute the 4,400 cubic feet per second (cfs) (approximate) of warm water so that it mixes with the water in the reservoir. However, when reservoir temperatures approach one or more of the NPDES limits, the condenser circulating water from one or more units is cooled by one or more helper cooling towers before it is released to the reservoir. BFN has seven mechanical-draft helper cooling towers that can dissipate waste heat to the atmosphere. Water is pumped through the main condenser to an open channel going to the towers of the circulating water pumps for each unit. Water is pumped to each helper cooling tower by lift pumps. The amount of water treated by the helper cooling towers depends on the amount of cooling needed for the plant to remain in compliance with the NPDES permit. TVA may also derate one or more BFN generating units to ensure compliance with NPDES thermal limits.

Normally water is drawn into the circulating water pumping station forebay from Wheeler Reservoir, pumped through the main condenser, and discharged back into the reservoir through a diffuser discharge system consisting of perforated metal pipes which extend across the reservoir channel to diffuse the warmer water from the plant. When reservoir temperatures approach one or more of the NPDES limits, the water is pumped from the reservoir, through the plant, and into an open channel going to the helper cooling towers. It is then pumped through the helper cooling towers and is returned to the reservoir through the diffusers.

1.2.4.2. Residual Heat Removal Service Water

The RHR service water system consists of four pairs of pumps located on the intake structure for pumping raw river water to the heat exchangers in the RHR system and four additional pumps for supplying water to EECW system. The EECW system distributes cooling water supplied by the RHR service water system to essential equipment during normal and accident conditions.

1.2.5. Transmission Lines

TVA is the owner and operator of the transmission lines that connect BFN to the transmission grid. Each BFN unit is connected into the existing TVA 500-kV transmission system by three 500-kV transmission lines via an onsite 500-kV switchyard (Figure 1.2-4). The 500-kV switchyard receives the output of Units 1, 2, and 3 generators and delivers this output to the 500-kV system network for transmission to system loads. BFN is also connected to the 161-kV switchyard through two 161-kV transmission lines. The 161-kV switchyard receives power from the 161-kV system network and delivers this power to station auxiliaries.

Normal BFN power is from the unit station service transformers connected between the generator breaker and main transformer of each unit. Startup power is from the TVA, 500-kV system network through the 500 to 22-kV main and 20.7- to 4.16-kV unit station service transformers. Auxiliary power is available through the two common station service transformers that are fed from two 161-kV lines supplying the 161-kV switchyard.

Continued operation of BFN would not require transmission system upgrades during the proposed subsequent period of extended operation. Any maintenance activities conducted in the transmission line rights-of-way (ROWs) would follow TVA’s best management practices for construction and maintenance of transmission lines, *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities* (TVA 2017b) and TVA’s programmatic consultation for ROW Vegetation management (TVA 2018a).

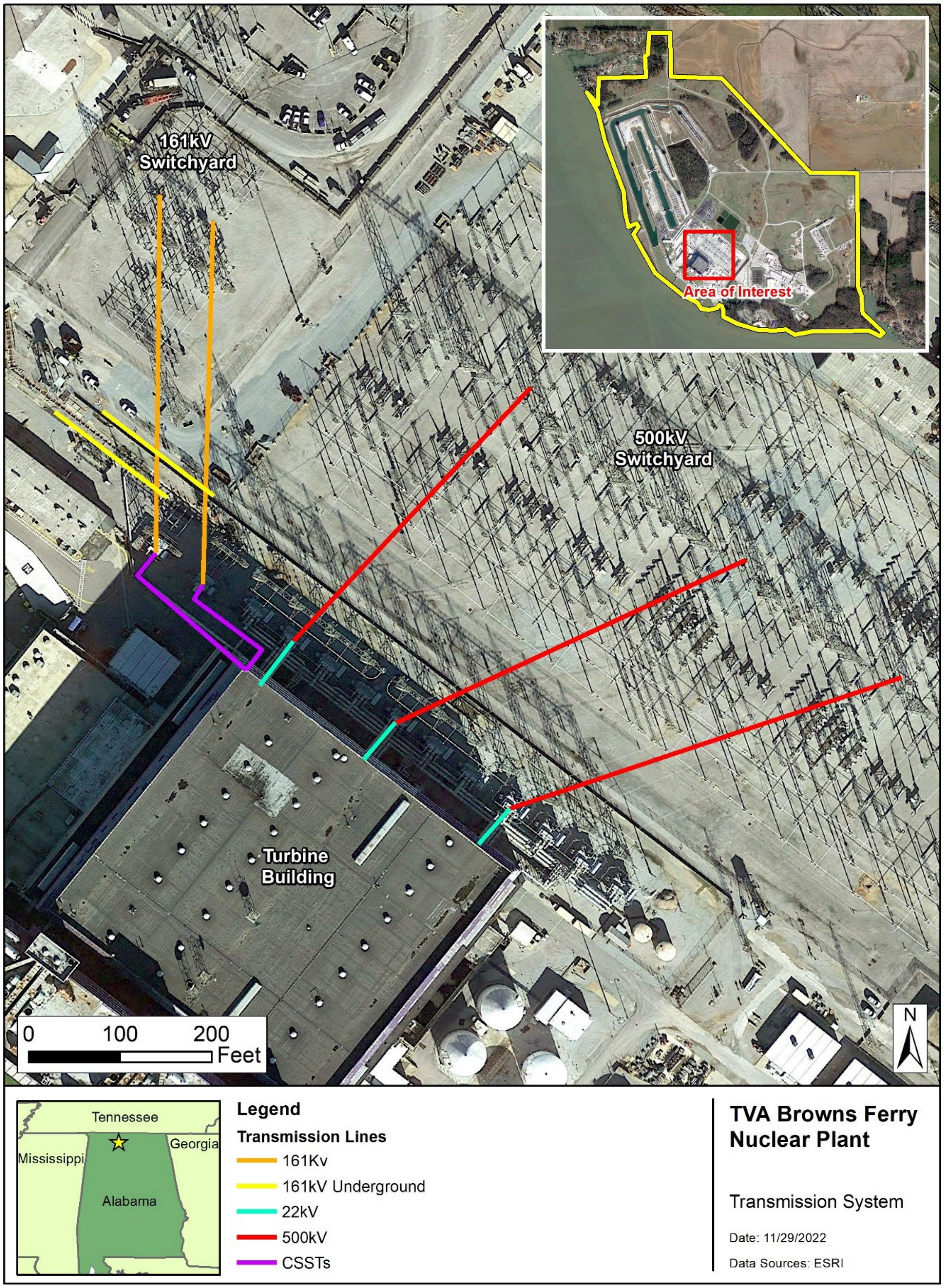


Figure 1.2-4. Browns Ferry Nuclear Plant Onsite Transmission Lines

1.3. The TVA Power System

TVA is a corporate agency and instrumentality of the United States, created by Congress and existing pursuant to the TVA Act of 1933 (16 U.S.C. Part 831) to, among other things, foster the social and economic welfare of the people of the Tennessee Valley region and promote the sustainable use and conservation of the Valley's natural resources. TVA generates and distributes electricity for business customers and local power distributors, serving more than 10 million people in parts of seven southeastern states. TVA is fully self-financed without direct Federal appropriations, and funds virtually all operations through electricity sales and power system bond financing. In addition to operating and investing its revenues in its electric system, TVA provides flood control, navigation, and management for the Tennessee River system, manages 293,000 acres of public land, and assists local power companies and state and local governments with economic development efforts.

TVA's generating assets include: five coal plants, three nuclear facilities, 29 hydroelectric dams, one pumped-storage hydroelectric plant, nine natural gas combustion turbine gas plants, eight natural gas combined cycle gas plants, one diesel generator site, and 13 solar energy sites. TVA has gas-co-firing potential at one coal-fired site as well as biomass co-firing potential at all of its coal-fired sites. TVA also purchases a portion of its power supply from third-party operators under long-term power purchase agreements (PPAs). In total, these assets constitute a portfolio of approximately 37,896 megawatts (MW). In FY 2020 about 10 percent of TVA's annual generation is from hydro; 15 percent is from coal; 21 percent is from natural gas; 41 percent is from nuclear; and the remainder is from PPAs from renewable and non-renewable resources. TVA also gains available electrical distribution capacity through its energy efficiency programs. Like other utility systems, TVA has power interchange agreements with utilities surrounding the Tennessee Valley Region, and routinely buys and sells electricity (TVA 2021f).

TVA also operates one of the largest transmission systems in the United States. It serves an area of 80,000 square miles through a network of about 16,200 miles of transmission lines, 500 substations, switchyards and switching stations, and over 1,300 individual customer connection points. The system connects to switchyards at generating facilities and transmits power from them at primarily either 161 kV or 500 kV to local power companies and directly served customers. For the past 18 years, the system has achieved 99.999 percent power reliability. It efficiently delivered nearly 163 billion kilowatt-hours of electricity to customers in FY 2018 (TVA 2019a). Additionally, the TVA transmission system has 69 interconnections with 13 neighboring utilities at interconnection voltages ranging from 69-kV to 500-kV. These interconnections allow TVA and its neighboring utilities to buy and sell electricity from each other and to wheel power through their systems to other utilities. To the extent that Federal law requires access to the TVA transmission system, the TVA transmission organization offers services to others to transmit power at wholesale in a manner that is comparable to TVA's own use of the transmission system, according to the Federal Energy Regulatory Commission (FERC) Standards of Conduct for Transmission Providers (18 CFR Part 358).

1.4. Need for Power

One of TVA's most important responsibilities is meeting the demand for electricity placed on its power system. Thousands of businesses, industries and public facilities, and millions of people, depend on TVA every day to supply their power needs reliably. That responsibility drives the purpose and need for the proposed action described in this SEIS.

1.4.1. Integrated Resource Plan

TVA's 2019 IRP provides a system-wide review on meeting projected future energy demands and the direction on potential replacement power sources that TVA is considering over the planning period from 2019-2038 (TVA 2019a). It shapes how TVA will provide low-cost, reliable, and clean electricity; support environmental stewardship; and foster economic development. Specifically, the 2019 IRP forecasted generating assets that would be added to, and removed from, TVA's fleet by 2028 and by 2038. The 2019 IRP and associated IRP Final Environmental Impact Statement (FEIS) (TVA 2019b) evaluated six scenarios or plausible futures, including No Nuclear Extension of BFN, with five strategies per scenario (potential TVA responses to those futures). Using these scenarios, TVA identified a range of potential resource additions and retirements throughout the TVA power service area based upon TVA's system-wide generation planning models. TVA estimated a capacity gap by comparing anticipated demand and current supply, and then determined the type and amount of additional generating resources or energy management services needed to fill the gap. TVA also considered whether retirements of certain resources may be economical (TVA 2019a). Because planning, permitting, and construction of new generating capacity and transmission require a long lead time, TVA must make decisions to build new generating capacity well in advance of the actual need.

This SEIS incorporates information used in the development of the 2019 IRP. The IRP FEIS (TVA 2019b) identified TVA's preferred alternative (Target Power Supply Mix) as the recommended planning direction. The implementation of the Target Power Supply Mix alternatives will result in a diverse generating portfolio and provide TVA the flexibility to make energy resource decisions consistent with least-cost planning. As the IRP is implemented, 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. Under the recommended planning direction, as with all but one planning strategy evaluated in the IRP, it is assumed that TVA will pursue the option for SLR of BFN Units 1, 2, and 3 for an additional 20 years (TVA 2019a).

1.4.2. Power Demand

TVA's long-term demand forecast is developed from individual forecasts of residential, commercial, and industrial sales. These forecasts serve as the basis for planning the TVA power system, budgeting, and financial planning. TVA considers forecasts based upon several potential future conditions, including scenarios for the high and low load growth. A description of TVA's load forecasting methodology is presented in Chapter 4 of the IRP. Figures 1.4-1 and 1.4-2 show the range of forecasts for system peak load and energy requirements forecasts as developed for the IRP. Both include modeling results of the Current Outlook scenario and the highest and lowest growth scenarios. Annual peak load growth over the 2019 through 2038 time period is 0.3 percent in the Current Outlook scenario and varies from a -0.7 percent CAGR in the lowest peak scenario to a 1.7 percent CAGR in the highest growth scenario. System energy requirements are flat in the Current Outlook scenario with energy declining annually 1.5 percent in the lowest scenario and going as high as 2.0 percent annually in the highest growth scenario. The planning period for the IRP was through 2038, so to arrive at the forecast through 2056, average annual growth through 2038 was assumed to remain constant through 2056. It would be highly unlikely that the actual load would exceed the high forecast or fall below the low forecast, given the range of possible outcomes used in the forecast modeling.

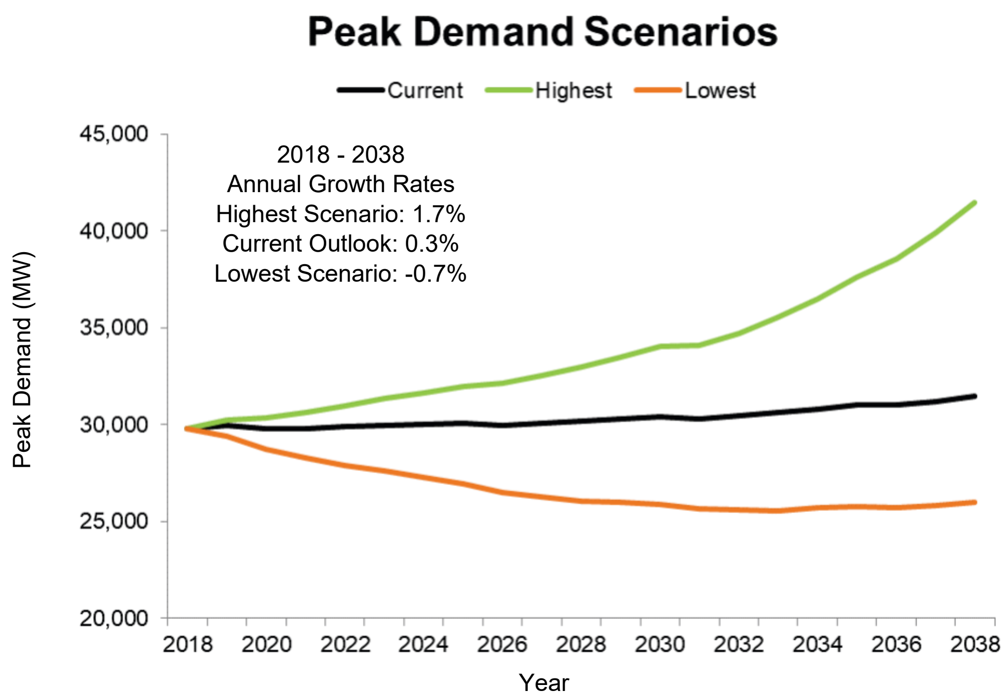


Figure 1.4-1. Peak Demand (MW) Forecast

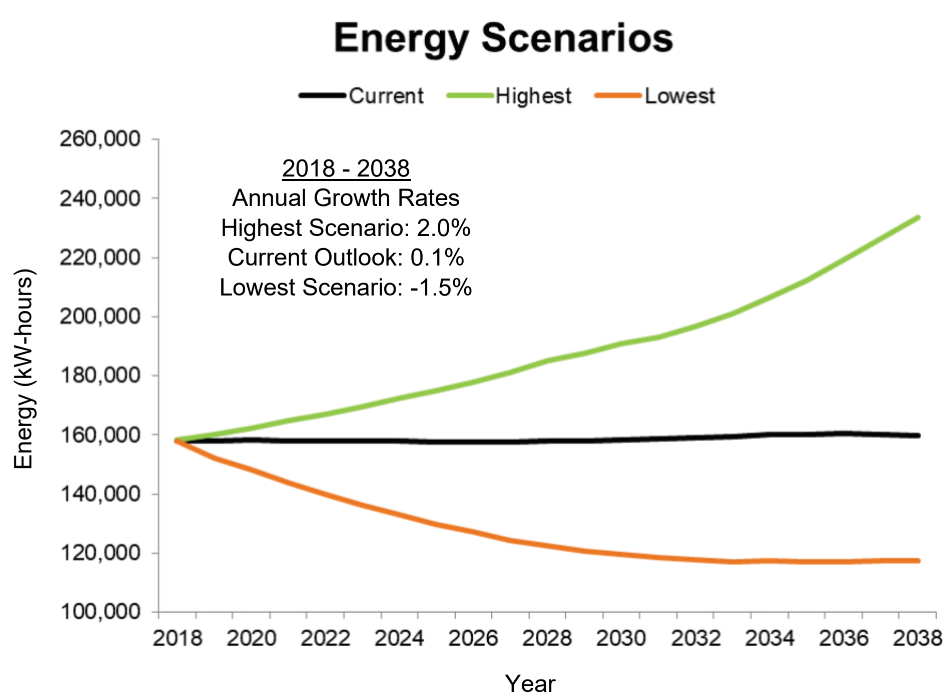


Figure 1.4-2. Energy (kilowatt-hours) Forecast

1.4.3. Power Supply

TVA's generation supply consists of a combination of existing TVA-owned resources, budgeted and approved projects such as new plant additions and updates to existing assets, and existing PPAs. Generating assets can be categorized both by whether the power they produce is used to meet base, intermediate or peak demand or used for storage, and by capacity type or energy/fuel source.

Baseload Resources: Due to their lower operating costs and high availability, baseload resources are used primarily to provide continuous, reliable power over long periods of uniform demand. They typically have higher construction costs than other energy sources, but may have lower fuel and variable costs, especially when fixed costs are expressed on a unit basis (e.g., dollars per megawatt hour [MWh]). An example of a baseload resource is a nuclear power plant. Some energy providers also use larger coal units and natural gas-fired combined cycle plants as incremental baseload generators (TVA 2019a).

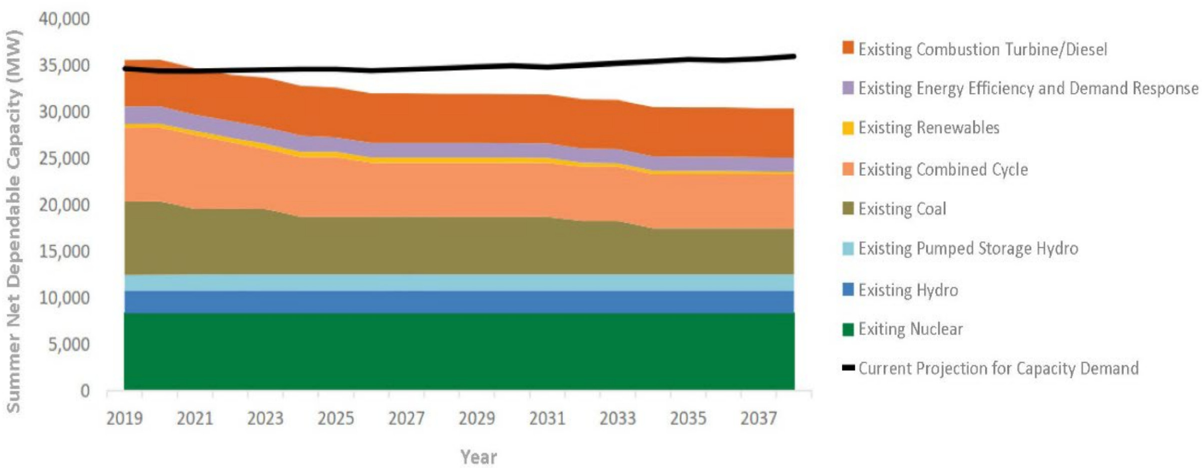
Intermediate Resources: Intermediate resources are used primarily to fill the gap in generation between baseload and peaking needs and provide backup and balance the supply of energy from intermittent wind and solar generation. These units are required to produce varying power loads in response to fluctuations in energy demand both during the course of a day and seasonally. Given current fuel prices and relative generating efficiencies, these units are typically more costly to operate than baseload units but less expensive than peaking units. Intermediate generation comes from natural gas-fired combined cycle plants, smaller coal units, and wind and solar generation. Solar and wind energy profiles align more closely with summer and winter load shapes, respectively. Hydro generating assets can also generally be categorized as intermediate resources, but their flexibility allows them to operate the full range from baseload to peaking. Hydro generation capacity is restrained by water availability and the various needs of the river system such as navigation, flood control and recreation (TVA 2019a).

Peaking Resources: Peaking units are expected to operate infrequently during short-duration, high demand periods. Their purpose is to help meet system reliability requirements, as they can start up and shut down quickly in response to sudden changes in either demand or supply. Typical peaking resources are natural gas-fired frame combustion turbines, aeroderivative combustion turbines, reciprocating internal combustion engines, and conventional hydro generation (TVA 2019a).

Storage Resources: Storage units usually serve the same power supply function as peaking units but use low-cost, off-peak electricity to store energy for generation during peak demand. An example of a storage unit is a hydro pumped-storage plant. These plants pump water to a reservoir during periods of low demand and release it to generate electricity during periods of high demand. Consequently, a storage unit is both a power supply source and an electricity user. Lithium-ion batteries are another example of a storage resource (TVA 2019a).

TVA uses a wide range of technologies to meet the power needs of the Valley residents, businesses, and industries. Figure 1.4-3 shows the current projection for capacity demand and for capacity supply from existing resources and PPAs, highlighting the capacity gap. This figure includes both owned and purchased resources, in megawatts of summer net dependable capacity, and is divided into fuel-type (i.e., nuclear, hydro, coal). The chart builds up from the bottom generally in a baseload, intermediate and peaking order, as some assets can serve dual roles. Figure 1.4-3 shows how TVA's existing capacity portfolio is expected to change through 2038, and this projection serves as the baseline firm capacity for optimizing all portfolios. The existing assets only include resources that currently exist, assets that are under contract, TVA

Board-approved changes to existing resources such as refurbishment projects, and TVA Board-approved additions. Existing resources decrease through 2038 primarily because of the retirement of coal-fired units and the expiration of existing PPAs. The renewable component of the existing portfolio is primarily composed of wind PPAs that expire in the early 2030s. Because the power generated from wind and other renewable resources is intermittent, the firm capacity (or the amount of capacity that can be applied to firm requirements) for these assets is lower than the nameplate capacity (TVA 2019a).



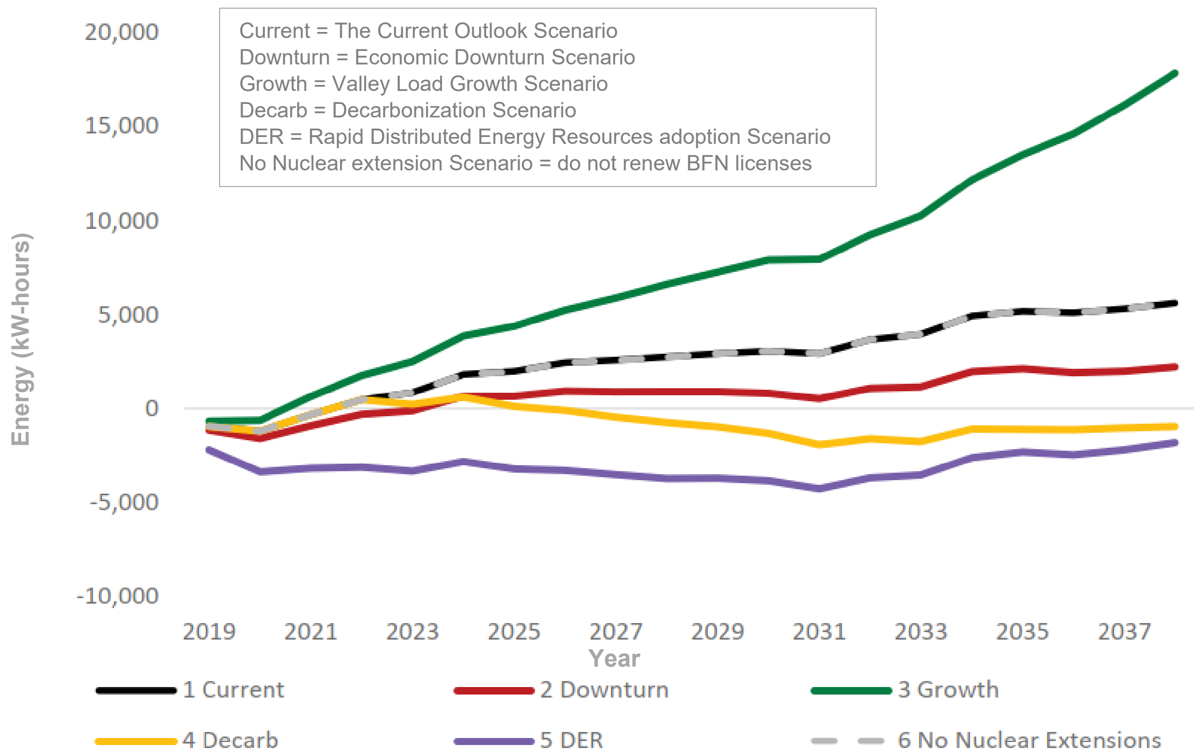
Source: (TVA 2019a)

Figure 1.4-3. Baseline Firm Capacity, Summer Net Dependable MW

In FY 2020, 41 percent of TVA's energy was produced from the nuclear fleet. Coal plants produced about 15 percent of the generation, while the gas fleet produced about 21 percent. Hydro plants produced approximately 10 percent, 13 percent was produced from PPAs from renewable and non-renewable resources (TVA 2021f).

A capacity gap is the difference between total supply and total demand. More specifically, it is the difference in megawatts between a power provider's existing firm capacity and the forecast annual peak adjusted for any interruptible customer loads and long-term planning reserve requirements. Figure 1.4-3 shows TVA's estimated capacity gap or shortfall based on the existing firm capacity and annual firm requirement for the Current Outlook scenario. Figure 1.4-4 shows the rage of capacity gaps corresponding to all the scenarios evaluated in the IRP and described in detail in Chapter 6 of the IRP. Firm requirements were greatest in the Valley Load Growth scenario (Scenario 3) and lowest in Rapid Distributed Energy Resources Adoption scenario (Scenario 5). The remaining scenarios fell within this range. The shape of the firm requirement curves influenced the type and timing of resource additions in the strategies. The timing of resource additions was a function of the existing system capacity and the impact of the attributes used to define each strategy. It is important to note that the capacity gap for the Current Outlook scenario (Scenario 1) and No Nuclear Extensions scenario (Scenario 6) are the same.

Chapter 8 of the IRP addresses the alternative strategies by which TVA could acquire additional capacity and generation to meet the need for power shown in Figures 1.4-3 and 1.4-4 (TVA 2019a). TVA anticipates using a mix of resources, including renewable resources (solar, wind, hydro), energy efficient demand response programs, and natural gas-fired generation to provide the additional resources to meet future needs. Given the magnitude of the capacity and energy need, and to avoid the risk of relying on only one fuel or technology, no single resource is used to meet all future energy and capacity requirements.



Source: (TVA 2019a)

Figure 1.4-4. Capacity Gap Range

1.5. The NEPA Process

This SEIS has been prepared consistent with CEQ's 2020 regulations for implementing NEPA at 40 CFR 1500-1508 (85 Federal Register [FR] 43304-43376, July 16, 2020). TVA's 2020 NEPA regulations at 18 CFR 1318 were also applied (85 FR 17434, Mar. 27, 2020). Further, the EA is consistent with CEQ's recently finalized rule (87 FR 23453, April 20, 2022) amending certain provisions of its 2020 regulations.

NEPA requires federal agencies to consider the reasonably foreseeable impacts of their proposed actions on the environment before choosing to take the actions. 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. If a major federal action is expected to have a significant environmental impact, the agency must prepare an EIS for public and agency review. The EIS process must include public involvement and analysis of a reasonable range of alternatives. This SEIS is an analysis of the potential impacts to the natural and human environment from the proposed action, as well as identified alternatives. CEQ regulations (40 CFR 1507.3) require federal agencies to make environmental review documents, comments, and responses a part of each agency's administrative record.

This SEIS provides updated information presented in the 2002 SEIS for the license renewal of BFN (TVA 2002). Many of the conditions described in the 2002 SEIS remain consistent such as site history, topography, geology, hydrology, and climate. Additionally, general conditions of BFN operation remain consistent with the 2002 SEIS. Changes that have occurred since 2002 include recovery and operation of Unit 1, expansion of the ISFSI pad, replacement of five of the original six helper cooling towers (Cooling Towers 1 and 3-6), construction and operation of Cooling Tower 7, and scheduled replacement of Cooling Tower 2 by 2027.

In September 2015, TVA requested an amendment to the 2006 Renewed Facility Operating Licenses to allow Units 1, 2, and 3 to operate at up to 120 percent of the operating license thermal power (OLTP; i.e., 120 percent of 3,293, or 3,952 megawatts thermal [MWt] per unit) (TVA 2015). The BFN units had previously been uprated by 5 percent (from 3,293 to 3,458 MWt) in 1998 (Units 2 and 3) and 2007 (Unit 1). Thus, the remaining power increase was approximately 15 percent increase for each BFN unit. In 2017, the NRC issued its Environmental Assessment and Finding of No Significant Impact for Browns Ferry Nuclear Plant Units 1, 2, and 3 (NRC 2017) supporting an increase in the maximum licensed thermal power level for each reactor from 3,458 MWt to 3,952 MWt.

1.5.1. Public Scoping and Review of the DEIS

The NEPA process requires public participation and interagency coordination and review during the preparation of an EIS. This section summarizes TVA's efforts to involve the public, agencies, and tribes to help define the content of the SEIS.

Public scoping was initiated on June 1, 2021, when TVA published a Notice of Intent (NOI) in the Federal Register. The NOI announced TVA's plans to prepare an SEIS to address the potential environmental effects associated with extending the operation of BFN Units 1, 2, and 3 for an additional 20 years (Appendix A). The NOI initiated a 30-day public scoping period, which concluded on July 1, 2021. In addition to publishing the NOI in the Federal Register, TVA published notices regarding this effort in two local newspapers (i.e., The Decatur Daily and The News Courier), issued a news release to media, and posted the news release on the TVA Web site.

TVA also created a virtual meeting room that was available for the duration of the project. The URL link to the virtual meeting room was included in the NOI and can still be accessed through TVA's website (https://www.tva.com/environment/environmental-stewardship/environmental-reviews/nepa-detail/browns-ferry-nuclear-plant-subsequent-license-renewal). The virtual scoping meeting room contains information on the NEPA process and the proposed action, as well as links to TVA and NRC websites related to the project. The virtual scoping meeting room also allows the public to submit a comment or feedback on the project during open comment periods (scoping and Draft SEIS review). Posterboards and screenshots from the virtual scoping meeting room are included in the Scoping Report (Appendix A).

As summarized in the Scoping Report, TVA received a total of 23 comments regarding the SLR of BFN Units 1, 2, and 3 from five commenters. Of the five comment submissions, two were from federal entities (U.S. Environmental Protection Agency [USEPA] and U.S. Geological Survey) and three were from members of the public. Nine of the 23 comments received were in regard to safety and aging infrastructure. The remaining comments received pertained to alternatives, general environmental concerns, air quality, water quality and stormwater, wetlands and streams, waste disposal, climate, and environmental justice. The comments related to TVA's proposed action are included in Appendix D of the Scoping Report (Appendix A of this SEIS).

A draft of the SEIS was released for public review and comment on February 10, 2023. The availability of the Draft SEIS and request for comments was announced in newspapers that serve the Limestone County area, and the Draft SEIS was posted on TVA's website. TVA's agency involvement included notification of the availability of the Draft SEIS to local, state, and federal agencies and federally recognized tribes. TVA also hosted an in-person public open house on March 14, 2023, from 6:00-8:00 pm central time, at Calhoun Community College-Decatur Campus, Advanced Technology Center Building #1 Lecture Hall, 6250 Hwy N, Tanner, AL 35671. Comments were accepted through March 14, 2023, via TVA's website, mail, and e-mail.

TVA received two comment letters from members of the public via TVA's website and one comment letter from the USEPA. TVA carefully reviewed all the comments. Comments raised during the comment period are summarized by topic along with TVA's responses to each comment in Appendix B. A copy of each of the comment letters is included at the end of the appendix.

The completed final SEIS will be transmitted to the USEPA, which will publish another NOA in the Federal Register. TVA will make a decision on the proposed action no sooner than 30 days after the USEPA's NOA of the final SEIS is published in the Federal Register. This decision will be based on the project purpose and need, anticipated environmental impacts as documented in the final SEIS, and cost, schedule, technological, and other considerations. To document the decision, TVA will issue a formal record of decision (ROD).

1.5.2. Issue and Resource Identification

Based on the scoping process, reviews, and assessments of the proposed action, TVA determined that the scope of the SEIS should include the following topics:

- Land Use
- Geology and Soils
- Surface Water Resources, Hydrology, and Water Quality
- Groundwater Resources
- Floodplains and Flood Risk.
- Wetlands
- Aquatic and Terrestrial Ecology
- Endangered and Threatened Species
- Managed and Natural Areas
- Recreation
- Air Quality, including Meteorology
- Global Climate Change and Greenhouse Gases
- Transportation
- Visual Resources
- Noise and Vibration
- Socioeconomics, including Environmental Justice
- Archaeological Resources and Historic Structures
- Hazardous, Solid, and Low-Level Nuclear Waste
- Radiological Effects of Normal Operations
- Uranium Fuel Cycle Effects
- Nuclear Plant Safety and Security
- Decommissioning

Decommissioning and ongoing spent fuel storage would be necessary actions regardless of TVA's decision to pursue SLR. BFN would undergo decommissioning either at the end of the current licenses or at the end of the proposed subsequent period of extended operation if it is approved by the NRC. A brief introduction of the possible methods and conditions of decommissioning and impacts that the eventual decommissioning of BFN will cause are discussed. Spent fuel would continue to be stored and kept safe at BFN as long as necessary until the DOE takes possession of it. Spent fuel would continue to be created by operating BFN until the end of the current or extended operational period of the operating licenses. Potential environmental impacts associated with ongoing spent fuel storage at the existing onsite ISFSI's at BFN are addressed in this SEIS.

Transmission lines connected to the BFN switchyard are an integral part of the TVA electrical system grid and would, therefore, be in use whether BFN is in operation or shut down. Maintenance (e.g., clearing vegetation in the ROW) of those transmission lines would likewise be a requirement while BFN is in operation, and probably beyond the BFN operational period to maintain the vital electrical system grid. Transmission line operation and maintenance does not depend upon the decision to renew BFN operating licenses; proposed maintenance activities and associated environmental effects would be identical regardless of the decision made. Therefore, the operation of transmission lines and maintenance of ROWs are not addressed in this SEIS. Any maintenance activities conducted in the transmission line ROWs would follow TVA's best management practices for construction and maintenance of transmission lines, *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities* (TVA 2017b) and TVA's programmatic consultation for ROW Vegetation management (TVA 2018a).

1.5.3. Projects Included in the Evaluation of Cumulative Effects

Cumulative effects are those resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

This SEIS considers the contribution of continued operation of BFN to potential regional environmental cumulative impacts. It will assess the potential significance of BFNs impacts in relation to other known or reasonably foreseeable projects. Impacts are defined in CEQ regulations (40 CFR 1508.1(g)) as changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives."

In this section, reasonably foreseeable actions authorized or funded by an agency (federal or non-federal) and taking place in the vicinity of BFN are identified. Possible cumulative effects associated with these actions are discussed in the relevant resource sections in Chapter 3. For the purposes of this analysis, actions include those that have been publicly announced before submittal to the NRC of the BFN SLRA. Reasonably foreseeable future actions are those that are ongoing (and will continue into the future), are funded for future implementation, or are included in publicly available plans covering the period prior to and during the operating periods of the renewed BFN licenses. The geographic area affected by cumulative impacts depends on the resource being considered (2013 GEIS). Reasonably foreseeable actions may include individually minor, but collectively significant, actions occurring over a period of time (2013 GEIS). Reasonably foreseeable projects which could contribute to cumulative impacts with respect to BFN include transportation projects and plans, additional industrial development, and water resources projects.

- Expansion of the onsite spent fuel storage capacity at BFN may be required in the future if a national storage solution for the permanent storage of spent fuel does not become available during the proposed subsequent period of extended operation. The current ISFSI storage pads are projected to be filled in year 2036 unless DOE takes possession of the spent fuel and removes it from the site for permanent disposal or processing. The addition of a third ISFSI storage pad to further increase storage capacity at BFN if needed is under consideration, but plans are in the conceptual stage and no installation schedule has been established. A 2017 siting study identified potential locations for an additional ISFSI storage pad.
- Limestone County does not have a comprehensive land use plan, but the cities of Athens (2013), Huntsville (2018), and Decatur (2018) have published either a land use plan or comprehensive plan (City of Decatur Alabama 2018a, Huntsville 2018, Martin 2013) All three cities are looking to increase population density, and although Limestone County is the third fastest growing county in Alabama (Limestone County 2021c), population growth in the area is slow compared to Alabama's average growth rate (City of Decatur Alabama 2018a). Desktop research did not result in identification of any information regarding major residential or industrial development projects within a 10-mile radius of BFN; however, it can be assumed that local residential, business, and commercial developments would occur during the proposed subsequent period of extended operation.
- The Federal Bureau of Investigation is expanding its current campus at the Redstone Arsenal in Huntsville, Alabama, approximately 30 miles east of BFN. Currently, there are approximately 860 employees at the campus, but the FBI anticipates having at least 3,400 people working there by 2026 (Ogrysko 2021).
- Cummings Research Park (CRP), which is approximately 24.5 miles east of BFN, is the second largest research park in the country and includes over 300 companies, more than 26,000 employees and 13,500 students (CRP 2021b). CRP published a Master Plan in 2016 (CRP 2016) and, currently, there is approximately 280 acres of land available for development (CRP 2021a).
- The Town of Courtland, Alabama, approximately 11 miles west of BFN on the south side of Wheeler Reservoir, was awarded a Community Development Block Grant by the State of Alabama Department of Economic and Community Affairs and has begun construction of approximately 8,400 linear feet of new water mains and new customer service lines to replace the aging water system. The Town of Courtland will be working with the West Morgan-East Lawrence Water and Sewer Authority (WMEL 2021).
- As of August 31, 2021, there was one transportation project under construction in Limestone County and eight additional projects were anticipated (ALDOT 2021b). All of these projects are more than 10 miles from BFN. The other counties adjacent to the BFN site, Morgan and Lawrence Counties, are on the south side of Wheeler Reservoir. There are two projects under construction in Morgan County and one planned project in Lawrence County (ALDOT 2021a, ALDOT 2021c), with the closest project being about.16.5 miles away in Lawrence County.

Cumulative impacts associated with these reasonably foreseeable future actions are addressed in the respective resource evaluations in Chapter 3. Cumulative effects are also summarized along with other impacts in Section 2.2 of this SEIS. Radiological effluent releases in water and air do not normally cause cumulative impacts because the limits for release are so restrictive and based on the principle that once released, below the specified limits, there is no cumulative impact. Appropriate environmental monitoring programs are in place to ensure there are no detectable cumulative effects in the local environment. See Section 3.20 for a description of the radiological environmental monitoring program.

1.6. Other Pertinent Environmental Reviews and Documents

BFN site-specific, TVA, and generic information in the following documents were evaluated and used where appropriate during the development of this SEIS. These related documents and their contents are presented in Table 1.6-1.

Table 1.6-1. Environmental Reviews and Documents Pertinent to the BFN SLR SEIS

Type of Review/Agency	Title	Decision of Finding	Summary / Relevance
Environmental Assessment (EA) / TVA	Browns Ferry Nuclear Plant Thermal Performance Program Cooling Tower Capacity Improvements	Finding of No Significant Impact (FONSI) issued June 2020	Action was to replace and upgrade cooling towers 1 and 2 (including the associated cooling tower lift pumps) and upgrade cooling tower 7.
EIS / TVA	2019 Integrated Resource Plan. Volume II. Final Environmental Impact Statement	Record of Decision (ROD) issued September 2019	Action was to assesses the natural, cultural, and socioeconomic impacts associated with the implementation of the 2019 IRP and analyze and identify the relationship of the natural and human environment to each of the five strategies considered in the IRP.
EA / NRC	Proposed Extended Power Uprate (EPU)	FONSI issued June 2017	BFN Operating License Amendment, referred to as an EPU, to authorize an increase in the maximum power level from 3,458 MWt to 3,952 MWt for each unit. The EPU represented an increase of approximately 14.3 percent above the licensed thermal power level of 3,458 MWt per unit.
Environmental Report / TVA	Attachment 42 – Supplemental Environmental Report	Not Applicable	Attachment to the EPU License Amendment Request. The TVA supplemental Environmental Report contained an assessment of the hydrothermal impacts of a proposed output power increase for BFN Units 1, 2, and 3.
GEIS / NRC	Generic EIS for License Renewal of Nuclear Plants (NUREG-1437), Revision 1	ROD issued May 2013	Action was to consider the environmental effects of renewing operating licenses of individual commercial nuclear power plants for an additional 20 years. (results codified in 10 CFR Part 51)

Type of Review/Agency	Title	Decision of Finding	Summary / Relevance
Supplemental EA / TVA	Browns Ferry Nuclear Plant Cooling Tower 3 Replacement	FONSI issued December 2012	Action was to replace cooling tower 3 with a more modern tower that included larger fan motors and a larger cold-water basin due to the partial collapse of the existing cooling tower 3 in July 2012 and the resulting unsafe condition.
EA / TVA	Browns Ferry Cooling Towers – Additions and Replacements	FONSI issued October 2010	Action was to replace four original cooling towers at BFN with larger units and construct Cooling Tower 7.
GEIS, Supplement 21/ NRC	Generic EIS for License Renewal of Nuclear Plants, Supplement 21 Regarding Browns Ferry Nuclear Plant, Units 1, 2, and 3. Final Report. NUREG 1437	ROD issued June 2005	Action was to renew the operating licenses for BFN for an additional 20-year period at EPU of 120 percent.
EA / TVA	Browns Ferry Nuclear Plant Extended Power Uprate for Units 2 and 3 EA, August 2003.	FONSI issued August 2003.	Action was to seek a license amendment from NRC for EPU. Based on new technical and economic analyses, the TVA proposed to use existing cooling towers and derate to mitigate potential thermal impacts of EPU instead of building new cooling towers.
SEIS / TVA	Final SEIS for Operating License Renewal of the Browns Ferry Nuclear Plant in Athens, Alabama, March 2002.	ROD issued May 2002	Action was to seek extension of NRC licenses for BFN Units 1, 2, and 3 at 120 percent of OLTP for an additional 20 years beyond the original 40-year operating license terms. Mitigation measures for increased thermal loads to surface waters included use of existing cooling towers, construction of a new cooling tower, and derating the plant as necessary.
EA / TVA	Browns Ferry Nuclear Plant Units 2 and 3 Power Uprate Project EA, March 2001.	FONSI issued March 2001	Action was to request a license amendment to increase the output of BFN Units 2 and 3 from 105 percent of OLTP to 120 percent.
EA / TVA	Browns Ferry Nuclear Plant Units 2 and 3 Power Uprate Project EA, August 1997.	FONSI issued August 1997	Action was to request license amendment from NRC to increase BFN Units 2 and 3 maximum power level to 105 percent of OLTP.
ES[1] / AEC[2]	Browns Ferry Nuclear Plant, Units 1, 2, and 3 Final ES, Volumes 1-3, July 1971.	ROD issued August 1972	Action was to construct and operate BFN.

[1] The early TVA EIS documents were titled Environmental Statements (ES)
[2] Atomic Energy Commission (AEC); now the Nuclear Regulatory Commission (NRC)

1.7. Permits, Licenses, and Approvals

TVA maintains applicable permits for operation of BFN and would obtain all necessary permits, licenses, and approvals required for the alternative selected. Table 1.7-1 provides a list of current permits and licenses that would be maintained throughout the proposed subsequent period of extended operation. Table 1.7-2 provides a list of the other federal environmental regulations and guidance that potentially are relevant to plant activities.

Table 1.7-1. Current Contracts and Permits

Contract or Permit Type	Current Authorization	Notes
NRC	DPR-33	Current Unit 1 operating license
NRC	DPR-52	Current Unit 2 operating license
NRC	DPR-68	Current Unit 3 operating license
NPDES	AL0022080	Permit issued June 2018; permit renewal anticipated 2023
Regulated Waste Permit (Resource Conservation and Recovery Act [RCRA])	AL8640015410	Regulated waste (Hazardous waste, used oil, universal waste permit)
Air	708-0003-X005	Minor source permit issued June 2017
Air	708-0003-X005	Synthetic minor permit (i.e., emergency generators, diesel FP, auxiliary boilers) issued November 2020
Radioactive material shipment	T-AL002-L22	License to ship radioactive materials, renewed annually
Radioactive material shipment	W0019	Ship radioactive material
Radioactive material shipment	1505009347	Ship radioactive material, renewed annually
Solid waste contract	14867	Republic Services

Table 1.7-2. Relevant Federal Environmental Regulations and Guidance

Statute / Agency / Executive Order	Authority	Activity Covered
NRC	10 CFR Parts 50, 51, and 54	Operation of commercial nuclear plants and license renewal.
Endangered Species Act, USFWS	16 U.S.C. §1531 *et seq.*	Consultation with USFWS in the event that proposed activities at BFN have potential to affect federally listed species.
Bald and Golden Eagle Protection Act	16 U.S.C. 668-668d	Federal statute that protects two species of eagles.
Migratory Bird Treaty Act	16 U.S.C. 703-712	Prohibits the take (killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by USFWS.
National Historic Preservation Act of 1966	16 U.S.C. 470 et seq.	Consultation with state and tribal historical preservation officers in the event that proposed activities at BFN have potential to impact historic properties and cultural traditions, and historical properties listed, or eligible for listing, on the National Registry of Historical Places.

Statute / Agency / Executive Order	**Authority**	**Activity Covered**
Clean Air Act	42 U.S.C. 7401 *et seq*.	Federal law that regulates air emissions from stationary and mobile sources.
Federal Clean Water Act	33 U.S.C. 1344 (Section 404) 33 U.S.C. 1341 (Section 401)	Actions involving wetlands and/or stream crossings would be subject to federal Clean Water Act Section 404 permit requirements. Section 401 Water Quality Certification. Alabama Department of Economic and Community Aquatic resource alteration permit may be required for any alterations to the streams and wetlands.
Rivers and Harbors Act of 1899	Section 10	Requires authorization from the Secretary of the Army, acting through the Corps of Engineers, for the construction of any structure in or over any navigable water of the United States.
Executive Order 11514*	40 CFR Parts 1500–1508	Requires federal agencies to protect and enhance the quality of the environment and develop procedures to ensure the fullest practicable provisions of timely public information and understanding of federal plans and programs that may have potential environmental impacts that the views of interested parties can be obtained.
Executive Order 11988*	18 CFR Part 1318 44 CFR Part 60	Requires federal agencies to avoid floodplain impacts to the extent practicable.
Executive Order 11990*	42 U.S.C. 4321 et seq.; 42 U.S.C. 4331(b)(3)	Requires federal agencies to avoid direct or indirect support of new construction in wetlands whenever there is a practicable alternative.
Executive Order 13423*	42 U.S.C. 4321	Subject to the availability of appropriations, requires agencies to implement sustainable practices including energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction.
Executive Order 12898*	32 CFR 651.17	Directs Federal agencies to identify and address disproportionately high and adverse health or environmental effects of Federal actions on minority and low-income populations
Executive Order 13985*	86 FR 7009	Requires federal agencies to advance racial equity, civil rights, racial justice, equal opportunity, and support for underserved communities.
Executive Order 13990*	86 FR 7037	Addresses protecting public health and the environment and restoring science to tackle the climate crisis. TVA considers Executive Order 13990 in the context of specific statutory requirements as directed by Congress in carrying out its mission.
Executive Order 14008*	86 FR 7619	Directs Federal agencies to tackle the climate crisis at home and abroad by wiring with other countries and partners. TVA considers Executive Order 14008 in the context of specific statutory requirements as directed by Congress in carrying out its mission.

* TVA is a wholly-owned corporate agency and instrumentality of the United States. Federal executive orders may create binding legal obligations for TVA only to the extent that Congress or the Constitution give the President the authority to bind TVA in the relevant area of law or guidance. Many Executive Orders expressly recognize that they do not “impair or otherwise affect . . . the authority granted by law to an executive agency or the head thereof” and

that they "shall be implemented consistent with applicable law and subject to the availability of appropriations." TVA considers relevant Executive Orders in applicable NEPA documents, consistent with applicable court opinion and relevant CEQ guidance, but is not required to comply with or adhere to Executive Orders that otherwise are inconsistent with the authorities granted to TVA through the TVA Act.

TVA anticipates seeking required permits or authorizations as appropriate, from the following governmental entities: NRC; U.S. Army Corps of Engineers; U.S. Coast Guard; USEPA; Alabama Department of Environmental Management; U.S. Fish and Wildlife Service (USFWS); Alabama State Historic Preservation Officer; and Tribal Historic Preservation Officers. TVA anticipates consulting with the required authorities including, but not limited to: The Endangered Species Act; Bald and Golden Eagle Protection Act; Migratory Bird Treaty Act; National Historic Preservation Act; Clean Air Act; and Federal Clean Water Act.

CHAPTER 2 – ALTERNATIVES

The purpose of the proposed action is to help provide continued generation of baseload power from the Browns Ferry Nuclear (BFN) site between 2033 and 2056 by obtaining the Nuclear Regulatory Commission (NRC) subsequent license renewals (SLRs). In addition to evaluating the continued operation of BFN, the Tennessee Valley Authority (TVA) has considered a wide range of options to identify feasible alternatives available to supply approximately 3,900 megawatts electric (MWe) of base load power generation to the Tennessee Valley if TVA does not submit a subsequent license renewal application (SLRA).

Relative to BFN, taking action to continue operation would result in pursuing SLRs. Taking no action to renew the BFN operating licenses would result in ceasing operation of each unit on or before 2033 for BFN Unit 1, 2034 for Unit 2, and 2036 for Unit 3. Alternatives to the proposed action would be the utilization of alternate means to provide adequate capacity and energy in the absence of BFN.

The purpose of this section is to describe the alternatives that were reviewed and discuss why the alternatives evaluated were chosen. A description of the alternatives considered in this Supplemental Environmental Impact Statement (SEIS) are described in Section 2.1. A description of alternatives considered but dismissed from further evaluation are described in Section 2.1.2. Section 2.2 provides a comparison of the alternatives, Section 2.3 provides a summary of impacts, Section 2.4 provides a brief discussion of the preferred alternative, and Section 2.5 provides a summary of mitigation measures and best management practices (BMPs).

2.1. Development of Alternatives

To begin the process of identifying, considering, and narrowing down the alternatives to those reasonably addressing the purpose and need of this proposed action, TVA began with the broad range of supply-side and demand-side actions identified in TVA's 2019 Integrated Resource Plan (IRP). TVA reviewed energy alternatives that meet system generating needs including construction of new generating assets (Section 2.1.2.2), energy alternatives not considered reasonable (Section 2.1.2) including purchased power (Section 2.1.3) and demand-side management (Section 2.1.2.2), and alternatives carried forward for evaluation (Section 2.1.4).

The following criteria were applied to select feasible alternatives to evaluate in detail in this SEIS:

- The option must substantially meet the stated purpose and need.
- Supply-side resource options must be capable of delivering capacity and energy comparable to that provided by BFN (either individually or in combination) without substantially greater environmental impacts.
- Resource options must utilize a developed and proven technology, or one that has reasonable prospects of becoming developed and proven in time to deliver sufficient power by the time BFN's current operating licenses would expire in 2033, 2034, and 2036.

TVA considered each of the replacement alternatives identified in TVA's 2019 IRP in addition to other alternatives (e.g., geothermal and ocean wave energy). These alternatives were evaluated based on their ability to provide reliable baseload power and their ability to be operational prior to the expiration of the current BFN renewed operating licenses.

TVA's 2019 IRP provides a system-wide review on meeting projected future energy demands and the direction on potential replacement power sources that TVA is considering over the planning period from 2019-2038 (TVA 2019a). Specifically, the 2019 IRP forecasted generating assets that would be added to, or removed from, TVA's fleet by 2028 and by 2038. The 2019 IRP and associated Final Environmental Impact Statement (FEIS) (TVA 2019b) evaluated six scenarios or plausible futures, including No Nuclear Extension of BFN, with five strategies per scenario (potential TVA responses to those futures). Using these scenarios, TVA identified a range of potential resource additions and retirements throughout the TVA power service area based upon TVA's system-wide generation planning models.

In this SEIS, TVA elected to present the assessment of a reasonable alternatives as a sliding scale of a combination of individual alternative replacement options, rather than individual alternatives or a single combination of alternatives. This allowed TVA to evaluate an alternative that aligns with TVA's evaluation in the 2019 IRP if there were no nuclear extension of BFN.

The analysis below favors the generation sources that TVA selected in the 2019 IRP for current and future power sources in the TVA service area. The power sources considered as reasonable replacements for the approximately 3,900 MWe of BFN generation include a combination of natural gas-fired combined cycle (CC) generation, natural gas combustion turbine (CT) generation, solar photovoltaic (PV) facilities, storage, and small modular reactors (SMRs). The following sections identify the replacement power sources considered as reasonable (Section 2.1.1) and power sources considered as unreasonable (Section 2.1.2).

2.1.1. Energy Alternatives Considered as Reasonable - Construction of New Generating Assets

Alternative generating technologies were evaluated to identify a combination of candidate technologies that would be capable of replacing the BFN total net baseload capacity of approximately 3,900 MWe at the time the BFN Unit 1, Unit 2, and Unit 3 licenses expire in 2033, 2034, and 2036, respectively. For purposes of this alternatives analysis, TVA assumed that the region of interest (ROI) within which facilities would be sited includes the entire TVA power service area because it is too early to know where exactly the replacement generating assets would be constructed. It is also assumed that each new generating asset would have its own separate environmental review under the National Environmental Policy Act (NEPA) since TVA, as a federal corporate instrumentality, performs NEPA assessments. Further, TVA has limited the analysis of impacts from new generating plant technology alternatives in this SEIS to the technologies it deems as reasonably likely to be commercially viable on a utility scale and operational by 2033. TVA also incorporated capacity factors of generating assets in their assumptions in the 2019 IRP. Capacity factor is a measure of a power plant's actual energy generation compared to the maximum amount it could generate in a given period without any interruption. Thus, capacity factor is the annual generation of a power plant divided by the product of the capacity and the number of hours of a given period. As power plants sometimes operate at less than full output, the annual capacity factor is a measure of both how many hours in the year the power plant operated and at what percentage of its entire production. Assets that run constantly, such as nuclear plants, provide a significant amount of energy with capacity factors greater than 90 percent.

As previously mentioned, the 2019 IRP forecasted TVA generating assets for 2028 and 2038. IRP Scenario 6 specifically evaluated strategies in which there would be no nuclear extension of

BFN. Because the existing BFN renewed operating licenses expire between 2033 and 2036, the 2028 forecasted generating capacity does not consider power replacement needs for the retirement of BFN. However, the 2038 forecasted generating capacity does account for replacement generating assets that would need to be commercially viable on a utility scale and operational before the expiration of BFN's renewed operating licenses in 2033, 2034, and 2036. The difference in the maximum forecasted generating capacity between 2028 and 2038 was calculated and is assumed to be the maximum incremental capacity that could be added for each generating asset to replace BFN power generation before the renewed operating licenses expire. Therefore, the alternative analysis was identified using a combination of the following power sources to meet the NRC criteria for reasonableness for replacement of the BFN generation during the proposed subsequent period of extended operation:

- Natural gas-fired CC generation
- Natural gas-fired CT generation
- Solar generation
- Energy storage
- Nuclear-powered generation in the form of SMRs

Even without consideration for the need of replacement generation at BFN, TVA already expects to add about 10,000 megawatts (MW) of solar generation by 2035 and an additional 4,000 MW of solar by 2038 to meet customer demands and system needs. Additions may be a combination of utility and distributed scale solar facilities. Integrating this significant number and quantity 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 which is why gas CTs and energy storage are also included in this alterative. A combination of gas CC, gas CT, solar, storage, and SMR power producing units would provide the equivalent generation to replace the current MWe of generation produced from BFN.

2.1.1.1. Natural Gas-Fired Combined Cycle Generation

Natural gas-fired CC plants are efficient intermediate power generation units with large energy potential as well as the ability to provide grid support and load follow. CCs are composed of multiple natural gas-fired CT generating units which are paired with heat recovery steam generators and one or more steam turbines for increased efficiency and power output. CCs are fully dispatchable year-round with the ability to ramp generation output up and down throughout the day. This ability to ramp up and down throughout the day is increasingly important as TVA begins integrating up to 10,000 MW of solar by 2035 and an additional 4,000 MW of solar by 2038. The high fuel efficiency, relatively low construction cost, and flexibility of CCs lend them to be good candidates for intermediate and baseload operations.

In the 2019 IRP, TVA evaluated the addition of up to 9,800 MW of incremental gas CC capacity by 2038 if a high level of load growth materializes. But for the IRP scenario that anticipated No Nuclear Extension of BFN (Scenario 6), up to 3,900 MWe of incremental gas CC capacity was added (TVA 2019a), of which 1,800 MWe was forecast to be added between 2028 and 2038 during the time when the existing BFN renewed operating licenses would expire. The IRP evaluation included four natural gas CC fueled options:

- One turbine and one steam generator (CC 1 x 1)
- Two turbines and one steam generator (CC 2 x 1)
- Three turbines and one steam generator (CC 3 x 1)
- Three by one integrated gasification combined cycle (IGCC) with carbon capture and storage

For purposes of this analysis, TVA assumed development of a modern natural gas-fired CC plant with design characteristics similar to those being developed elsewhere in the TVA region. TVA has chosen to evaluate a CC plant using a closed-cycle cooling system with cooling towers at an alternate site, due to the lack of available land within the site boundaries of BFN. The CC plant would have an operating life of 40 years. It is assumed that the plant would be designed to minimize air emissions (i.e., heat recovery steam generators equipped with a selective catalytic reduction system and ammonia vaporizers). Table 2.1-1 presents the basic characteristics for the CC gas-fired alternative, and impacts are described in Section 2.1.1.1.

Table 2.1-1. 500-MWe Gas-fired Turbine Annual Emissions (tons per year)

Natural Gas-Fired Stationary Gas Turbines		Simple Cycle		Combined Cycle	
Pollutant NOx and CO Controlled, Others Uncontrolled	**AP-42 Emission Factor (lb/MMBtu)**	**lb/hr**	**TPY**	**lb/hr**	**TPY**
Criteria Pollutants[1]:					
NO_x (Lean Pre-mix Control)	9.90E-02	440	1,925	302	1,324
CO (Lean Pre-mix Control)	1.50E-02	67	292	46	201
VOC	2.10E-03	9	41	6	28
SO_2	3.4E-03	15	66	10	45
PM/PM10/PM2.5 filterable	1.90E-03	8	37	6	25
HAPs[1]:					
Total HAP			**20**		**14**
1,3-Butadiene	4.3E-07	0	0	0	0
Acetaldehyde	4.0E-05	0	1	0	1
Acrolein	6.4E-06	0	0	0	0
Benzene	1.2E-05	0	0	0	0
Ethylbenzene	3.2E-05	0	1	0	0
Formaldehyde	7.1E-04	3	14	2	9
Naphthalene	1.3E-06	0	0	0	0
PAH	2.2E-06	0	0	0	0
Propylene Oxide	2.9E-05	0	1	0	0
Toluene	1.3E-04	1	3	0	2
Xylenes	6.4E-05	0	1	0	1
	40 CFR 98 Emission Factor (kg/MMBtu)	**lb/hr**	**TPY**	**lb/hr**	**TPY**
GHGs[2]:					
CO_2	53.06	519,378	2,274,878	357,073	1,563,978
CH_4	0.001	10	43	7	29
N_2O	0.0001	1	4	1	3
CO_2e			2,277,227	357,441	1,565,594

[1] Emission factors from EPA's AP42, Chapter 3.1, Tables 3.1-1, 3.1-2a, 3.1-3

[2] Emission factors from 40 CFR 98, Subpart C, Tables C-1 & C-2 for Natural gas (Tables updated in Federal Register Nov. 2013)

2.1.1.2. Natural Gas-Fired Combustion Turbine Generation

Natural gas-fired simple cycle frame CT plants are peaking units with the ability to start and ramp up quickly on short notice as well as the ability to provide grid support and load following. Simple cycle frame CT plants are composed of multiple natural gas-fired CT generating units. CTs draw in air at the front of the unit, compress it, mix it with fuel, and ignite it. The combustion occurs immediately, allowing gases to then expand through turbine blades connected to a generator to produce electricity. CT power plants normally run on natural gas as a fuel; however, they may also be run on low-sulfur fuel oil if needed (TVA 2022e). CTs are fully dispatchable year-round with the ability to meet capacity needs during short periods, typically have the lowest installed capital cost per MW, and offer flexibility to assist in the integration of renewable resources. Aeroderivative (Aero) CT units are highly efficient peaking units similar to TVA's existing natural gas simple cycle frame CTs, but they offer higher cycling capability and no start-up costs. They can achieve full generating capacity from a cold start very quickly and allow for multiple daily starts to more closely follow load. Simple cycle frame CTs have a capacity factor of 1-10 percent while Aero CTs have a capacity factor of 10 to 45 percent.

In the 2019 IRP, for the IRP scenario that anticipated no license extension of BFN (Scenario 6), up to 6,500 MWe of gas CT capacity was forecast in 2038, of which 5,900 MWe was forecast to be added between 2028 and 2038 during the time when the existing BFN renewed operating licenses would expire (TVA 2019a). The IRP evaluated five different natural gas CT options: two simple cycle frame combustion turbines with either three or four turbines, and three Aero CT configurations with two, four, or six turbines. However, CT units generally have a capacity factor less than 5 percent. A 250-MW natural gas-fired CT unit could theoretically produce 2,190 GWh of energy if it ran every hour of the year, but the CT unit would likely only operate about 440 hours of the year and produce only about 110 GWh, resulting in a low capacity factor (TVA 2019a).

Investments in adding CTs to the peaking fleet aligns with the models in the IRP, which recommended substantial solar additions over the next two decades, by enhancing system flexibility to integrate renewables and distributed resources. As the amount of solar generation on the TVA generation portfolio continues to increase, flexibility of the remainder of the fleet becomes even more important. Therefore, TVA assumed development of single-cycle frame CTs or Aero CTs to ensure TVA maintains a reliable peaking fleet and to enhance system flexibility by facilitating the integration of intermittent renewable resources such as solar. As an example, TVA is proposing the addition of 10 natural gas-fired Aero CTs at the existing Johnsonville CT Reservation which would be operational no later than December 31, 2024 (TVA 2022f) and aid, in some combination with the other energy alternatives, in replacement of BFN generation.

2.1.1.3. Solar (with and without storage)

Solar PV systems consist of interconnected PV cells that convert sunlight into electricity. Utility-scale solar costs have fallen substantially over the past 10 years, with forecasts indicating continued declines in real dollars throughout the balance of the decade. Depending on the configuration, technology employed, and other factors, in-Valley utility-scale solar farms can expect a 20 to 27 percent capacity factor. While relatively inexpensive on a cost per megawatt-hour (MWh) basis, solar farms are not dispatchable and generation is intermittent in nature, varying by time of day, weather, and season.

At present, approximately 250 MWe of utility generating capacity in the TVA region is purchased solar power through several programs and long-term power purchase agreements (PPAs). TVA obtains the renewable energy credits from these sites, and the existing PPAs extend through the late 2030s. The 2019 IRP estimated the addition of up to 14,000 MW solar by 2038. For the no nuclear extension scenario in the IRP, up to 5,900 MW solar generation was forecast by 2038, of which 3,800 MWe was forecast between 2028 and 2038 during the time when the existing BFN renewed operating licenses would expire. It is unknown at this time, but it is possible that some of these new solar facilities would be located on TVA-owned lands in the BFN vicinity. Each facility would require varying amounts of land based on its generation capacity.

To provide dependable peak capacity needs for the TVA system, solar generation must be paired with dispatchable resources, such as storage or gas. Battery energy storage systems (BESS) typically represent one of the lowest cost storage options today and setups include a capacity output rating in MW along with an energy rating in MWh, which are customizable at each facility. Dividing the energy rating by the capacity rating provides the number of hours of duration that can be expected from the system at full output. Many utilities have found that four-hour BESS systems provide a good balance of price, output, and duration. The combination of utility-scale solar and battery storage would provide a carbon-free alternative to replace a portion of the BFN generation.

2.1.1.4. Storage (Battery Energy)

Storage units usually serve the same power supply function as peaking units but use low-cost, off-peak electricity to store energy for generation at peak times. As solar penetration on the system continues to increase, long-duration storage facilities will become increasingly more important to balance system demand. The 2019 IRP factored in the addition of up to 5,300 MW by 2038. For the No Nuclear Extension scenario in the IRP, up to 3,000 MW storage was added by 2038 to remain consistent with TVA’s strategy of having a diverse mix of power-generation, of which 1,600 MWe was forecast between 2028 and 2038 during the time when the existing BFN renewed operating licenses would expire. For example, for every 100 MW of distributed solar, TVA included an additional 10 MW of battery storage in their projection modeling (TVA 2019a). The IRP evaluated several types of storage: utility-scale battery storage, pumped storage, compressed air energy storage (CAES), and fuel cells. However, only a few are considered as possible options for supplementing the generating capacity of BFN if the renewed licenses are not subsequently renewed. Storage options considered not reasonable are described below in Section 2.1.2.1.

Most storage additions evaluated in the IRP were anticipated to be utility-scale batteries (TVA 2019a). It was estimated that these batteries would have a maximum capacity of 100 MW summer net dependable capacity (SND) capacity at an efficiency of 88 percent and storage capacity of approximately 4 hours (TVA 2019a). Lithium-ion batteries are another example of a storage resource (TVA 2019a). At the end of 2019, lithium-ion batteries represented more than 90 percent of the installed power and energy capacity of large-scale battery storage in operation in the United States primarily because they have a high energy density, high-cycle efficiency, and fast response times (EIA 2021). A BESS, as discussed in Section 2.1.1.3, typically represents one of the lowest cost storage options today. TVA is installing its first grid-scale BESS near an industrial complex in Vonore, Tennessee. The Vonore BESS will use lithium-ion batteries capable of generating up to 20 MW and storing 40 MWh of energy, which is enough electricity to power over 10,600 homes for three hours. The Vonore BESS will require approximately 10-15 acres of land (TVA 2020c, TVA 2022j).

A new hydro pumped storage unit was also evaluated in the IRP as a resource option. The pumped-storage option would use three reversible turbine generators to either take electricity from the grid by pumping water into a higher altitude reservoir during periods of excess power or add electricity to the grid by using the pumped water to power a turbine as it falls from the upper to the lower reservoir. While TVA currently operates one large hydro energy storage facility in the southeast (i.e., Raccoon Mountain Pumped-Storage Plant which has a SND capacity of about 1,600 MW), TVA is also in the process of initiating a pumped storage study to explore potential sites and develop cost estimates for additional pumped storage on the TVA system. TVA modeled the addition of a pumped storage unit providing 850 MW SND capacity. Although long timelines are required to meet environmental requirements and for construction of pumped storage, this type of storage may be a potentially viable option (in combination with other generation alternatives) by the time the last existing BFN renewed license would expire in 2036 (Unit 3).

2.1.1.5. New Nuclear - SMR

TVA has extensive nuclear operating experience with seven operating nuclear units at three sites, including BFN. The 2019 IRP included the addition of SMRs totaling 1,200 MW to replace one of the three BFN Units in the No Nuclear Extension scenario (TVA 2019a). SMRs require less space and are more flexible to operate than a traditional nuclear plant. Their smaller footprint and standardized manufactured components mean they can be built more quickly, are easier to operate and better fit into the landscape due to their compact size (TVA 2022a). TVA currently holds the only early site permit from the NRC for SMRs at its Clinch River site in Oak Ridge, TN. SMRs have the 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. As yet, no SMRs have been built in the United States, and only NuScale holds an early NRC license authorization for an SMR design. There are substantial cost and timeline risks associated with first-of-a-kind deployment of new technology. Successful partnerships with the U.S. Department of Energy (DOE) and other utility stakeholders are critical to the deployment of this new technology. TVA believes that SMRs could play a role in meeting capacity needs in the early 2030s as additional capacity is retired or expires. TVA has published the Final Programmatic Environmental Impact Statement and ROD for the Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park in Oak Ridge, Tennessee (TVA 2022c) and has announced the New Nuclear Program to explore innovative technology and potential locations beyond the Clinch River site for advanced nuclear reactors to support TVA's decarbonization goal (TVA 2022h). Therefore, construction of SMRs may be a potential base-load generation alternative to SLR for BFN Unit 1, in some combination with the other energy alternatives analyzed here.

2.1.2. Energy Alternatives Not Considered Reasonable

The full range of energy alternatives to replace BFN include power sources that will require development of new generation and power alternatives that will not require new generation, such as purchased power and demand side management. This section addresses the energy alternatives that were not considered reasonable for additional evaluation with regard to replacement of the BFN generation.

2.1.2.1. Alternatives Requiring New Generating Capacity

Wind

Wind is intermittent and, therefore, by itself is not capable of providing firm, fixed, dispatchable baseload power. The capacity factor of a wind turbine normally ranges from 25 percent to 50 percent, although higher capacity factors can be achieved during windy periods (TVA 2021m). For wind power to be viable as a discrete source of power generation that is available during peak hours, energy storage would need to be considered in the planning process, similar to solar. As outlined in the 2019 IRP, wind from both outside and inside the Valley has challenging economics. Out-of-Valley wind must be imported to TVA across interconnected systems, driving significant transmission expense. In-Valley wind would have lower intensity and efficiency and would result in lower capacity factors and higher effective costs (TVA 2019a). Furthermore, there are limited wind resources in the eastern United States and potentially large environmental impacts associated with development of a wind facility. Because wind resources are energy- and capacity-limited resources (TVA 2019a), construction of new wind farms in the TVA service area was not factored into any of the IRP portfolios.

Historically, it has been more financially advantageous to acquire wind power resources through PPAs (TVA 2019a). But TVA does not consider purchasing power to make up for a large portion of generation capacity of BFN as a reasonable alternative to the BFN SLR. There is risk that purchased power could not be delivered and TVA would need to plan total generating reserves to accommodate the potential for undelivered purchased capacity. Therefore, wind power (with or without energy storage) is not considered a reasonable alternative for the replacement of BFN generating capacity.

Hydropower

Construction of a new large-scale hydropower facility capable of generating utility-scale power would require considerable siting considerations due to the area that would be inundated to provide water storage for generation, and the overall environmental impacts associated with the development of the facility would be LARGE. If a new run-of-the-river hydroelectric generating facility was developed in the TVA region (i.e., a facility that redirects the natural flow of a river through a hydroelectric facility with little to no storage), land requirements would be approximately 0.5 acres/MW (TVA 2019b). Based on this estimate, replacement of the generating capacity of only one BFN unit would require approximately 600 acres.

TVA has a Hydro Modernization Program through which outdated turbines and other equipment in the existing hydroelectric plants are replaced and modernized. This has resulted in increases in generating capacity and average efficiency of the hydroelectric plants (TVA 2019b). In the 2019 IRP, all portfolios reflect continued investment in the hydroelectric fleet to maintain capacity and consideration of additional hydro capacity where feasible; however, no new hydropower projects were considered (TVA 2019a). TVA has concluded that construction of a new hydropower facility would have severe environmental impacts and the improvements to existing hydroelectric generating facilities would not be enough to replace BFN generation. Therefore, hydropower is not considered a reasonable alternative to the BFN SLR.

Geothermal

To produce electric power with geothermal energy, underground high-temperature reservoirs of steam or hot water are tapped by wells and the escaping steam rotates turbines to generate electricity (Unwin 2019). Geothermal energy can achieve average capacity factors of 92 percent and can be used for baseload power where this type of energy source is available (Geothermal Energy Association 2013). The major challenge for geothermal development lies in geothermal resource mapping. The National Renewable Energy Laboratory (NREL) has not identified any viable sites for geothermal energy in the eastern United States (NREL 2021). Geothermal energy resources that can be developed for power generation are primarily located in the western United States. Geothermal power plants are currently generating power in Alaska, California, Hawaii, Idaho, Nevada, New Mexico, Oregon, and Utah (NREL 2021). Therefore, TVA has concluded that geothermal energy is not a reasonable alternative to the BFN SLR in the TVA service area.

Biomass

Biomass includes wood waste, animal and other organic waste, certain agricultural crops or waste, energy crops (crops grown specifically to produce biomass for use as fuels), landfill gas, wastewater methane, and other types of waste residues used to create electricity. The generating facilities have typically been built on heavily disturbed landfills or other industrial sites and occupy small land areas. TVA currently purchases electricity generated from landfill gas and wood wastes and generates biomass electricity from Chestnut Ridge Landfill gas (TVA 2019a). The environmental impacts of this generation are, overall, beneficial due to the avoidance of methane emissions and utilization of residues at wood and grain processing plants.

Currently, the largest municipal waste plant in the United States produces 96 MWe of baseload generation (ERC 2018). The land requirements for these vary and are plant specific. In the 2019 IRP, TVA evaluated two options for new biomass generation, including a dedicated biomass facility and a repowered coal unit in which TVA would convert one or more of its existing smaller coal-fired units to exclusively burn biomass. Most of the components of a biomass plant could likely be sited on an existing TVA plant reservation, on areas that have been previously disturbed, but the generating capacity of a biomass facility would be limited due to fuel delivery constraints (TVA 2019a). Fuels for a biomass-fueled generating facility are available in various areas of the TVA region but utilizing municipal solid waste for electricity would be dependent on being close to large population centers that generate large amounts of waste. Otherwise, the harvesting and transportation of trees for use as fuel can result in adverse environmental impacts including the modification or loss of wildlife habitat, sedimentation, reduction in soil fertility, loss of old growth forest, change in forest type and understory vegetation, altered scenery, and competition with other wood-using industries (TVA 2019a).

Overall, biomass plants are unable to produce the large baseloads of electricity that nuclear plants generate without the construction of multiple smaller facilities. The construction and operation of a biomass plant of the size necessary to act as an alternative to BFN would result in MODERATE to LARGE environmental impacts to land use, water quality, ecological resources, and air quality. Therefore, biomass is not considered a reasonable alternative for replacement of the BFN SLR.

Ocean Wave and Current Energy

Although TVA's 2019 IRP did not include tidal, ocean wave or current energy in its energy planning scenarios, these technologies are being included for consistency with licensing applications for other nuclear facilities.

The potential for ocean energy in Alabama has been estimated at 3 terawatt hours (TWH) along the outer shelf and 2 TWH along the inner shelf (EPRI 2011). This potential for ocean energy is low in Alabama and the technology is in its early stages of commercial development. Only one wave energy test site project is currently operating in the Unites States off the coast of Hawaii (DOE 2019) and there are two potential tests sites off the coast of Oregon (PacWave 2021). There is very minimal information available regarding the implementation of this technology in the United States. Additionally, the environmental impacts associated with these facilities have not yet been studied in any detail in the United States. At most, ocean energy would be available only through PPAs, and TVA does not consider purchasing power to make up for a large portion of generation capacity of BFN a reasonable alternative to the BFN SLR. Therefore, ocean energy is not considered a reasonable alternative for replacement of BFN generating capacity.

Combination of Only Renewable Resources (including Solar)
A combination of only renewable resources as generating assets was also considered. This could include any combination of solar, wind, hydropower, biomass, and ocean wave and current energy. Each of these resources was discussed in the sections above. As previously discussed, wind and solar are intermittent and wind is not a viable generation source within the Valley. TVA has not considered new hydropower as a future generating asset in the IRP and upgrades to existing hydropower facilities would be insufficient to replace more than a fraction of the BFN generation. Biomass plants would not be able to produce large amounts of electricity to make a significant contribution to making up the baseload generation of BFN without MODERATE to LARGE environmental impacts. Finally, ocean wave and current energy is not a realistic option because it is in the very early stages of development and because PPAs would be required if available.

The most viable renewable resource is solar which, because of the intermittent nature of the resource cannot be the sole replacement BFN generation. Therefore, using a combination of only renewable resources as an alternative to the BFN SLR was considered but dismissed.

Storage
As discussed in Section 2.1.1.4, TVA has evaluated several types of storage options in the 2019 IRP. Utility-scale battery storage and pumped storage were evaluated as potentially reasonable energy alternatives considered. However, CAES and fuel cells were not considered reasonable alternatives for the replacement of BFN generating capacity.

CAES plants are similar to a pumped-storage plant (Section 2.1.1.4) with the major difference being that instead of pumping water from a lower to an upper reservoir, a CAES plant uses a gas turbine to compress air into an underground cavern where it can be stored under pressure until electricity is required. The pressurized air is then heated and directed through a conventional generator to produce electricity. It is estimated that the SND capacity is approximately 330 MW with 70 percent efficiency; however, there are very few operating CAES plants and information on these systems and their environmental impacts is limited. In addition, they likely would not be commercially available before the existing BFN renewed operating licenses expire, and their environmental impacts is limited. Therefore, a CAES plant is not considered a reliable alternative to the BFN SLR.

Fuel cells as a reliable generation alternative are not presently economically or technologically competitive with other alternatives. The Energy Information Administration (EIA) projects that fuel cells may cost $7,224 per installed kilowatt (total overnight capital costs) (EIA 2022), which is higher than most generation technologies analyzed in the 2019 IRP and this SEIS. This high cost is associated with the durability of fuel cells and the technology to convert natural gas to hydrogen. Therefore, fuel cells are not considered a reliable alternative to the BFN SLR.

Oil
Petroleum (Oil)-fired power plants are generally used for short periods during times of peak electricity demand and otherwise operate mostly at low capacity factors because of the high price, air pollution restrictions, and lower efficiencies of their aging generating technology (EIA 2017). TVA currently owns five diesel generators, but construction of new oil-fired generation does not fit into TVA's policy to replace high carbon emission fuel sources with generation that has a lower carbon footprint (TVA 2019a). TVA expects to phase out petroleum power purchases by 2028 and has committed to developing cleaner energy and continue to reduce environmental impacts. There are no diesel fuels or other petroleum-based resource options as a primary fuel source under consideration in the 2019 IRP because of the large amounts of

carbon dioxide and hazardous air pollutants from these facilities. Thus, TVA has concluded that, due to the high costs and lack of obvious environmental advantage, burning oil to generate electricity is not a reasonable alternative to the BFN SLR.

Coal

TVA currently operates five coal-fired power plants consisting of 25 active generating units with a total capability of approximately 6,900 MW. For the past few years, TVA has implemented a program to reduce coal-fired baseload generation in its service area, retiring and proposing to retire existing coal-fired generation. TVA's program to reduce coal-fired baseload generation in its service area is fundamental to Agency efforts to reduce carbon emissions and comply with anticipated carbon regulation that will become successively more difficult to meet with existing coal fired facilities. Coal mining results in significant environmental impacts on numerous resources including air quality, water quality, and biological resources. The mining and combustion (burning) of coal also release high levels of greenhouse gases, including methane and carbon dioxide, contributing to climate change impacts. Due to higher relative capital costs, none of the 2019 IRP scenarios included additional coal in the capacity expansion, but it did include six coal expansion options, including two coal-fired IGCC options and four supercritical pulverized coal (SCPC) facilities (TVA 2019a). Coal-fired IGCC is a gasification process that produces synthetic natural gas from coal to use as fuel in the combined cycle process. SCPC are similar to conventional pulverized coal plants, but they can operate at much higher temperatures and pressures to increase efficiency. This results in the use of less coal and lower emissions. However, implementation of IGCC and SCPC options are very cost prohibitive compared to natural gas and IGCC technologies have been installed on a very limited scale (TVA 2019a).

TVA has identified the retirement of several of their coal-fired power plants and no new coal-fired generation is proposed in the IRP; therefore, this source of generation is not considered a reasonable alternative to the BFN SLR.

2.1.2.2. Alternatives Not Requiring New Generating Capacity

Purchased Power

TVA has evaluated conventional and prospective power supply options that could be reasonably implemented before the existing BFN renewed operating licenses expire. The TVA Act authorizes TVA to exchange, buy or sell power with 13 neighboring electric utilities at interconnection voltages ranging from 69-kV to 500-kV. This arrangement gives TVA the ability to purchase power when its generating capacity cannot meet demand or when purchasing power from a neighboring utility is more economical for TVA than generating it. The arrangement also allows TVA to sell power to neighboring utilities when its generation exceeds demand (TVA 2019a). Purchased power does not include solar PPAs which are electrical power agreements in which TVA purchase solar electricity from specific companies that intend to own and operate solar facilities specifically to sell the power to an electric power company. Although purchased power can be a component of a reasonable alternative, there is risk that purchased power will not be delivered and TVA must plan total generating reserves to accommodate the potential for undelivered purchased capacity (TVA 2019a). Therefore, TVA does not consider purchasing power to make up for the total generation capacity of BFN as a reasonable alternative to the BFN SLR.

Demand-Side Management

Demand side resources, such as Energy Efficiency (EE) and Demand Response (DR), reduce demand by either installing efficiency measures to reduce energy use across all hours or provide on-demand load reduction during times of heavy demand by issuing a “call” to contractually non-firm load. TVA currently offers EE programs under its EnergyRight® brand, in partnership with Local Power Companies, and will continue to offer programs for the foreseeable future. In recent years, TVA has placed increased emphasis on its missional offerings, including low-income assistance through its Home Uplift program and community redevelopment through its Community Centered Growth program. TVA also has extensive experience with DR, with over 1,500 MW of DR capacity today. A large percentage of this capacity is currently contracted with industrial customers, although TVA has DR contracts for aggregated commercial customers as well. Additionally, TVA has been piloting a program in the residential DR space, which has the potential to offer additional diversification in its DR portfolio. TVA anticipates initiating an updated Energy Programs Potential Study in 2021 and completing it in 2022, which will further inform costs and depth of EE and DR potential in the Tennessee Valley. Demand side EE and DR resources are well positioned to help TVA absorb load growth resulting from increased electrification of the economy, from sources such as electric vehicles or appliance fuel switching (gas to electric). However, demand side resources do face challenges around timing and limits on dispatchability. EE programs take time to scale and market, while also facing increasing costs for higher depth and penetration levels. DR programs allow TVA to offset physical capacity needs; however, they are limited in the number of calls available. While demand side options have the potential to contribute to the overall system solution, the capacity and energy needs required to replace the generating power of BFN make these options not viable replacement options.

Uprating and Delayed Retirement of Existing Generating Capacity

Extending the lives of existing non-nuclear generating plants beyond the time they were originally scheduled to be retired represents another potential alternative to SLR. Since 2010, TVA has retired six coal-fired power plants (33 generating units) and currently has five coal-fired power plants consisting of 25 active generating units. However, several of these units will be retired before or near the expiration date of the existing BFN renewed operating licenses. TVA does not consider the delayed retirement of coal-power generating assets to be a reasonable alternative to the BFN SLR because it is not in line with TVA's commitment to reduce carbon emissions and goal of moving toward net-zero carbon emissions by 2050 (TVA 2021h). For these reasons, TVA does not consider the delayed retirement of non-nuclear generating units to be a reasonable alternative to the BFN SLR.

2.1.3. Conclusion

TVA operates the nation's largest public power system. It provides power to more than 10 million people, through 153 local power companies and 58 directly served customers, in an area encompassing 80,000 square miles, including most of Tennessee and parts of Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Virginia (TVA 2019a). TVA's portfolio has evolved over the past decade to a more diverse, reliable, and cleaner mix of generation resources. Currently, more than half of TVA's generation is carbon-free. TVA's current generating assets include 3 nuclear sites, 5 coal-fired sites, 29 hydroelectric sites, 1 pumped-storage site, 9 combustion turbine gas sites, 8 combined cycle gas sites, 1 co-generation unit, and 13 solar energy sites. These assets provided 37,896 MW (megawatt) summer net capability at the end of FY 2021 (TVA 2021f). This capacity included units fueled by nuclear (41 percent), natural gas (21 percent), coal (15 percent), hydroelectric (10 percent), and 13 percent from renewable and non-renewable purchased power (TVA 2021h). The diversity of generation sources is designed to provide reliable, low-cost power while reducing the risk of disproportionate reliance on any single resource.

TVA has considered alternatives to providing capacity and energy from 2033-2056, including renewing BFN operating licenses and other alternatives requiring or not requiring new generating capacity. Power uprates of existing generation assets are not sufficient by themselves to meet forecasted capacity needs. Even with substantial energy demand reduction through conservation measures, TVA would still have to add new generation to balance resources with the projected load requirements through 2056.

Construction of other types of generating capacity as an alternative to the BFN SLR was evaluated and included fossil fuel energy sources as well as renewable and nuclear energy sources. As described in Section 2.1.2, alternatives such as wind, hydropower, geothermal, biomass, ocean wave and current energy, combinations of only renewable energy, storage, oil, and coal, are not reasonable alternatives to the BFN SLR for various reasons. Wind resources are energy- and capacity-limited and not a viable generation source in the Tennessee Valley region. Environmental impacts associated with the development of new hydropower resources would be LARGE as compared to the BFN SLR and improvements to existing hydropower generating facilities would not be sufficient to replace BFN generation. Viable sources of geothermal energy have not been identified in the Tennessee Valley region. Construction of a biomass plant sufficient to replace BFN generation would result in MODERATE to LARGE environmental impacts. Minimal information is available regarding ocean wave and current energy generation and at best this power would only be available through PPAs and would be insufficient to make up for a large portion of BFN generation capacity. A combination of only renewable resources (including solar) was considered. For the reasons described above, most renewable generation options would not produce significant generation. Solar is intermittent and therefore is insufficient to be the sole, or even the major component of replacement generation for BFN. Therefore, using a combination of only renewable resources as an alternative to the BFN SLR was considered but dismissed. CAES and fuel cell storage options are not viable alternatives due to limited information about the technology (CAES) and cost (fuel cells). TVA expects to phase out petroleum power purchases by 2028, implementation of IGCC and SCPC options are cost prohibitive and IGCC technologies have limited implementation, further, TVA has committed to developing cleaner energy and continue to reduce environmental impacts and no new coal-fired generation is proposed in the IRP, therefore, both oil and coal are not viable alternatives to BFN generation.

Construction of new generating assets sufficient to replace BFN generation would have to include a combination of sources including a mix of natural gas-fired CC generation, natural gas-fired CT generation, solar generation, energy storage, and nuclear-powered generation in the form of SMRs. No single generation option would be sufficient to replace BFN generation.

Additionally, TVA considered alternatives not requiring new generating capacity including purchased power, demand-side management, and uprating and delayed retirement of existing generating capacity. Although purchased power can be a component of a reasonable alternative, there is risk that purchased power will not be delivered and TVA must plan total generating reserves to accommodate the potential for undelivered purchased capacity. Therefore, TVA does not consider purchasing power to make up for the total generation capacity of BFN as a reasonable alternative to the BFN SLR. Demand side resources such as EE and DR face challenges around timing and limits on dispatchability. The capacity and energy needs required to replace the generating power of BFN make these options not viable replacement options. Delayed retirement of coal-power generating assets is not in line with TVA's commitment to reduce carbon emissions and goal of moving toward net-zero carbon emissions by 2050 (TVA 2021h). This would also result in higher environmental issues, does not meet the goals identified in the 2019 IRP to lower air emissions. Therefore, delayed retirement of non-nuclear generating units is not a viable alternative to the BFN SLR.

2.1.4. Alternatives Carried Forward for Evaluation

As described in Section 2.1, TVA has considered a wide range of actions to supply 3,900 MWe of baseload power generation between the years 2033-2056 and to meet the other identified purposes of this proposed action. Relative to BFN, taking action to continue operation would result in pursuing renewal of the operating licenses for Units 1-3. Taking no action to renew the BFN operating licenses would result in ceasing operation of BFN Unit 1 in 2033, Unit 2 in 2034, and Unit 3 in 2036. Subsequently, TVA would need to rely on alternate means to provide adequate capacity and energy in the absence of BFN. As described above, alternatives sufficient to meet the project purpose and need include construction of new generating capacity. Therefore, in this SEIS, changes in the construction of new generating capacity to compensate for the loss of BFN are key components of implementing a No Action Alternative.

2.1.4.1. Alternative A – No Action Alternative

The No Action Alternative (Alternative A) would be the decision not to submit a SLRA to the NRC and renew the BFN operating licenses in accordance with NRC regulations. If Alternative A were to be selected, TVA would allow the current BFN operating licenses to expire at the end of their terms, shutting down each unit no later than the current license expiration dates: December 20, 2033 for Unit 1, June 28, 2034 for Unit 2, and July 2, 2036 for Unit 3.

Unlike the Proposed Action, the No Action Alternative does not provide a means of meeting future electric system needs. Therefore, unless replacement generating capacity is provided as part of the No-Action Alternative, approximately 3,900 MWe of baseload generation would no longer be available to meet TVA's electricity customers' needs, and the alternative would not satisfy the Purpose and Need for the Proposed Action. For this reason, the No-Action Alternative is defined as having two components: (1) replacing the generating capacity of BFN with alternative generating supply available during or by the end of the term of the existing BFN operating licenses and (2) decommissioning the BFN facility, as described below.

BFN's 3,900 MWe of electric generating capability provides power to the Tennessee Valley Power Service Area. The Tennessee Valley obtains approximately 40 percent of its power from nuclear generation and BFN provides approximately half of that total. This power would be unavailable to customers in the event the existing BFN renewed operating licenses are not subsequently renewed. Replacement options to consider include construction of a combination of new generating capacity using energy from natural gas, solar, storage, and nuclear SMRs. Section 2.1.1 describes each of these feasible alternatives in detail. The alternative energy options described in Section 2.1.1 are considered part of the No Action Alternative.

<u>Decommissioning</u>

If BFN is shut down as required by the current licenses, each unit would then be required to enter the long-term process of decommissioning. TVA notes that decommissioning activities and their impacts are not discriminators between the Proposed Action and the No Action Alternative as BFN will have to be decommissioned regardless of the NRC decision on SLR, which would only postpone decommissioning for another 20 years. TVA evaluated the impacts from decommissioning in the supplemental EIS for the license renewal of BFN, which concluded that the timing of decommissioning would not influence the environmental impacts of decommissioning (TVA 2002). The NRC had also established in the 2013 GEIS that the timing of decommissioning operations does not substantially influence the environmental impacts of decommissioning (NRC 2013). During decommissioning, BFN would be placed in a safe condition and all fuel would be removed from the reactors. Once BFN achieves safe shutdown conditions, the current BFN work force (2,147 permanent and contract workers) would decline over a period of a few years to a minimal maintenance size.

Decommissioning activities would begin after the permanent and safe shutdown of the units is achieved and after the formal decommissioning plans are approved by the NRC. TVA typically begins making future land-use decisions after NRC decommissioning plans are approved. During decommissioning, a new but smaller temporary work force would be employed to deconstruct the radioactive components and structures, while stored radioactive waste would be shipped offsite for permanent disposal. Based on potential new land-use changes, the work force would remove and clear any buildings, structures, facilities, impoundments, etc. that would not be part of the new land-use plans for the site property. The goal of decommissioning would be to remove and appropriate dispose of all radioactive materials throughout the BFN facility and return the site to a condition that no longer requires any control or oversight by the NRC.

The ISFSI would continue to be regulated by the NRC under its separate general license. The ISFSI would be operated as a separate facility until the DOE takes responsibility for the spent fuel and removes it from the site. Eventual decommissioning of the ISFSI would be conducted according to NRC and other applicable requirements.

Upon achieving shutdown conditions, the base load electrical power generation capacity would be lost, and TVA's ability to provide adequate power could be affected. TVA has the responsibility to ensure that the loss of BFN electrical base load generation does not adversely impact the TVA transmission system and its customers. Taking no action to renew the BFN operating licenses would result in ceasing operation of BFN Unit 1 in 2033, Unit 2 in 2034, and Unit 3 in 2036. Subsequently, TVA would need to rely on alternate means to provide adequate capacity and energy in the absence of BFN. Alternatives sufficient to meet the project purpose and need include the construction of new generating capacity. Therefore, in this SEIS, changes in the construction of new generating capacity to compensate for the loss of BFN as described in Section 2.1.1 are key components of implementing a No Action Alternative.

2.1.4.2. Alternative B – BFN Subsequent License Renewal

Under Alternative B TVA would seek renewal of operating licenses to allow for the continued operation of Units 1, 2, and 3 for an additional 20 years. Under Alternative B, TVA would submit the SLRA to the NRC. Assuming the NRC approves the SLRA, BFN would be available as a reliable base load generation plant until midnight on December 20, 2053 for Unit 1, until midnight on June 28, 2054 for Unit 2, and until midnight of July 2, 2056 for Unit 3.

<u>Continued Operation During the Proposed Subsequent Period of Extended Operation</u>

Under Alternative B, the three General Electric Boiling Water Reactors (BWRs) would continue to operate within the approved design basis and operational limits as allowed by the NRC licenses. Routine operations would include operation at extended power uprate. Chapter 1 provides a detailed description of BFN.

Under Alternative B, the BFN BWRs would continue to produce steam and electrical power by steam-driven turbine generators. The cooling water needed to support BFN power generation would be drawn from Wheeler Reservoir. Once-through cooling would continue to be used, with helper cooling towers operating when river temperatures near one or more of the NPDES limits to ensure BFN complies with regulatory thermal limits. Water from the circulating water system would continue to be discharged into Wheeler Reservoir in accordance with BFN's NPDES permit. As discussed in Section 3.1, water withdrawal and discharge would continue to be approximately 3,160 million gallons per day (MGD) and 3,154 MGD, respectively for all three units (as estimated from water use between 2016 and 2022); there is little consumptive water loss (approximately 6.73 MGD) with this method of operation.

Solid Low Level Radioactive Waste (LLRW) would continue to be generated during the proposed subsequent period of extended operation. During the proposed subsequent period of extended operation, the quantity of dry active waste (DAW) processed and shipped offsite annually would be expected to be consistent with current annual generation volumes; for example, approximately 34,600 cubic feet of LLRW was generated at BFN in 2020. Routine releases of small amounts of radioactive liquids and gases would also continue during the proposed subsequent period of extended operation and would continue to be controlled in accordance with federal regulations to ensure protection of human health and the environment. Section 3.21 provides a detailed discussion of radioactive wastes.

Operation of BFN during the proposed subsequent period of extended operation would continue to support TVA's goal of reducing carbon emissions from electrical power generation. Air emissions from nuclear generation are extremely low, with emissions related mostly to the offsite uranium fuel production, transportation, vehicle use, and occasional use of onsite support equipment such as emergency diesel generators and heavy equipment. BFN's greenhouse gas emissions are incredibly low in comparison with fossil-fueled electrical power generation. In 2019, coal-fired electricity generation made up 23 percent of United States electricity generation and produced 2,257 pounds of carbon dioxide (CO_2)/MWh of electricity, while natural gas-fired electricity generation made up 38 percent of United States electricity and produced 976 pounds of CO_2/MWh (EIA 2021). Nuclear power made up about 20 percent of United States electricity generation in 2019 and is considered a zero-emission energy source (EIA 2021), so the continued operation of BFN supports TVA's carbon free generation portfolio goals. For further discussion of air quality and greenhouse gases, see Section 3.12.

Routine maintenance and upkeep of BFN would continue through the proposed subsequent period of extended operation to ensure the safe and reliable operation of the three units. All programs, procedures, and training of personnel would ensure the units could continue to operate at a high capacity factor (>90 percent) and produce reliable base load generation.

Current work force requirements, approximately 2,147 personnel, would continue during the additional years of operation. No changes in manpower for normal operations or refueling outage support are anticipated. Very little change to current operational needs would be expected.

Refueling of one third of the fuel in each unit is performed approximately every 24 months. Refueling outages occur for approximately 28 to 45 days. During each refueling outage, spent fuel would be removed from the reactor core and new fuel bundles would replace the old. The unusable spent fuel would be stored in the spent fuel storage pools until they could be moved to dry cask storage on the onsite ISFSI.

The renewal of the BFN licenses would allow for the proposed subsequent period of extended operation of the units under the same requirements, technical specifications, and limits currently in place. Any changes to the provisions of the operating licenses (i.e., license amendments) would require NRC approval in accordance with applicable regulations. No changes would be expected for the permits currently in place. The current programs, procedures, and permits would be followed; no major changes would be needed to implement this alternative.

The routine plant operation and maintenance activities that would be performed during the proposed subsequent period of extended operation are not refurbishments as described in Sections 2.1.2 of the GEIS (NRC 2013) and would be managed in accordance with appropriate TVA programs and procedures.

Base Load Generation, Reliability, and Grid Stability

During the proposed subsequent period of extended operation, BFN would continue to supply approximately 3,900 MWe of base load power for a period of 20 additional years. BFN would be expected to continue to supply reliable power by maintaining an average capacity factor of greater than 90 percent. Due to its large and stable generation capacity, BFN would be able to support transmission grid stability, ensuring consistent electrical frequency and voltage.

Uranium Usage and Spent Fuel

Extended operation during the proposed subsequent period of extended operation would require approximately 10 additional fuel cycles per unit, resulting in approximately 3,900 acres of additional land being affected by the uranium mining necessary to fuel BFN. This acreage was calculated by using the NRC estimation of approximately 1 acre per MW would be affected for mining and processing the uranium during the operating life of a nuclear power plant (NRC 1996). The uranium would likely be sourced from Canada, Australia, or the United States. The generic calculation of land use is for the lifetime of a nuclear unit, and is conservative for this analysis of only 20 years.

BFN has two onsite ISFSI storage pads used to safely store spent fuel in licensed and approved dry cask storage containers. The ISFSI pads are licensed separately from BFN Units 1, 2, and 3 Renewed Facility Operating Licenses and would remain in place until the DOE takes possession of the spent fuel and removes it from the site for permanent disposal or processing. Expansion of the ISFSI would be required in the future if a national storage solution for the storage of spent fuel does not become available during the proposed subsequent period of extended operation. The current ISFSI storage pads are projected to be filled on or before year 2036. The addition of a third ISFSI storage pad to further increase storage capacity is under consideration, but plans are in the conceptual stage and no installation schedule has been established. A siting study conducted in 2017 showed that the BFN site has adequate space onsite to accommodate the construction of an additional ISFSI pad if necessary. The environmental impacts associated with this potential expansion would be assessed as needed under a future licensing and NEPA process.

Waste

On September 19, 2014, the NRC approved the final rule on "Continued Storage of Spent Nuclear Fuel" (10 Code of Federal Regulations 51.23) and associated Generic Environmental Impact Statement for Continued Storage of Spent Nuclear Fuel (NUREG-2157), expressing the NRC's confidence that it is technically feasible to safely store spent nuclear fuel without significant environmental impacts. The evaluation of environmental impacts of continued storage were site-specific reviews, but NRC concluded that impacts would not vary significantly across sites, and could be analyzed generically (NUREG-2157).

Non-radioactive waste (general trash, hazardous waste, and special waste) would be generated at the same annual rates as they are currently generated at BFN. From January to June 2021, BFN generated 2.04 tons. BFN also has an active recycling program that segregates and recycles scrap metal, cardboard, office paper, wood pallets, aluminum cans, plastic bottles and batteries. The segregated materials are accepted for recycling by TVA-approved waste vendors. The average monthly hazardous waste generated between 2016 and 2022 was approximately 5,380 lbs. Detailed discussion of non-radioactive waste is provided in Section 3.19.

Decommissioning

As described in Section 2.1.4.1, decommissioning activities and their impacts are not discriminators between the Proposed Action and the No Action Alternative as BFN will have to be decommissioned regardless of the NRC decision on SLR, which would only postpone decommissioning for another 20 years. The characteristics of decommissioning as described in Section 2.1.4.1 apply to the Proposed Action Alternative.

2.2. Summary of Impacts

Table 2-2 below provides a summary of the potential environmental impacts of the Action and No Action Alternatives. As a general guide to the evaluation of impacts for this SEIS, significance is used as a subjective interpretation of the intensity of the impact. As used here, the term small means that there will be no quantifiable alteration of the resource. Moderate refers to impacts that can be observed and must be considered as causing some change to the resource. A large impact clearly produces an observable impact, and the impact would clearly need to be evaluated for mitigation or producing an impact that may eliminate it from consideration due to a definite negative impact. The terms small, moderate, and large are used to evaluate impacts throughout this SEIS.

There are substantial differences between the alternatives concerning air emissions. Should TVA decide to take no action to renew BFN operating licenses, the likely increased use of existing gas units, as well as the potential construction of additional gas units, would increase emissions from those sources. Under Alternative B, continued operation of BFN helps reduce emissions of carbon and air pollutants, consistent with TVA's environmental policy.

Table 2.2-1. Summary of the Environmental Impacts of the No Action and Action Alternatives

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Land Use	Changes in land use, land acquisition, or land conversion.	*Impacts of BFN shutdown:* No changes in onsite land use patterns. Potential decrease in offsite land-use impacts from decreased uranium mining demand. *Impacts due to new generation assets:* Alternative sources for energy include a combination of natural gas-fired combined cycle (CC) generation, natural gas combustion turbine (CT) generation, solar photovoltaic (PV) facilities, energy storage facilities, and small modular reactors (SMRs). Some of these alternative sources could be sited on the nearly 880-acre BFN site and some would be sited offsite. Impacts to land use associated with construction of these new sources for energy would be small to moderate.	No changes to offsite or onsite land use Impacts associated with expansion of ISFSI would be assessed under a licensing process separate from that of the BFN SLR. Incremental contribution to cumulative impacts to land uses would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Geology and Soils	Seismic adequacy	*Impacts of BFN shutdown:* No impacts from potential minor seismic event(s) would be expected during shutdown activities. *Impacts due new generation assets:* The site chosen for any replacement generation facility would be evaluated for geologic conditions and potential seismic impacts during the site-selection process Impacts would largely be associated with ground-disturbing activities associated with the new construction and would be expected to be small.	No changes or new impacts.
	Changes or use of geological resources	*Impacts of BFN shutdown:* Anticipated impacts to soils from decommissioning would be small. *Impacts due new generation assets:* Potential effects from construction could include excavation, grading, and blasting. Impacts could range from small to moderate and would depend on the type and extent of soil disturbance activities.	No changes or new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Surface Water	Surface water hydrology and water quality.	*Impacts of BFN shutdown:* Impacts to surface water quality would be small, and potentially beneficial. *Impacts due to new generation assets:* The characteristics of the surface water impacts would be expected to be small because they would be controlled under an NPDES permit that would be regulated by the state in which the plant(s) is located. There is a potential that some erosion and sedimentation may occur during construction; however, construction would be temporary, and the implementation of best management practices (BMP) should limit any potential impacts to surface water quality. Depending on the water source, the impacts on water quality caused by plant discharge could have noticeable impacts. The plant would have to maintain compliance with the plant's NPDES permit. Impacts would be expected to be small.	All releases to surface water would be controlled as per NPDES permits and impacts would remain small. BFN complies with current NRC regulations. No change is anticipated regarding potential impacts from the current level of small impacts anticipated.
	Surface water use and trends.	*Impacts of BFN shutdown:* Impacts to surface water use would be small, and potentially beneficial. *Impacts due new generation assets:* Surface water use impacts would depend on the volume of water withdrawn for makeup water for each new generation source relative to the amount available from the intake source and the characteristics of the surface water. The overall impacts could be small for water use impacts during normal flows and possibly large impacts during extreme low-flow conditions. Potential impacts can be mitigated by derating (reducing the thermal output of the plant by reducing its electrical power rating) during periods of thermal sensitivity.	Direct, indirect, and cumulative effects of chemical and thermal discharges would be small. No changes in current level of small impacts to water supply. No cumulative effects to water supply are expected.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Surface Water (continued)	Hydrothermal effects of plant operation.	*Impacts of BFN shutdown:* Impacts would be small, and potentially beneficial. *Impacts due new generation assets:* Hydrothermal impacts on surface water from an SMR or gas-fired plant would be site specific, and dependent on the volume and temperature of water discharged. The use of cooling towers and compliance with the NPDES permit should minimize impacts which could range from small to large.	BFN would continue to operate within the thermal limits set by BFN's NPDES permit and without measurable adverse impact. BFN is in compliance with current NRC and ADEM regulations related to thermal discharge evaluation requirements; therefore, no change regarding any potential impact from the current level of small impact would be anticipated, including to cumulative impacts.
	Chemical additives for plant operation.	*Impacts from BFN shutdown:* The use of chemical additives would decrease and eventually end resulting in small and potentially beneficial impacts. *Impacts due new generation assets:* Plant discharges would be regulated by the state in which the plant is located. An NPDES permit would be required, and the plant would comply with applicable water quality standards and criteria. Therefore, when the new generation source commences operation, the direct, indirect, and cumulative effects of chemical discharges would be expected to be small.	Current use and discharge of chemical additives is expected to remain the same during the proposed subsequent period of extended operation. There would be no change in impact from the current level of small impact.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Groundwater	Chemical and radiological impacts to groundwater.	*Impacts from BFN shutdown:* No effects to the groundwater hydrology, groundwater use, or groundwater quality.	No change from current level of small impact.
	Groundwater use.	*Impacts due new generation assets:* Groundwater impacts for new generation resources would depend on the use of groundwater and construction activities required to build the plant, aquifer conditions, and other withdrawals and on the type of plant constructed. With compliance with all permits and regulations and use of BMPs, chemical and radiological impacts to groundwater would be anticipated to be small. Although it is unlikely that groundwater would be used for makeup and/or cooling water, it would depend on site-specific conditions and therefore the impacts could be moderate to large.	No groundwater use at BFN. No impact anticipated.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Floodplains and Flood Risk	Construction or modification of the floodplain.	*Impacts from BFN shutdown:* No impact is anticipated on any floodplain or flood risk since a majority of the site is located outside of the floodplain. Negligible beneficial impacts would occur if facilities within the 100-year floodplain were removed upon shutdown. *Impacts due to new generation assets:* Construction and operation of a new plant(s) would introduce construction impacts and new incremental operational impacts. All proposed construction would be evaluated to ensure consistency with EO 11988. Proper standard erosion-control measures would be followed to minimize the potential for adverse impacts on floodplains. Therefore, impacts would be anticipated to be small.	No increase in flood risk and no new impacts to floodplains in the Wheeler Reservoir watershed.
Wetlands	Destruction of wetlands or degradation of wetland functions.	*Impacts from BFN shutdown:* No impacts to wetland resources on or in the vicinity of BFN would be anticipated. *Impacts due to new generation assets:* Construction of new generating sources for energy would result in small to large impacts depending on the physical location of the plant structures and footprint.	Impacts would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Aquatic Ecology	Destruction of aquatic organisms; degradation or destruction of aquatic habitat.	*Impacts due to BFN shutdown:* Elimination of impingement and entrainment, thermal effects, non-cooling water discharge, maintenance dredging, and other operational effects generally would be expected to be small and beneficial for aquatic resources. *Impacts due to new generation assets:* Construction and operation of new SMR plant(s) could range from small to large depending on plant design, organisms present, source water, and receiving water. Construction and operation of other generating sources would range from small to large depending on location of the plant and supporting structures. Impacts would be mitigated through use of BMPs and adherence to permit and regulatory requirements.	Impacts from impingement and entrainment, thermal effects, non-cooling water discharge, maintenance dredging, and other operational effects would be small.
Terrestrial Ecology	Removal or degradation of terrestrial vegetation, wildlife habitat, and/or wildlife.	*Impacts due to BFN shutdown:* The elimination of operational effects would be expected to be small and beneficial for terrestrial resources. *Impacts due to new generation assets:* In association with construction of a new generation facility, impacts would occur to terrestrial plants cleared to accommodate the new plant site. Wildlife in the vicinity may be able to relocate and would have lesser impacts due to displacement, habitat loss, and fragmentation. Direct and indirect impacts from construction of these new sources for energy would range from small to moderate. Small cumulative impacts to terrestrial vegetation and wildlife.	No change from current BFN operations and impacts would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Endangered and Threatened Species	Mortality, harm, or harassment of federally listed or state-listed species including impacts to their critical habitat.	*Impacts due to BFN shutdown:* The elimination of operational effects would be expected to be small and beneficial for threatened and endangered species. *Impacts due to new generation assets:* Possible alternative sources could be sited onsite or offsite. Small to large indirect and direct impacts from alterations in land use patterns and human population density and growth rates that could alter habitats. Construction of generating sources could have small to large cumulative impacts from potential habitat loss, habitat fragmentation, and loss of biodiversity.	No effect on the gray bat, Indiana bat, northern long-eared bat, and tricolored bat. BFN operations that could result in tree removal would be assessed in separate environmental reviews and Section 7 Consultation would occur as appropriate to address potential impacts. Small impacts on monarch populations, bald eagles, migratory birds, aquatic species.
Managed and Natural Areas	Degradation of the value or quality of natural areas.	*Impacts due to BFN shutdown:* No impacts to managed and natural areas in the vicinity would be expected. *Impacts due to new generation assets:* Avoidance planning would likely place any potential new generation plants at a safe distance from most natural areas, therefore impacts would be small. However, over time there could be small to large cumulative impacts resulting from additional development.	Impacts would remain small. Cumulative impacts would be small.
Recreation	Degradation or elimination of recreational facilities or opportunities.	*Impacts due to BFN shutdown:* No impacts are anticipated. *Impacts due to new generation assets:* Alternative generation facility locations would be assessed for potential adverse impacts. If a potential facility were sited near a recreational, scenic, or culturally significant area, then noise, dust, viewshed, and watershed impacts could range from small to moderate.	No impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Air Quality, Climate Change and Greenhouse Gasses	Local meteorology and meteorological conditions.	*Impacts due to BFN shutdown:* No impact to meteorology and impact to air quality would be slightly beneficial. *Impacts due to new generation assets:* Prior to construction of a new generating plant, local meteorological conditions would be evaluated to model dispersion characteristics as well as the potential impact on the local air quality from the operation of the new facility.	No impact.
	Emissions resulting in increases of air pollutants.	*Impacts due to BFN shutdown:* Once the destruction and recycling of site structures and facilities began, there would be a brief period of increased pollutant emissions from construction-type activities resulting in temporary adverse air quality impacts. These would be minimized through use of BMPs and adherence to all applicable regulations. *Impacts due to new generation assets:* Construction of alternative generation sources would result in a temporary increase in fugitive dust emissions, vehicular traffic emissions, heavy equipment emissions, and concrete batch plant emissions. BMPs would be used to control the sources of emissions, and the impacts would be small and of short duration. Depending on alternative power generation methods, adverse operational impacts to air quality would be small to moderate.	BFN is not a significant source of air pollutants, and the impact of operation for an additional 20-year period would be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Meteorology, Air Quality, Climate Change and Greenhouse Gasses (continued)	Climatology and effects due to climate change.	*Impacts due to BFN shutdown:* Small impacts on GHGs as a result of emissions during decommissioning. These impacts would be temporary and would not be expected to contribute to climate change. *Impacts due to new generation assets:* Small impacts on GHGs from the construction of alternative generation sources. These impacts would be temporary and would not be expected to contribute to climate change. Operation of a new SMR or solar plant(s) would not create a significant source of pollutants including GHG, because those facilities produce considerably less air pollutants when compared to fossil-fueled generation sources. Therefore, the environmental impact of a new SMR or solar plant(s) would be small. Operation of a new natural gas-fired turbine plant would increase some GHGs and impacts would be small to moderate.	The impacts of BFN on global climate change and greenhouse gas emissions would be expected to be small. Impacts of climate change on continued operations would be expected to be small.
	Gasoline and diesel emissions from vehicles and equipment.	*Impacts due to BFN shutdown:* Vehicle and equipment emissions would initially increase during decommissioning of BFN which would result in small temporary impacts on GHG emissions. *Impacts due to new generation assets:* Vehicle and equipment emissions would initially increase during construction of any alternative generation resources which would result in small temporary impacts on GHG emissions.	No changes or new impacts would occur.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Transportation	Elevated levels of traffic from construction work force and deliveries.	*Impacts due to BFN shutdown:* Any decline in traffic due to plant closure would likely be partially offset by future development. *Impacts due to new generation assets:* Construction and operation of a new generation facility would potentially impact the transportation infrastructure and traffic load on the roadways associated with a site. Mitigation of potential transportation impacts due to the location of a facility may be necessary because of expected increases in construction and operation traffic. Therefore, impacts could range from small to moderate.	No changes or new impacts expected.
Visual Resources	Effects on scenic quality, degradation of visual resources.	*Impacts due to BFN shutdown:* No adverse impacts. *Impacts due to new generation assets:* The impact on the visual resources of an area would be dependent upon the physical, biological, and cultural characteristics of the potential new generation site. The level of impact anticipated during construction and operation would range from small to moderate and vary depending upon viewer distance from the site, the abundance of trees, hilly terrain, and mitigation measures used, such as utilizing landscape materials on site, and painting techniques applied to facility structures.	No new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Noise and Vibration	Generation of noise at levels causing a nuisance to the community.	*Impacts due to BFN shutdown:* A drop in industrial noise would result in a small beneficial impact long-term. *Impacts due to new generation assets:* Noise impacts for a new generation facility and transmission systems are dependent on the distance to the nearest critical receptor. Noise for the construction of a new generation plant is expected to be small to moderate (depending on location and type of sensitive receptor) because most noise-producing construction activities are of short duration and the construction is temporary, and there are numerous mitigation methods that can be implemented to limit the impact of noise. Operational noise would also be anticipated to be small.	Impacts would be small. No change from the current condition.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Socioeconomics	Changes in local populations, employment, and incomes.	*Impacts due to BFN shutdown:* Impacts related to loss of jobs and income would be short-term and small. *Impacts due to new generation assets:* Potential effects from construction and operation of new assets could help offset the loss of jobs from BFN shutdown, it could also result in a small shift in population both during construction and operation. Therefore, impacts could range from small to moderate, depending on site specific site conditions.	No changes in operating employment levels. No new impacts to population, local employment, or income.
	Changes in availability of housing.	*Impacts due to BFN shutdown:* May cause housing costs to slightly decrease which would result in short-term and small impacts. *Impacts due to new generation assets:* Population shifts related to construction of new generation sources could place pressures on the housing market during both construction and operations. impacts could range from small to large depending on available housing surrounding the potential site areas.	No changes or new impacts.
	Local government revenues.	*Impacts due to BFN shutdown:* Small impact on local government revenues as a result in potential changes in TVA's payment in lieu of taxes. *Impacts due to new generation assets:* Construction and operation of replacement generation sources would result in a beneficial impact if the total amount of TVA-managed land in any individual county increased. Revenue increases would be proportionally small. Impacts from construction and operation would be beneficial.	No changes or new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Socioeconomics (continued)	Police, fire, and medical services.	*Impacts due to BFN shutdown:* Phased reduction in the need for public safety services and emergency personnel. These changes would likely be offset by continued growth in the counties in the vicinity of BFN. *Impacts due to new generation assets:* Depending on the proximity to population centers and the availability of emergency services in the vicinity of these generation resources, the influx of construction workers could impact the ability of an area's police, fire, and medical facilities to provide support requiring additional resources. The expansion of public safety services would support incoming operational staff and families expected to permanently move to the area, as well as other further county population growth. Therefore, impacts could range from small to moderate.	No changes or new impacts.
	Schools and education.	*Impacts due to BFN shutdown:* The loss of operational jobs could result in a loss of population and result in reduced school enrollment. Impacts would likely be small. *Impacts due to new generation assets:* The arrival of workers and the facility would bring new monies to a region through direct and indirect spending, and in the long run, the costs of providing education for additional students should be offset by the increase in tax revenues and plant equivalent payments, therefore impacts should be small.	No changes or new impacts.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Environmental Justice	Disproportionate effects on low-income and/or minority populations.	*Impacts due to BFN shutdown:* impact is expected to be short-term and small with no disproportionate impacts to potential environmental justice communities of concern. *Impacts due to new generation assets:* Environmental justice issues would depend on the proposed location of the new generation assets and impacts could range from small to moderate based on pressure on food and housing process, or increases in road congestion or noise near residential communities	No disproportionate effects on low-income or minority populations. No incremental contribution of the continued operation of BFN to the cumulative environmental justice conditions in the region during the proposed subsequent period of extended operation

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Archaeological and Historic Resources	Damage to archaeological sites or historic structures.	*Impacts due to BFN shutdown:* Any decommissioning activities, including but not limited to demolition could result in adverse effects to the National Register of Historic Places-eligible BFN historic district and contributing structures Should any activity related to decommissioning be proposed that would modify BFN or affect any of the potentially-eligible archaeological sites, TVA will follow the steps of §800.5 for assessing adverse effects and, if required, the steps of §800.6 for resolving adverse effects. *Impacts due to new generation assets:* All lands involved in the undertaking would likely need an inventory and evaluation of cultural resources to identify historic properties and may require avoidance plans or other actions to mitigate adverse effects from proposed ground-disturbing actions and/or visual effects related to physical activities at the proposed site. The effects on cultural resources could, depending on the site, range from small to large. The anticipated NHPA Section 106 process would ensure that any historic properties would be properly identified and managed and that potential impacts would be considered and mitigation developed as appropriate.	No effect to archaeological and historic resources within BFN site or vicinity are expected. Should any activity related to SLR be proposed that would modify BFN or affect any of the potentially-eligible archaeological sites, TVA will follow the steps of §800.5 for assessing adverse effects and, if required, the steps of §800.6 for resolving adverse effects.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Hazardous, Solid, and Low-Level Radioactive Wastes	Generation and disposal of hazardous, sold, and low-level radioactive wastes.	*Impacts due to BFN shutdown:* Impact on the environment from waste generated during the period of decommissioning would be small. *Impacts due to new generation assets:* The quantities and types of solid waste generated by the construction and operation of replacement generation resources would be determined primarily by the number of acres, the initial condition of the selected site(s), and the location and type of technology chosen. Any construction and demolition wastes generated during the building and renovation process would be managed through the TVA waste disposal contracts to access the permitted disposal capacity or recycling facilities, as needed. Construction of new transmission lines has a potential to produce large volumes of solid waste. TVA-established management practices would ensure impacts to the public and the environment are small.	Waste would continue to be handled according to TVA approves procedures and federal regulations. Impacts would continue to be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Radiological Effects of Normal Operations	Effects to humans and nonhuman biota from normal radiological releases.	*Impacts due to BFN shutdown:* Decommissioning effluent releases would be small. *Impacts due to new generation assets:* There would be no radioactive effects during the construction of a new SMR plant(s) unless the construction takes place at the location of another operating nuclear plant, or there are multiple units being built and one unit becomes operational before the other(s). The radiological impacts from the construction of a new nuclear plant would be of minor significance to the construction workers. There would be no expected observable impacts from radioactive liquid or gaseous releases from a new SMR plant(s) during normal operations. The REMP would be set up for the new SMR plant(s) to ensure there are no measurable indirect or cumulative effects to the environment offsite of the new location or to the public. There would be no radioactive impacts from the construction and operation of other potential generation resources.	Annual doses to the public are well within regulatory limits; no observable health impacts are expected. No changes or new impacts are expected. Doses to nonhuman biota would be well below regulatory limits; no noticeable effects are expected and impacts are expected to remain small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Uranium Fuel Cycle Effects	Radioactive waste volumes and disposal.	*Impacts due to BFN shutdown:* Impacts associated with radioactive waste handling, storage, and transportation for decommissioning activities would be expected to be small. *Impacts due to new generation assets:* If new SMR generation were selected, the approved design would be subject to the same requirements for handling and processing radioactive waste at BFN. Similar to BFN, the environmental impacts associated with radioactive waste handling, storage, and transportation would be expected to be small and potentially less than BFN. There would be no environmental impact related to radioactive waste during the construction or operation of any non-nuclear power generation facility.	Impacts to the public and the environment resulting from processing, storage, and transportation of solid radwaste, including cumulative effects of waste storage from BFN would remain small. During decommissioning, the plant would ship all stored radioactive material to be processed or to its final disposal. Transportation impacts of all types of radioactive waste would be expected to be small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Uranium Fuel Cycle Effect (continued)	Radioactive waste transportation.	*Impacts due to BFN shutdown:* Generation of routine operational radioactive waste would cease. However, decommissioning of active components would generate waste and result in in small impacts. *Impacts due to new generation assets:* Impacts associated with radioactive material transportation at any new SMR facility would be small.	The impact to members of the public resulting from processing, storage, and transportation of solid low-level radioactive waste would be small.
	Spent fuel.	*Impacts due to BFN shutdown:* No additional spend fuel would be generated after BFN is shutdown. Small impacts as it is operated under a separate license. *Impacts due to new generation assets:* Impacts associated with spent fuel storage at any new SMR generation facility would be expected to be small. There would be no environmental impact related to spent nuclear fuel during construction or operation of any non-nuclear power generation facility. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses	Small impacts from the operation of the ISFSI, as it is operated in accordance with all applicable regulations. Additional ISFSI storage capacity would be required before 2036 if DOE does not take possession of spent fuel. Impacts from the construction and operation of an additional storage pad would be assessed in a separate evaluation and would be expected to have small cumulative impacts including small direct impacts from radiation doses from the ISFSI for onsite workers and people in the surrounding area.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Nuclear Plant Safety and Security	Postulated design-basis accidents.	*Impacts due to BFN shutdown:* All equipment and facilities would be properly maintained to ensure high integrity and safety of all systems through the end of operation and decommissioning. *Impacts due to new generation assets:* Impacts at any new SMR facility would be expected to be small. For any non-nuclear electrical power generation facility, there would be no applicable environmental impact related to DBAs.	In all cases, the doses to an assumed individual at the exclusion area boundary and low population zone are a fraction of the regulatory dose limits. Environmental risks due to postulated radiological accidents are small.
	Severe accidents.	*Impacts due to BFN shutdown:* Impacts would no longer be applicable. *Impacts due to new generation assets:* Impacts at any new SMR facility would be expected to be small and of no significance. For any non-nuclear electrical power generation facility, there would be no applicable environmental impact related to severe radiological accidents.	Severe accident analysis indicates that the risk is small and meets all safety goals.
	Plant security.	*Impacts due to BFN shutdown:* Small impacts and bound by the server accident scenarios. *Impacts due to new generation assets:* Impacts for an SMR facility would be bound by the severe accident scenarios and would be expected to remain small. For any non-nuclear electrical power generation facility, nuclear plant security regulations are not applicable.	TVA is in compliance with all regulations on plant security and plant security related impacts would remain small.

Resource	Attribute/Potential Effects	Alternative A – BFN Shutdown	Alternative B – BFN Subsequent License Renewal
Nonradiological Public Health and Safety	Electric shock and microbiological hazards.	*Impacts from BFN shutdown:* Electric shock hazards from in-scope transmission lines would be nullified. Impacts to public health would be small and beneficial from the reduced heating of waters for thermophilic organisms. *Impacts due to new generation assets:* Potential effects from construction and operation of new generation assets would be evaluated in separate analyses and impacts could range from small to moderate.	The public is precluded from accessing the site and from direct contact with transmission lines, therefore, possible shock hazard is small. No new impacts to public health from thermophilic organisms are anticipated.
Decommissioning	Environmental, cultural, and socioeconomic impacts.	Impacts would be similar to Alternative B and small.	Delaying decommissioning of the BFN reactors as a result of SLR would have small beneficial and negative impacts.

2.3. The Preferred Alternative

TVA has identified Alternative B – BFN Units 1, 2, and 3 SLR as the preferred alternative. Implementing the preferred alternative would provide the Tennessee Valley with an additional 20 years of reliable base load power while promoting TVA's goals to eventually eliminate carbon emissions, make beneficial use of existing assets, and deliver power to TVA's service area at the lowest feasible cost. As an existing plant, continued operation of BFN would not result in additional environmental impacts to new resources, while contributing to meeting the demand for base load energy sources on the TVA system in the future.

2.4. Summary of Mitigation Measures and Best Management Practices

Best Management Practices (BMPs) identified in Chapter 3 to avoid, minimize, or reduce adverse impacts to the environment in association with the preferred alternative are summarized below. Because BFN would continue operating within all applicable federal, state, and local regulations and because no new construction or modifications to the facility would occur during the proposed subsequent period of extended operations, no new mitigation measures would be required beyond those already implemented as a result of initial construction and operations.

- BMPs would be implemented including those described in A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority (TVA 2017b), stormwater pollution and Spill Prevention, Control, and Countermeasure (SPCC) plan, and other permit conditions
- BFN also has an Integrated Pollution Prevention Plan that addresses storage, secondary containment, and inspections of fuel, hazardous materials, and chemicals like biocides. Attachment 5 of the plan provides an inventory of all of the tanks, pumps, transformers, and other containers where these materials are used or stored, including the type of secondary containment for each. The secondary containment limits the potential for minor chemical spills to occur outside of containment areas.
- The discharge of chemicals to surface water would be regulated by the conditions set forth in the NPDES permit.
- Dredged material would be disposed of on land lying and being outside the 500-year floodplain in an onsite spoils area and above the 500-year flood elevation.
- Water-use and water-dependent structures and facilities would be located within 100-year floodplains, and flood-damageable equipment and facilities would be located at a minimum outside 100-year floodplains, and Critical Actions would be located at a minimum outside 500-year floodplains
- All handling and disposal of non-radioactive and radioactive wastes would be in accordance with applicable rules, regulations, and requirements of local, state, and federal laws.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The Browns Ferry Nuclear Plant (BFN) has been the subject of many environmental reviews. The environmental consequences of constructing and operating BFN were addressed comprehensively in Tennessee Valley Authority's (TVA's) 1972 Final Environmental Statement (TVA 1972). Subsequent environmental reviews have updated that original analysis (Section 1.6). This chapter updates the information contained in those earlier reviews and identifies any new or additional effects that could result from the proposed subsequent period of extended operation of BFN.

TVA has identified the significance of the impacts associated with each issue as small, moderate, or large, to be consistent with the NRC criteria found in 10 CFR Part 51, Subpart A, Appendix B, Table B-1, footnote 3:

> SMALL – Environmental effects are not detectable or are so minor that they will neither destabilize nor noticeably alter any important attribute of the resource. For the purposes of assessing radiological impacts, the Commission has concluded that those impacts that do not exceed permissible levels in the Commission's regulations are considered small.
>
> 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.

The following sections evaluate the potential environmental impacts of the BFN subsequent license renewal (SLR) and of the no action alternative for all the potentially affected environmental and human health resources.

3.1. Land Use

Located in Limestone County, Alabama on the north shore of Wheeler reservoir at Tennessee River Mile (TRM) 294, BFN is across the reservoir from Lawrence and Morgan Counties. This section addresses land use in the three counties within six miles of BFN, as shown in Figure 1.2-2.

3.1.1. Affected Environment – Land Use

3.1.1.1. Offsite Land Use

<u>Limestone County</u>

As shown in Figure 1.2-1, BFN is located in Limestone County in northwest Alabama. The County is bordered by Lauderdale County to the west, Madison County to the east, and Lawrence and Morgan Counties to the south on the southern shore of the Tennessee River. Northern Limestone County is bordered by Giles and Lincoln Counties in Tennessee. Limestone County is approximately 559 square miles or 357,760 acres of land (Siebenthaler 2020). Limestone County has several types of natural features due to its location at the foothills of the Appalachian Mountains. The section of the Tennessee River that flows along Limestone County's southern borders extends 77 miles and includes Wheeler Reservoir formed from impounding dams, Guntersville Dam and Wheeler Dam (TVA 2021l). The county has various types of trails including eight public birding trails along Wheeler Reservoir and throughout the

Wheeler National Wildlife Refuge (Alabama Birding Trails 2021). Other trails and outdoor recreation areas sit along the Elk River, which flows for 15 miles from Veto, Alabama south to the Tennessee River (Limestone County 2021a). The Swan Creek Wildlife Management Area is also located within Limestone County, approximately 5 miles southeast of BFN.,

Located in Decatur, Alabama about 15 miles to the southeast of BFN, Wheeler National Wildlife Refuge is a unit of the National Wildlife Refuge System consisting of 35,000 acres of Limestone and Morgan County. The land is used to manage and protect a diverse range of habitats including federally listed, threatened, or endangered species. Recreational activities at the Wheeler National Wildlife Refuge include wildlife education and observation, hiking, boating, fishing, and seasonal day camps (USFWS 2017, USFWS 2020b).

BFN is located on Wheeler Reservoir at TRM 294 in Limestone County. The Reservoir extends from Guntersville Dam at TRM 349 to Wheeler Dam at TRM 274.9. Table 3.1-1 describes land cover in the 6-mile (10-kilometer) region based on data downloaded from the National Land Cover Database (NLCD) 2019 (NLCD 2019). Figure 3.1-1 shows the land cover within a 6-mile radius of BFN.

Table 3.1-1. Land Cover Within a 6-Mile Radius of BFN Property Boundary

Land Use/Land Cover Type	6-Mile Radius Acreage	Percent of Total (%)
Cultivated Crops	23,499.40	32.45
Open Water	15,999.16	22.1
Hay / Pasture	10,985.12	15.17
Woody Wetlands	8,894.84	12.28
Deciduous Forest	3,070.03	4.24
Developed, Open Space	2,334.35	3.22
Emergent Herbaceous Wetlands	1,550.93	2.14
Developed, Low Intensity	1,208.94	1.67
Evergreen Forest	1,128.78	1.56
Developed, Medium Intensity	1,016.20	1.4
Developed, High Intensity	796.43	1.1
Mixed Forest	705.49	0.97
Shrub/Scrub	561.86	0.78
Herbaceous	454.66	0.63
Barren Land (Rock/Sand/Clay)	201.62	0.28
Total	72,407.82	100

Source: Land cover data from NLCD 2019 (as shown in Figure 3.1-1).

Limestone County contains six incorporated cities and towns (Ardmore, Athens, a small portion of Decatur [which is primarily located in Morgan County], Elkmont, Lester, and Mooresville), of which only Athens and Decatur are within the 6-mile radius of BFN. The City of Athens which is the seat of Limestone County, published a future land use and development plan in 2013 that discusses further urban development and expansion plans to meet the needs of their growing population (Limestone County 2021d, Martin 2013). Similar to the overall population of the state, Limestone County is experiencing population growth.

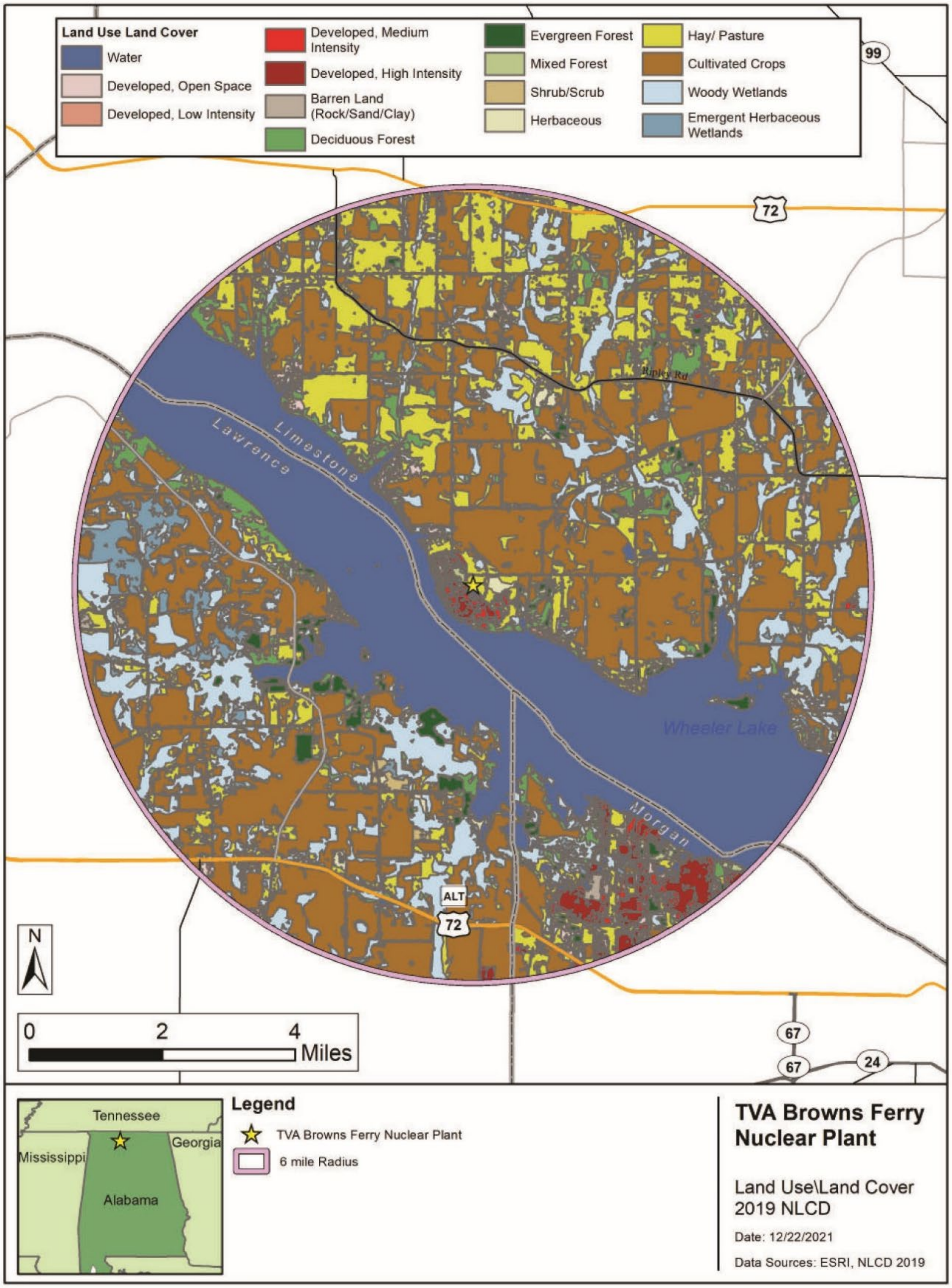


Figure 3.1-1. 6-Mile Radius BFN Land Use/Land Cover Map

Over 48 years, from 1969 to 2017, the amount of land used as farmland reduced by a total of 76,473 acres of farmland, representing a 25.4 percent loss of farmland in Limestone County. In 1969, the county used 301,295 acres for agriculture. By 2017, only 224,822 acres of the county was used for agriculture (USDA 2017b, USDA 1969).

Lawrence County

Lawrence County is situated in northwest Alabama. The County is bordered by Morgan County to the east, Cullman County to the southeast, Winston County to the south, Colbert and Franklin Counties to the west, and Lauderdale and Limestone Counties across the Tennessee River to the north. Lawrence County is approximately 693 square miles or 443,520 acres. The section of the Wheeler Reservoir that borders Lawrence County extends 64 miles (Lawrence County Chamber of Commerce 2021a). About 22.5 miles south of BFN, Bankhead National Forest takes up a quarter of the county's southern portion. Lawrence County is also home to many other natural areas, including Mallard-Fox Creek State Wildlife Management Area (about 2.5 miles south of BFN), Joe Wheeler State Park (about 13 miles southeast of BFN) and other wilderness areas and recreation parks (Lawrence County Chamber of Commerce 2021a, Lawrence County Chamber of Commerce 2021b).

Lawrence County contains six incorporated cities and towns (Courtland, Hatton, Hillsboro, Moulton, North Courtland, and Town Creek), of which only a small portion of Hillsboro is within the 6-mile radius of BFN. Although there are no zoning, building, or occupancy permits required in unincorporated areas of Lawrence County, local municipalities have primary authority and responsibility for land development and zoning within their respective limits. As a result, zoning regulations vary from municipality to municipality, with some being much more restrictive than others. However, Lawrence County does have subdivision regulations, a floodplain ordinance, and a pipe/access permit (Lawrence County Road Department 2020).

The population of Lawrence County is experiencing an overall increase in population (USCB 2022a). The amount of farmland has decreased since 1969. In 1969, there were 260,081 acres of farmland in Lawrence County. By 2017, farmland totaled only 213,747 acres, or a loss of 46,334 acres (17.8 percent) between 1969 and 2017 (USDA 2017a, USDA 1974).

Morgan County

Morgan County is situated in northwest Alabama. The County is bordered by Limestone and Madison Counties to the north, Marshall County to the east, Winston and Cullman to the south, and Lawrence County to the west. It is approximately 579 square miles of land or 370,560 acres (USCB 2021a). With 40 miles along Wheeler Reservoir, Morgan County is abundant with trails, parks, marinas, and ports. The County seat, the City of Decatur, has many parks and recreational areas including parts of the Wheeler National Wildlife Refuge and throughout the built-up urban areas along the Wheeler Reservoir (Morgan County Alabama 2021a). There are seven cities/towns in Morgan County (Decatur, Eva, Falkville, Hartselle, Priceville, Somerville, and Trinity), and the rest of the land is unincorporated (Morgan County Alabama 2021b). As shown in Figure 1.2-2, only the extreme northwestern tip of Morgan County is within the 6-mile radius of BFN along with parts of Decatur and Trinity, with an arm of Decatur hugging the shoreline of Wheeler Reservoir to the north and east of Trinity. As shown in Figure 3.1-1, most of Decatur's land use is high and medium intensity developed land along Wheeler Reservoir (NLCD 2019). In the past, Decatur has been a focal point of development within Morgan County and future growth is anticipated (City of Decatur Alabama 2020). Morgan County and the City of Decatur have coordinated an approach to growth and land development, zoning and ordinances, and other land use actions in the City of Decatur's 2018 Comprehensive Plan as well as their 2020-2024 Consolidated Plan and 2020 Action Plan (City of Decatur Alabama 2018a, City of Decatur Alabama 2020).

Similar to the overall population of the state, Morgan County is experiencing population growth (USCB 2021a, USCB 2022a). Over 48 years, from 1969 to 2017, the amount of land used as farmland reduced by a total of 96,636 acres of farmland, representing a 41.7 percent loss of farmland in Morgan County. In 1969, the county used 231,500 acres for agriculture. By 2017, only 134,864 acres of the county was used for agriculture (USDA 2017c, USDA 1969).

3.1.1.2. Onsite Land Use

BFN consists of approximately 880 acres. The BFN generation facility includes buildings and facilities as described in Section 1.2 (also see Figure 1.2-3).

Table 3.1-2 and Figure 3.1-2 show the amount of onsite acreage in various land cover categories based on data downloaded from the NLCD 2019 (NLCD 2019). It should be noted that the land cover classifications in the NLCD are based on satellite data and may not represent actual ground conditions. For example, no hay/pasture or cultivated crops are actually grown within the BFN property.

Table 3.1-2. Land Cover Within the BFN Property Boundary [1]

Land Use/land Cover Type	Onsite Acreage	Percent of Total (%)
Hay / Pasture	233.16	26.7
Developed, Medium Intensity	174.87	20.02
Developed, High Intensity	92.85	10.63
Developed, Low Intensity	87.05	9.97
Herbaceous	52.34	5.99
Deciduous Forest	43.89	5.02
Open Water	41.91	4.8
Developed, Open Space	33.69	3.86
Cultivated Crops	30.1	3.45
Mixed Forest	29.5	3.38
Woody Wetlands	26.71	3.06
Barren Land (Rock/Sand/Clay)	16.81	1.92
Shrub/Scrub	5.83	0.67
Evergreen Forest	4.79	0.55
Emergent Herbaceous Wetlands	0.22	0.03
Total	873.72	100

Note: Fee acreage for the BFN Reservation is approximately 880 acres. A land survey has not been conducted to create a Geographic Information System (GIS) shapefile of the property. The GIS shapefiles of the BFN Reservation used for this analysis includes 873.72 acres of the property.
Source: Land cover data from NLCD 2019 (as shown in Figure 3.1-2).

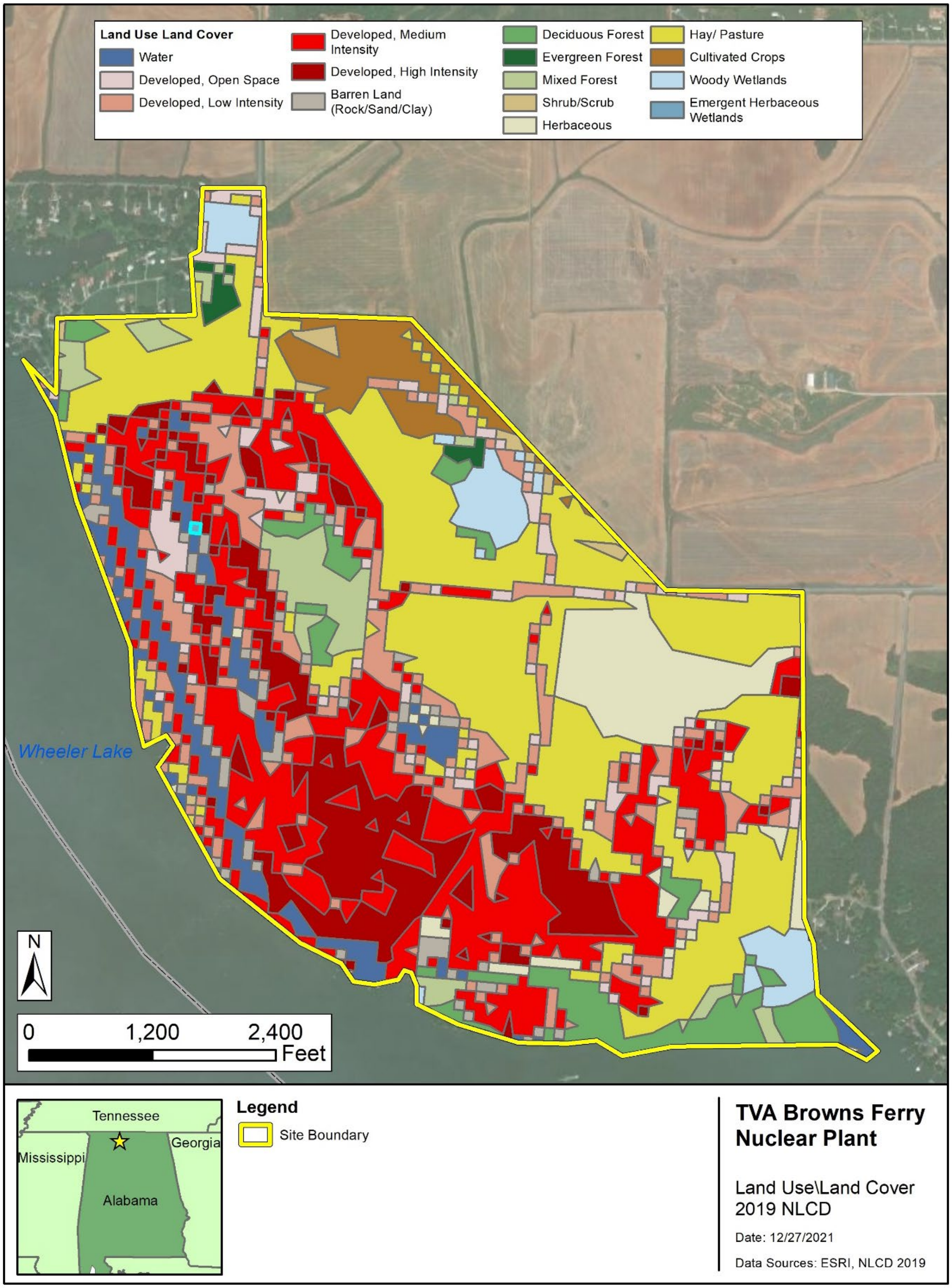


Figure 3.1-2. Onsite BFN NLCD Land Use/Land Cover Map

3.1.2. Environmental Consequences – Land Use

This section addresses impacts to land use from the No Action Alternative (Alternative A) and from the proposed subsequent period of extended operation of the BFN SLR (Alternative B). Regardless of the option chosen, decommissioning must be completed within the 60-year period following permanent cessation of operations and permanent removal of fuel.

Alternative A – No Action Alternative

Under the No Action Alternative, no changes in onsite land-use patterns would be anticipated. While the plant would undergo decommissioning, the site would probably remain developed, possibly with the establishment of an alternative generation resource. If uranium fuel is no longer required at BFN, there could be a resulting decrease in land-use impacts at source uranium mining operations due to reduced demand.

TVA would need to replace the 3,900 megawatts electric (MWe) of BFN generation under the No Action Alternative. Some of these alternative sources could be sited on the nearly 880-acre BFN site and some would be sited offsite. Should a new facility be constructed on a greenfield site, changes to offsite land use would be anticipated with the potential for loss of natural habitat and agricultural land. Should the site be a brownfield or developed site, impacts to land use would vary. If the replacement generation resource included an SMR plant(s) there may be no net change in offsite land-use impacts from the mining of uranium fuel, if supplies destined to be used during the proposed BFN subsequent period of extended operation were redirected for use at the SMR facility. It is also possible construction of the new generation facilities would result in additional land-use impacts for transmission, railroad, and/or pipeline ROWs. Potential effects would be evaluated in separate analyses once new generation construction project locations and technologies are specifically identified. Impacts to land use associated with construction of these new sources for energy would be small to moderate.

Alternative B – Proposed Action

Under the BFN SLR Alternative, the Preferred Alternative, TVA would have the option to continue operating BFN Units 1, 2, and 3 during the proposed subsequent period of extended operation until the renewed operating licenses expire in 2053, 2054, and 2056, respectively, before terminating operations and initiating decommissioning for the units in accordance with the Nuclear Regulatory Commission (NRC) requirements. Under this Alternative, ongoing operations at BFN during the proposed subsequent period of extended operation would not be expected to result in changes to onsite land use. No refurbishment or other changes to plant structures or activities would be associated with the SLR for BFN.

The current independent spent fuel storage installation (ISFSI) storage pads are projected to be filled on or before year 2036, if the U.S. Department of Energy (DOE) does not develop a permanent offsite storage in the foreseeable future. In that case, an additional ISFSI storage pad would be required to further increase storage capacity during the proposed subsequent period of extended operation. If necessary, the BFN site has adequate space onsite to accommodate the construction of a third ISFSI pad. Impacts associated with this expansion would be assessed under a licensing process separate from that of BFN Units 1, 2, and 3 Subsequent Renewed Facility Operating Licenses.

Continued operation of BFN during the proposed subsequent period of extended operation would not be anticipated to impact to offsite land use. No major refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would affect offsite land use. Continued maintenance and outages would not result in new impacts to offsite land use beyond those previously considered.

Therefore, because changes anticipated for onsite land use during the proposed subsequent period of extended operation would be small and because no changes are anticipated to change current impacts to offsite land use, the overall impact to land use associated with the BFN SLR would be small and the incremental contribution to cumulative impacts to land use would also be small.

3.2. Geology and Soils

3.2.1. Geology

3.2.1.1. Affected Environment – Geology

BFN is located on the southern margin of the Highland Rim section of the Interior Low Plateaus physiographic province (USGS 2003). This is characterized by a young-to-mature plateau exhibiting moderate relief. Elevations vary from 600 feet above mean sea level (msl) on the north shore of Wheeler Reservoir to approximately 800 feet above msl 10 miles north at Athens, Alabama. Surface water generally flows from the northeast to the southwest through Poplar, Round Island, and Mud Creeks.

BFN is located on a river terrace surface with an average elevation of 575 feet above msl. This surface represents a historic floodplain of the Tennessee River developed when the river was flowing at a higher level. The most recent floodplain is now inundated by the waters of Wheeler Reservoir. Plant grade is at 565 feet above msl. Throughout most of the Paleozoic Era the region was at or slightly below sea level, and more than 5,000 feet of limestone, dolomite, and shale were deposited.

The plateau on which the BFN site lies is underlain by near-horizontal limestone strata of Mississippian age having an aggregate thickness of slightly over 1,000 feet. According to the Alabama Geological Survey, the formations and their maximum thicknesses, in ascending order are: Fort Payne (207 feet); Tuscumbia (200 feet); Ste. Genevieve (43 feet); Bethel (40 feet); Gasper (160 feet); Cypress (7 feet); Golconda (70 feet); Hartselle (200 feet); and Bangor (90 feet). The bedrock is mantled by varying thicknesses of cherty clay, silt, sand, and gravel of residual and alluvial origin. The only formations within the BFN Reservation are the unconsolidated materials overlying bedrock and the Tuscumbia limestone and the Fort Payne Formation (USDA 2021).

Within the BFN property boundary, the beds of the Tuscumbia and Fort Payne formations are essentially horizontal in orientation. The direction of dip varies considerably but has an overall westward major component. Bedrock is cut by a pattern of near-vertical joints, and close to the surface of bedrock solution channels have developed along these joints, especially in the Tuscumbia Limestone. At depth in the less soluble Fort Payne, the joints are tight and most are cemented with calcite.

Faulting is not a significant factor in considering the geologic structure in the BFN area. No active faults showing recent surface displacement are known within a 200-mile radius of the site. The nearest known ancient fault is in Lawrence County, Alabama, 16.5 miles to the west-southwest from the BFN site, and is one of three apparently related near-vertical faults. The vertical displacement varies from 0 to 60 feet and cuts Mississippian bedrock. At the BFN site, the only indications of any rock movement are small shears along bedding planes which represent minor readjustments between beds when the area was uplifted at the end of the Paleozoic Era.

Seismicity

BFN is located in an area remote from any known centers of significant seismic activity. The site is 16.5 miles from the nearest known inactive fault and approximately 200 miles from the closest known major active fault, the New Madrid region of the Mississippi Valley. The New Madrid region was the center of a few great earthquakes more than 200 years ago and is currently home to very numerous lighter shocks. Over the past half-century, a few major earthquakes centered at distant points, several light-to-moderate shocks at distant points, and several light-to-moderate shocks with nearer centers have affected the Decatur area at low-to-moderate intensity (TVA 2014). There is continuing seismic activity in the Mississippi Valley, and there is the possibility of another large earthquake in the New Madrid region of Missouri, Arkansas, Tennessee, and Kentucky. An earthquake of intensity XI or XII on the Modified Mercalli Intensity (MMI) Scale at New Madrid might be felt in the Decatur area with an intensity of VII (TVA 2014). An MMI of XI or XII results in total destruction with few to any structures standing. And the corresponding MMI of VII in the Decatur area would result in slight to moderate damage to ordinary structures. Figure 3.2-1 provides a map of earthquake epicenters within 50 miles of BFN. As shown in Figure 3.2-1, most earthquakes in the vicinity of BFN are low energy magnitude 2 and 3 earthquakes. Figure 3.2-2 presents a seismic hazard map within 50 miles of BFN.

Overall, the BFN site is underlain by massive formations of bedrock, thus, providing adequate foundations for all plant structures. The major seismic activity experienced at the site has been caused by distant major earthquakes (TVA 2014).

In response to the recommendations of the NRC's Fukushima Task Force, TVA developed a strategy to improve the ability of each TVA operating nuclear plant, including BFN, to cope with a severe accident using lessons learned from the Fukushima accident. In 2014, TVA completed a re-evaluation of seismic and flood hazards. The existing facilities were constructed to withstand seismic events, but proposed measures would improve TVA's ability to cope with seismic events. TVA has implemented a seismic walk down methodology that meets NRC guidance. During the seismic walk-down, it was determined that Unit 1 and 2 Common Diesel Auxiliary Board Transformers had vulnerabilities and, consequently, TVA replaced both transformers(TVA 2014).

BFN is not located within the 100-year floodplain or below the TVA Flood Risk Profile elevation, thus the BFN site provides a reasonable level of protection from flooding, including flooding associated with seismic events (TVA 2013).

3.2.1.2. Environmental Consequences – Geology

This section addresses impacts to the geologic environment the associated with the No Action and Action Alternatives.

Alternative A – No Action Alternative

Under the No Action Alternative, BFN would undergo shutdown and decommissioning which would have negligible impacts on local onsite geology. There would be no major construction activity onsite. BFN is in compliance with current NRC regulations related to seismic evaluation requirements; therefore, no change regarding any potential impact from the current level of small impact would be anticipated. The future expansion of the spent fuel storage capacity may result in additional seismic evaluation if required by the NRC, however, that would be addressed in a separate licensing and environmental review. Therefore, cumulative impacts to geology would also be expected to be small.

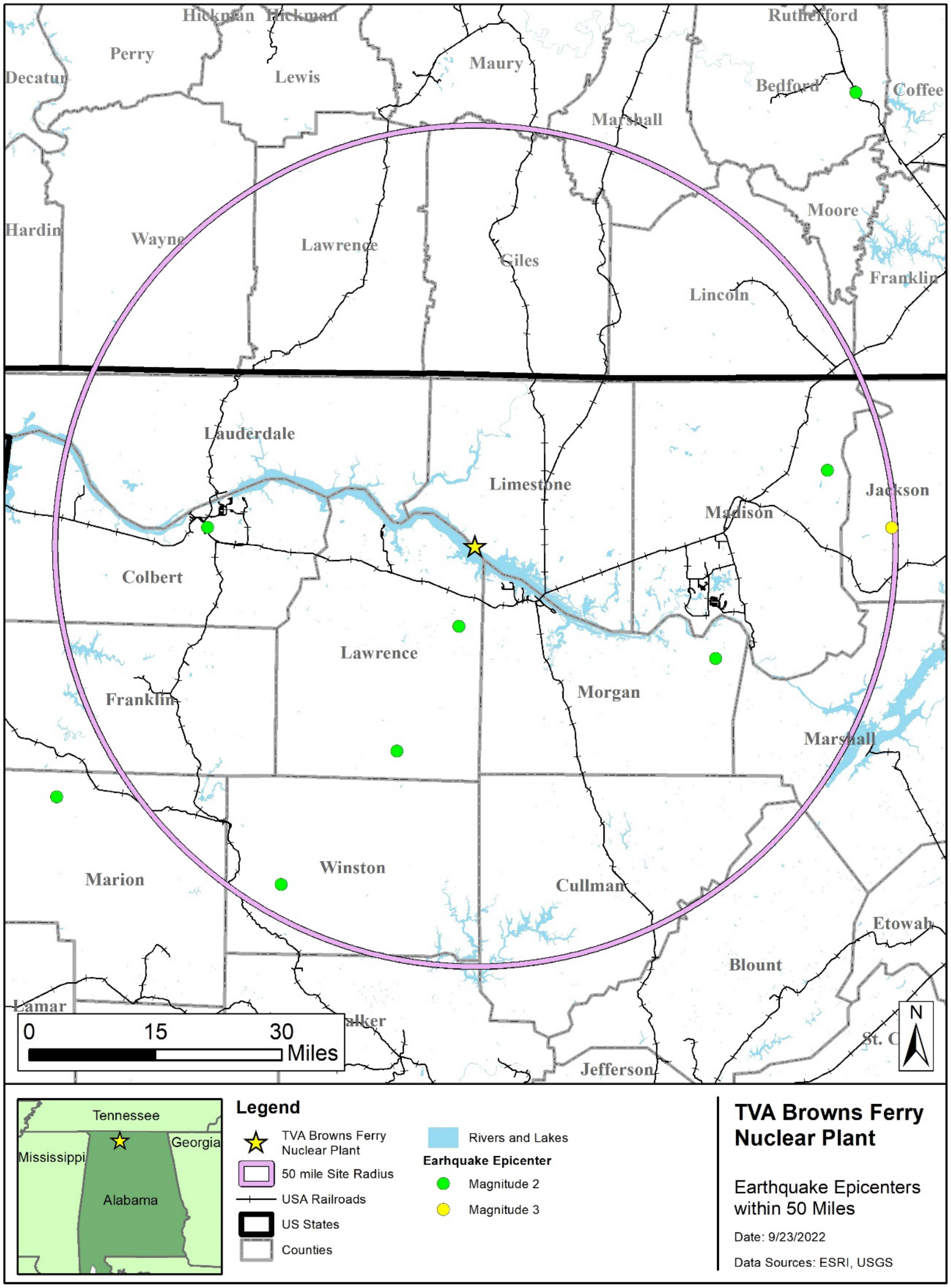


Figure 3.2-1. Earthquake Epicenters within 50 Miles of BFN

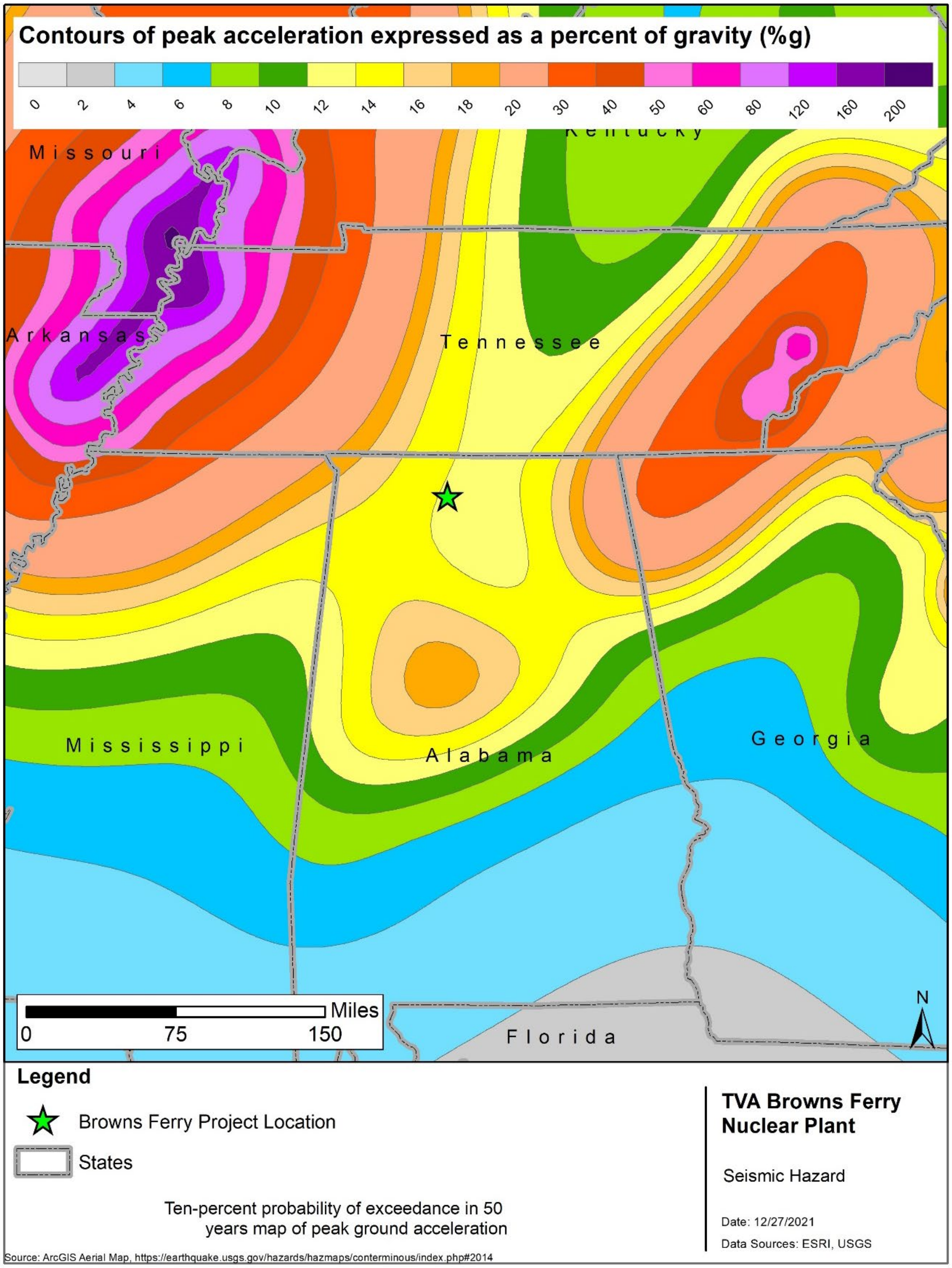


Figure 3.2-2. Seismic Hazard Map within 50 Miles of BFN

The shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. The site chosen for any replacement generation facility would be evaluated for geologic conditions and potential seismic impacts during the site-selection process. Impacts to geology would be associated with the ground-disturbance activity and could include excavation and blasting. Should the replacement generation be an SMR plant(s), that facility would be required to meet or exceed the current federal regulations for seismic performance (10 CFR Part 50, Appendix S). It is assumed the impacts related to seismic activity for any other generation resource would be less than those for an SMR plant(s). Therefore, the impacts related to geology, including seismic activity would be expected to be small for the replacement generation resource. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

Under Alternative B, continued operation of BFN units should have no impact on geological resources or the natural level of seismic activity in the area. Because no changes are anticipated to existing conditions with respect to geological resources during the proposed subsequent period of extended operation, the impact to the region's geology from the continued operation of BFN would be small. BFN is in compliance with current NRC regulations related to seismic evaluation requirements. No change regarding any potential impact from the current level of small impacts would be anticipated during the proposed subsequent period of extended operation.

3.2.2. Soils

3.2.2.1. Affected Environment – Soils

Soils at the site have been extensively excavated and reworked as a result of BFN construction. Figure 3.2-3 provides the soil map for the BFN property based on the initial 1966 soil survey. Some of these soils are likely no longer present within the central areas of BFN. Table 3.2-1 shows the characteristics of the mapped soils. The initial soils investigation program in 1966 was performed to establish the allowable bearing value for soil-supported structures. It was determined that the original ground surface was at approximately 15 feet above the planned final plant grade. The top 15 to 20 feet was classified as alluvial terrace deposits consisting of a red to reddish brown sandy clay with a lean to medium lean silty clay with a maximum thickness of 30 feet. Below the alluvial terrace deposits was approximately 40 feet of medium to fat clays and plastic silts interbedded with beds of gravelly chert (TVA 2006). The groundwater table was detected at an elevation of 555.1 feet above msl, corresponding with the current level of Wheeler Reservoir.

A soil investigation was also performed in 1980 to support the low-level radioactive waste (LLRW) storage facility. As referenced in the Browns Ferry Nuclear Plant Low-Level Radwaste Storage Facility Pathway Analysis, measured soil thickness varied from 37 to 50 feet (TVA 2006). The uppermost layer consisted of red lean clays to depths ranging from 2 to 18 feet and averaging 16 feet. Below this layer was an intermediate layer of discontinuous tan to red medium to high plasticity clays. These clays were up to 26 feet thick and averaged 16 feet in thickness. Immediately above bedrock, a continuous layer of basal cherty clay (clayey chert) averaging 18 feet thick was encountered.

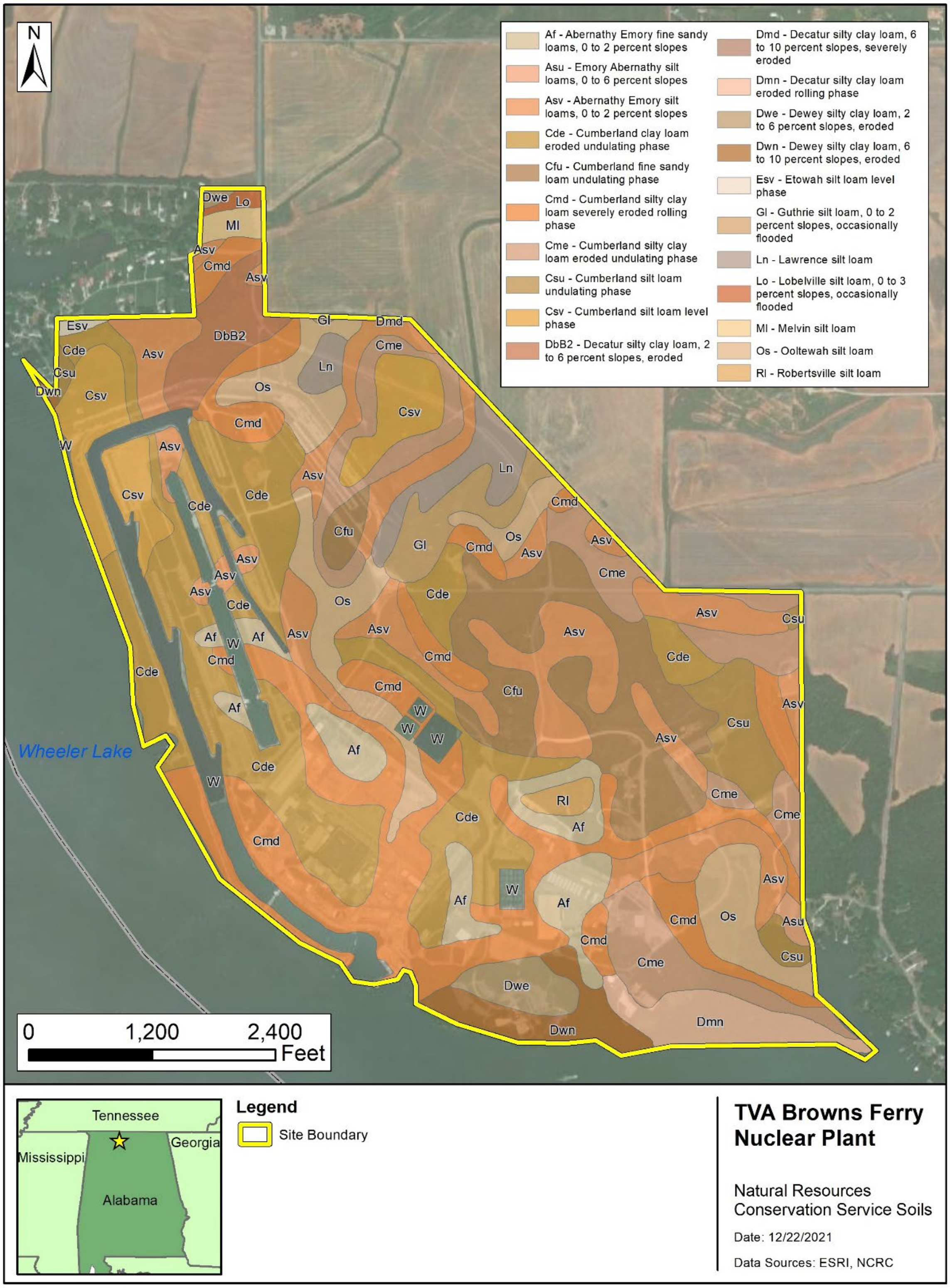


Figure 3.2-3. BFN Soil Map

Table 3.2-1. Agricultural Soil Characterization Details

Map Designation	Soil Series (a)	USDA Soil Texture Classification	Prime Farmland	Farmland of Statewide Importance	Erosion Potential (a)
Af	Abernathy Emory, 0 to 2 percent slopes	fine sandy loams	Yes	No	0.32
Asu	Emory Abernathy, 0 to 6 percent slopes	silt loams	Yes	No	0.43
Asv	Abernathy Emory, 0 to 2 percent slopes	silt loams	Yes	No	0.43
Cde	Cumberland eroded undulating phase	clay loam	Yes	No	0.28
Cfu	Cumberland undulating phase	fine sandy loam	Yes	No	0.28
Cmd	Cumberland severely eroded rolling phase	silty clay loam	No	No	0.28
Cme	Cumberland eroded undulating phase	silty clay loam	Yes	No	0.28
Csu	Cumberland undulating phase	silt loams	Yes	No	0.32
Csv	Cumberland level phase	silt loams	Yes	No	0.32
DbB2	Decatur, 2 to 6 percent slopes, eroded	silty clay loam	Yes	No	0.32
Dmd	Decatur, 6 to 10 percent slopes, severely eroded	silty clay loam	No	Yes	0.28
Dmn	Decatur eroded rolling phase	silty clay loam	No	Yes	0.28
Dwe	Dewey, 2 to 6 percent slopes, eroded	silty clay loam	Yes	No	0.24
Dwn	Dewey, 6 to 10 percent slopes, eroded	silty clay loam	No	Yes	0.28
Esv	Etowah level phase	silt loam	Yes	No	0.32
Gl	Guthrie , 0 to 2 percent slopes, occasionally flooded	silt loam	No	No	0.43
Ln	Lawrence	silt loam	Yes	No	0.32
Lo	Lobelville , 0 to 3 percent slopes, occasionally flooded	silt loam	Yes	No	0.32
Ml	Melvin	silt loam	No	Yes	0.37
Os	Ooltewah	silt loam	No	No	0.43
Rl	Robertsville	silt loam	No	No	0.43

Source: (NRCS 2020)

3.2.2.2. Environmental Consequences – Soils
This section addresses impacts to soils from the No Action and Action Alternatives.

<u>Alternative A – No Action Alternative</u>
Shutdown and decommissioning of BFN could result in ground-disturbing activities including site grading during site restoration activities. Anticipated impacts to soils from decommissioning would be small.

Under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. If the new generation resources were constructed on a greenfield site, impacts to soils from ground disturbing activities could range from small to moderate depending on the presence of prime farmland soils or farmland of statewide importance and the level of impact to those farmland soils as compared to regional trends. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

<u>Alternative B – Proposed Action</u>
Under Alternative B, impacts to soils on the site as a result of activities associated with the proposed subsequent period of extended operation would be insignificant. No refurbishment or plant modifications are currently scheduled that would result in soil impacts during the proposed subsequent period of extended operation. Minor ground disturbing activities associated with onsite maintenance activities could impact soils. With no changes to existing conditions with respect to soils anticipated during the proposed subsequent period of extended operation, there would be no anticipated incremental contribution to cumulative impacts to the region's soils associated with the continued operation of BFN.

3.3. Surface Water Resources
The dominant water requirement at most nuclear power plants is cooling water, which in most cases is obtained from surface water bodies. For this reason, most power plants are located near suitable supplies of surface water, such as rivers, reservoirs, or lakes. Because of the interaction between power plants and surface water, issues may arise in terms of both quantity and quality. A summary of the surface water hydrology and water quality for BFN, including a discussion about alternatives and their impacts, is presented in this section.

3.3.1. Surface Water Hydrology and Water Quality

3.3.1.1. Affected Environment – Surface Water Hydrology and Water Quality
<u>Surface Water Hydrology</u>
BFN is located on the north shore of Wheeler Reservoir at TRM 294 in Limestone County, Alabama. For orientation, TRM 0.0 is downstream where the Tennessee River joins the Ohio River in Paducah, Kentucky (TVA 2021g). Wheeler Dam is downstream of BFN at TRM 274.9 and Guntersville Dam lies upstream at TRM 349.0. The location of BFN is within the TVA reservoir system is shown in Figure 3.3-1.

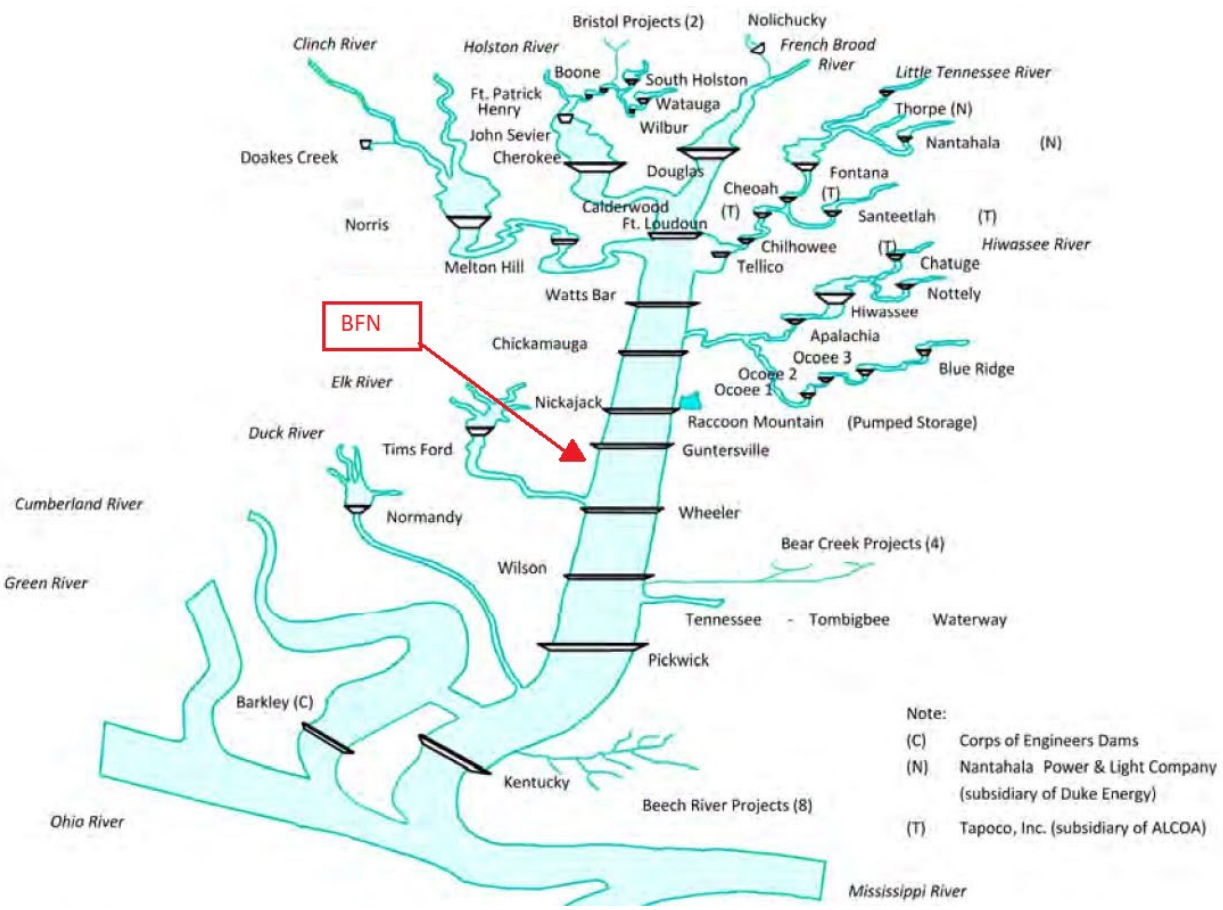


Figure 3.3-1. TVA Reservoir System

Wheeler Reservoir was created in 1936 as one of the first major dam projects on the Tennessee River for flood control, power generation, and navigation as well as for aquatic resources, water supply, and recreation (TVA 2021j). It is one of nine reservoirs that create a stairway of navigable water on the Tennessee River from Knoxville, Tennessee, to Paducah, Kentucky and is the second largest reservoir in the 652-mile Tennessee River System (TVA 2021j). Wheeler Reservoir covers a surface area of 67,070 acres, has 1,027 miles of shoreline, has a volume of 1.05 million acre-feet, and has a hydraulic retention time of 10.7 days. The width of Wheeler Reservoir in the vicinity of BFN ranges from 1 to 1.5 miles and is relatively shallow, with an average depth of 15 feet and a maximum depth of 60 feet. Normal summer pool elevation is 556 feet above msl, with a minimum level of 550 feet above msl. Wheeler Reservoir usually reaches summer elevation annually by April 15. Fall drawdown, in anticipation of winter rains, usually begins after Labor Day (TVA 2021i). The 7Q10 flow rate for the Tennessee River ranged from 4,880 cubic feet per second (cfs) at TRM 333.9 to 8,650 cfs at TRM 256.7 (USGS 2017). The 7Q10 flow rate is the lowest 7-day average streamflow occurring on average once every 10 years. TRM 256.7 is located 2.7 miles downstream of Wilson Dam, and TRM 333.9 is located 39 river miles above BFN. Average daily flow of the Tennessee River at the Guntersville Dam from 1939 to 2015 was 33,500 cfs. The average annual daily minimum flow of the Tennessee River from 2017 to 2021 was 13,231 cfs.

There are also several artificial secondary surface water bodies associated with operations on the site, including the hot water channel, cold water channel, intake channel, wastewater lagoons, and sediment ponds. Water level elevations in these secondary surface water features, particularly the hot water channel and cold water channel, are dependent on various plant operations and the water level in Wheeler Reservoir. The intake channel is generally maintained at an elevation equivalent to that in Wheeler Reservoir (Arcadis 2021).

Onsite Surface Water Features
Field assessments of onsite surface water features were conducted in September 2021 to determine stream, drainage, pond, and wetland presence, extent, and condition within the BFN site (TVA 2021c). Wetland features are discussed in Section 3.6.1.

Stream and drainage features present on the BFN site are summarized in Table 3.3-1. Streams were delineated in the field using the methods contained within the U.S. Army Corps of Engineers (USACE) *Jurisdictional Determination Form Instructional Guidebook*. Streams were assessed and classified as perennial, intermittent, or ephemeral in the field using the Tennessee Division of Water Pollution Control’s *Hydrologic Determination Field Data Sheet* (Version 1.5). The entire length of each stream was walked to assess the various geomorphic, hydraulic, and biological parameters associated with determining stream classification.

Table 3.3-1. Summary of Streams and Drainage Features

Stream ID	Width (ft) at Top of Bank	Depth (ft) at Top of Bank	TDEC Score
Ditch 1	NA	NA	NA
Ditch 2	NA	NA	NA
Stream 1	10.5	5.0	40.0
Stream 2	6.0	2.0	19.0
Stream 3	3.0	2.5	19.0
Stream 4	4.0	0.5	10.5
Stream 5	12.0	9.0	32.5
Stream 6	6.0	2.0	15.0
Stream 7	17.5	8.0	40.5
Stream 8	18.0	6.0	27.5

Source: (TVA 2021c)
NA = not applicable

Delineated stream/drainage features included two constructed ditches, two ephemeral streams, three intermittent streams, and three perennial streams. General descriptions of each feature identified within the BFN site are provided below. See Figure 3.3-2 for feature locations.

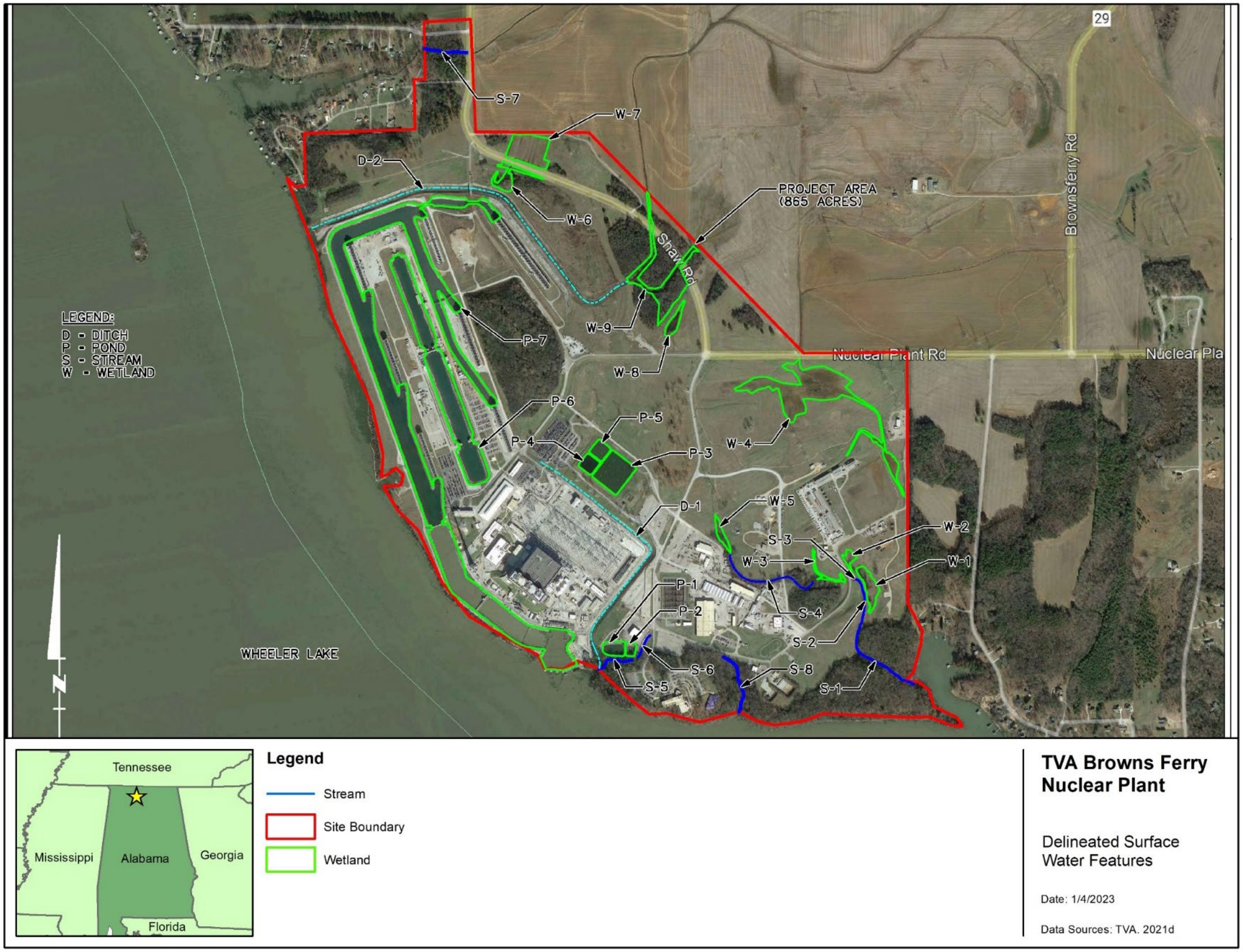


Figure 3.3-2. Delineated Surface Water Features

Stream 1 was identified in the southeastern portion of the site, downstream of Stream 2. Hydrology within the drainage basin has been significantly altered by development. The channel alignment also appears to have been straightened during past activities on the property. Much of the water observed within the channel appears to be backwater from Wheeler Reservoir and not contribution from upstream sources. Fish and amphibians were readily observed along the reach. Hydric soils were also observed within the channel. Stream 1 has an average width of 10.5 feet and average depth of 5 feet.

Stream 2 was identified in the southeastern portion of the site. Hydrology within the drainage basin has been significantly altered by development. Much of the channel bottom is covered by wetland plants. Flowing water was observed, though the stream is dominated primarily by pools and appears to lack the energy required to erode a significant channel through the soil profile. Hydric soils were observed within the channel. Stream 2 has an average width of 6 feet and an average depth of 2 feet.

Stream 3 is located downstream of Wetland 2 and flows south into Stream 2. The stream is hydrologically supplied by stormwater runoff that is stored in Wetland 2 and slowly released downstream. Hydrology within the drainage basin has been significantly altered by development. Considering the length of this stream is less than 25 feet, its depth (2.5 feet) suggests that high flows are common following large rain events. Stream 3 lacks much structure in terms of geomorphology and more closely resembles a roadside ditch than a stream. Hydric soils were observed within the channel. Stream 3 has an average width of 3 feet and an average depth of 2.5 feet.

Stream 4 flows east through the site where the channel dissipates upstream of Wetland 3. Hydrology for this stream has been significantly altered by development. This wet weather conveyance reach lacks the frequent flows and erosive energy necessary to scour out a true channel. Field observations indicate that the stream exhibits flow only immediately following large rain events. The sinuosity of the reach is due to modification of the channel from development of the property. Hydric soils were not observed within the channel. Stream 4 has an average width of 4 feet and an average depth of 0.5 feet.

Stream 5 was identified northwest of the Training Center downstream of Stream 6. The stream flows southwest through the property and into Wheeler Reservoir. The channel is severely incised with channel depths exceeding 10 feet. Hydrology within the drainage basin has been significantly altered by development. Aquatic life was observed in the downstream end of the reach where backwater from Wheeler Reservoir extends upstream. Hydric soils were observed within the channel. Stream 5 has an average width of 4 feet and average depth of 2 feet.

Stream 6 was identified northwest of the Training Center upstream of Stream 5. The upstream end of Stream 6 is a headwall where stormwater captured by storm infrastructure discharges. The channel bottom and side slopes are lined with rip rap to prevent erosion and scour following rain events. Hydrology within the drainage basin has been significantly altered by development. Water was not observed within the channel of this wet weather conveyance during field investigation. Hydric soils were not observed within the channel. Stream 6 has an average width of 6 feet and an average depth of 2 feet.

Stream 7 was identified in the northern portion of the property near the intersection of Paradise Shores and Shaw Road. The stream flows east to west through a narrow portion of the property. Continuous bed and bank, grade control, and in-channel structure were readily observed in the field. The channel is well developed through the soil profile. Aquatic life was observed throughout the reach. Hydric soils were observed within the channel. Stream 7 has an average width of 17.5 feet and an average depth of 8 feet.

Stream 8 was identified northeast of the Training Center and flows south through the property to flow into Wheeler Reservoir. The upstream end of Stream 8 is a headwall where stormwater captured by storm infrastructure discharges. The channel bottom and side slopes are lined with rip rap in the upstream portion of the reach to prevent erosion and scour during rain events. Continuous bed and bank, grade control, and lack of vegetation within the channel were readily observed in the field. The reach is well developed through the soil profile. Hydric soils were observed within the channel. Stream 8 has an average width of 18 feet and an average depth of 6 feet.

Ditch 1 was identified southeast of the Turbine Building and converges with Stream 5 near the property boundary. Backwater from Wheeler Reservoir was observed in the downstream end of the feature. No ordinary high-water mark was observed during field investigation. The channel bottom and side slopes are lined with rip rap to prevent erosion and scour following construction of the channel.

Ditch 2 was identified northwest of the cooling towers and extends to the downstream end of Wetland 9. No ordinary high-water mark was observed during field investigation. The channel bottom and side slopes are lined with rip rap to prevent erosion and scour following construction of the channel.

Seven ponds totaling approximately 69 acres are present on the BFN site (See Figure 3.3-2 for locations). General descriptions of each feature are provided below.

Pond 1 and Pond 2 are adjacent to each other between the Intake Forebay and Training Center. The ponds are lined with an impermeable membrane and likely function to provide water for facility operations. Ponds 1 and 2 appear to be isolated with no outlet structures observed. No vegetation was observed within the ponded areas.

Ponds 3, 4, and 5 are adjacent and located north of the 500 kilovolt (kV) Switchyard. The ponds are part of a three-pond system designed to manage wastewater from facility operations. The ponds appear to be isolated with no outlet structures observed.

Pond 6 is located northwest of the Administration Building between two rows of cooling towers. The pond is divided into three chambers and appears to be used for facility operations. Pond 6 appears to be isolated from adjacent waters with no inlet or outlet structure observed. Pond slopes are lined with rip rap and no vegetation was observed.

Pond 7 was identified along the western property boundary adjacent to Wheeler Reservoir. The pond is divided into chambers that provide cold water to facility operations. Water is supplied to Pond 7 via the Intake Forebay located on Wheeler Reservoir. Slopes of the pond are lined with rip rap and no vegetation was observed.

Water Quality

Stormwater and Other Discharges

The Alabama Department of Environmental Management (ADEM) has USEPA authorization to implement the National Pollutant Discharge Elimination System (NPDES) in Alabama for facilities such as BFN. ADEM (1) regulates thermal discharges in accordance with CWA Section

316(a) to control thermal impacts on the aquatic environment in the receiving water, and (2) implements CWA Section 316(b) requirements to ensure that the location, design, construction, and capacity of industrial cooling water intake structures reflect the best technology available for reducing adverse environmental impacts. The BFN NPDES permit (No. AL0022080) also regulates discharges of pollutants to Wheeler Reservoir in outflows including once-through cooling water from the condenser circulating water, raw cooling water, turbine building station sump effluent, intake building sump effluent, and liquid radwaste system (ADEM 2018). The NPDES permit was renewed by TVA with an effective date of July 1, 2018, and expiration date of August 31, 2023. TVA will continue to renew and comply with the permit as long as the outfalls remain operational. The permit establishes discharge limitations and monitoring requirements for specific constituents by outfall, based on the type of wastewater discharged through the respective outfall.

To comply with Section 316(a) permit requirements, BFN evaluates the status of the aquatic community in Wheeler Reservoir downstream of the plant thermal discharge every two years to support continuance of its thermal variance for the plant CCW discharge (Outfall DSN001) in a renewed permit. Results of these 316(a) evaluations are submitted to ADEM during each permit renewal, and a granted continuance is based on a successful demonstration that a balanced indigenous population of fish and wildlife was present and being maintained in Wheeler Reservoir downstream of the plant. The BFN plant has maintained a good compliance record with its 316(a) criteria throughout each NPDES permit term since first authorized in the late-1970s; ongoing biological monitoring has consistently demonstrated that the mixing zone criteria are protective of aquatic communities in the river near the facility.

BFN continues its compliance with all Section 316(b) requirements outlined in its NPDES permit and in accordance with the Section 316(b) Cooling Water Intake Structure Rule. BFN submitted information for the cooling water intake structure as required by the permit and Section 122.21(r) on January 28, 2022, prior to the required 180 days before expiration of the current permit. Once it receives the final BTA determination for entrainment from ADEM in the subsequent permit, BFN will continue 316(b) compliance by submitting to ADEM its chosen method to reduce impingement mortality and implementation schedule for the next permit cycle.

Section 303(d) of the Clean Water Act

Alabama assesses the water quality of streams every other year and develops a draft 303(d) list for impaired waterbodies. Under Section 303(d) of the 1972 Clean Water Act (CWA), States, territories, and authorized tribes are required to develop lists of impaired waters. These are waters that do not meet water quality standards. The law also requires that these jurisdictions establish priority rankings for waters on the lists and develop total maximum daily loads (TMDLs) for these waters with the goal of removing them from the 303(d) list over time (USEPA 2021b). Table 3.3-2 presents the impairment information for Wheeler Reservoir from the Alabama 2020 303(d) list (ADEM 2020). The only impaired waterbody in Wheeler Reservoir listed in the table below that is not of low TMDL priority is Elk River (AL06030004-0405-101), which is listed as high priority.

<u>TVA Reservoir Monitoring Program</u>

Wheeler Reservoir has been monitored for ecological health every two years since 1994, and more recently every three years, with the most recent report released for 2017. There are five health indicators that have been used to assess aquatic health: dissolved oxygen, chlorophyll, benthic macroinvertebrate community, fish assemblages, and sediment quality. Values of good, fair, or poor are assigned to each metric.

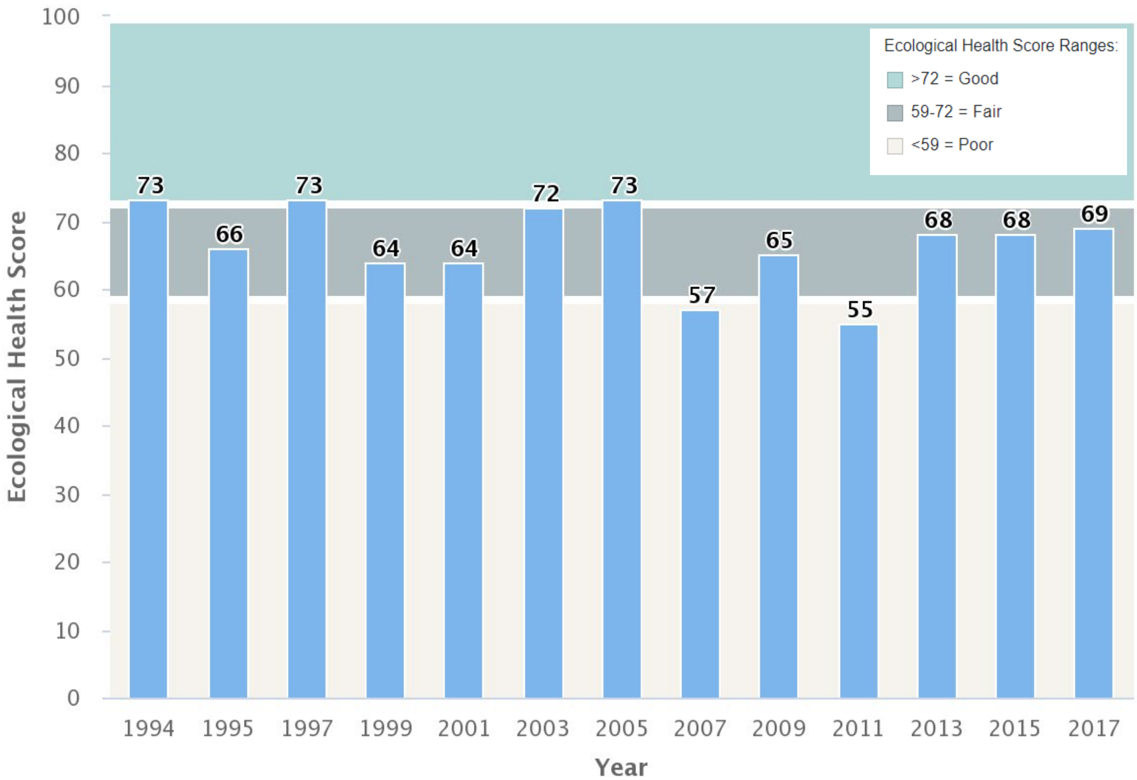
Table 3.3-2. 303(d) List of Impaired Waters and Tributaries to Wheeler Reservoir

Waterbody ID	Impaired Waterbody	County	Cause	Pollution Source
AL06030002-1205-100	Tennessee River (Wheeler Lake) from Wheeler Dam to five miles upstream of Elk River	Lawrence, Lauderdale	Nutrients	Agricultural
AL06030002-1101-101	Swan Creek from Wheeler Lake to Huntsville Browns Ferry Road	Limestone	Nutrients	Agriculture Municipal Urban runoff/storm sewers
AL06030002-1101-111	Swan Creek (Wheeler Lake)	Limestone	Nutrients	Agriculture
AL06030002-0906-600	Limestone Creek (Wheeler Lake) from Tennessee River to end of embayment	Limestone	Mercury	Atmospheric deposition
AL06030002-1014-101	Flint Creek (Wheeler Lake)	Morgan	Nutrients	Agriculture
AL06030002-1014-103	Flint Creek from L&N Railroad to Alabama Highway 36	Morgan	Mercury	Atmospheric deposition
AL06030002-1103-111	Round Island Creek (Wheeler Lake) from Tennessee River to end of embayment	Limestone	Mercury Nutrients	Atmospheric deposition Agriculture
AL06030002-0505-111	Indian Creek (Wheeler Lake) from Tennessee River to end of embayment	Madison	Nutrients	Agriculture
AL06030002-0606-111	Cotaco Creek (Wheeler Lake) from Tennessee River to end of embayment	Morgan	Nutrients	Agriculture
AL06030002-0902-100	Tennessee River (Wheeler Lake) from Flint River to Guntersville Dam	Madison, Marshal	Nutrients	Agriculture
AL06030002-0904-100	Tennessee River (Wheeler Lake) from Indian Creek to Flint River	Madison, Marshal	Nutrients	Agriculture
AL06030002-0906-102	Tennessee River (Wheeler Lake) from Cotaco Creek to Indian Creek	Madison, Marshal	Nutrients	Agriculture
AL06030002-1102-102	Tennessee River (Wheeler Lake) from US Highway 31 to Flint Creek	Limestone, Morgan	Nutrients	Agriculture
AL06030002-1102-103	Tennessee River (Wheeler Lake) Flint Creek to Cotaco Creek	Limestone, Madison, Morgan	Nutrients	Agriculture
AL06030002-1102-211	Bakers Creek (Wheeler Lake) from Tennessee River to end of embayment	Limestone	Nutrients perfluorooctane sulfonate (PFOS)	Agriculture Industrial
AL06030002-1102-311	Dry Branch (Wheeler Lake) from Tennessee River to end of embayment	Limestone	Nutrients	Agriculture
AL06030002-1107-102	Tennessee River (Wheeler Lake) from five miles upstream of Elk River to US Highway 31	Limestone, Lawrence	Nutrients PFOS	Agriculture Industrial

Waterbody ID	Impaired Waterbody	County	Cause	Pollution Source
AL06030002-1201-111	Spring Creek (Wheeler Lake) from Tennessee River to end of embayment	Lawrence	Nutrients	Agriculture
AL06030002-1202-200	Neeley Branch from Snake Road bridge to its source	Lauderdale	Pathogens (*E.coli*)	Pasture grazing
AL06030004-0405-101	Elk River (Wheeler Lake) from Tennessee River to Anderson Creek	Lauderdale and Limestone	pH and nutrients	Crop production (non-irrigated) and pasture grazing
AL06030002-1204-101	Second Creek (Wheeler Lake) from Tennessee River to first bridge upstream from US 72	Lauderdale	Nutrients	Agriculture

Source: (ADEM 2020)

Four locations are monitored: forebay (deep, still water near the dam) at TRM 277.0, middle reservoir at TRM 295.9, Elk River embayment (Elk River Mile 6.0), and the inflow (river-like area at the extreme upper end of reservoir) at TRM 348.0 (TVA 2018c). The data from these sites characterize the Wheeler Reservoir's biological conditions and water quality near the BFN site. General ecological health has been rated as "good" or "fair" for all monitoring years except for 2007 and 2011 when it was rated "poor" due in large part to the low flow (drought) conditions (Figure 3.3-3). Table 3.3-3 presents the 2017 ecological health ratings for Wheeler Reservoir at the four monitoring sites. These metrics are briefly explained in the following paragraphs (TVA 2018c).



Source: (TVA 2018c)

Figure 3.3-3. Wheeler Reservoir Ecological Health Ratings, 1994-2017

Table 3.3-3. Reservoir Ecological Health Indicators for Wheeler Reservoir, 2017

Monitor Location	Dissolved Oxygen	Chlorophyll	Bottom Life	Fish	Sediment
Forebay	Poor	Poor	Poor	Good	Good
Mid-reservoir	Good	Good	Good	Good	Fair
Elk River embayment	Poor	Poor	Poor	Good	Good
Inflow	-	-	Good	Good	-

Source: (TVA 2018c)
"-" indicates no data was available at this location for the health indicators tested.

Reservoir Ecological Health Indicators

Dissolved Oxygen

The reservoir has a notable gradient in dissolved oxygen concentrations, decreasing from the surface to the bottom. Low dissolved oxygen concentrations are particularly evident during summer and fall seasons. Dissolved oxygen data were not collected for the inflow location. Dissolved oxygen in 2017 was rated “good” at the mid-reservoir location and “poor” at the forebay and the Elk River embayment. The lower ratings were due to low dissolved oxygen concentrations (<2 milligram per liter) in the lower water column during the summer. Dissolved oxygen has rated “good” at the mid-reservoir location in all previous years, but ratings have varied between “good”, “fair”, and “poor” at the forebay and embayment locations, primarily in response to reservoir flows (TVA 2018c).

Chlorophyll

High chlorophyll levels in surface waters indicate the presence of algae in surface waters. Algae are typically an indicator of increased nutrient concentrations usually due to fertilizer runoff into surface waters. Chlorophyll concentrations can increase and decrease rapidly due to changing conditions which can affect other health indicators such as dissolved oxygen and fish life. In 2017, chlorophyll levels were rated as “good” in the mid-reservoir and “poor” in the forebay and Elk River Embayment. Chlorophyll data were not collected for the inflow location. Chlorophyll levels are typically highest in the summer when water temperatures are higher and there are increased concentrations of nutrients, particularly nitrogen and phosphorus.

Bottom Life

Bottom life, or benthic communities, are a measure of the water quality of incoming water and sediment. Decreased water quality and increased rates of sedimentation or sediment contamination can negatively impact bottom life. In 2017, the mid-reservoir and inflow were both considered “good”, while the forebay and Elk River Embayment were both considered “poor”. The “poor” ratings at the Elk River Embayment and forebay were due to low dissolved oxygen concentrations in the summer, which leads to low populations of benthic communities with only some tolerant benthic invertebrates surviving (TVA 2018c).

Fish Health

Fish health is a measure of the type and abundance of fish located in the reservoir as well as their overall health. Fish health is an important measure of water quality. For all four locations that were measured, fish health was rated as “good”, indicating that water quality was good for fish communities. A total of 51 species of fish were observed throughout the reservoir including largemouth bass, benthic invertivores and intolerant species (species that require good water quality conditions) were well represented at each location (TVA 2018c).

Sediment

Sediment quality is based on the detection and concentration of chemicals in the sediment including pesticides, polychlorinated biphenyls (PCBs), dichlorodiphenyltrichloroethane (DDT), chlordane, and heavy metals. Sediment was rated “good” at the forebay and Elk River embayment because low levels of PCBs were detected, and metals concentrations were within background limits. Low levels of PCB were detected in the mid-reservoir, so it was rated “fair”. Sediment quality is typically rated “good” at all three locations, excluding the inflow location. In previous years, PCBs have been detected at various locations throughout the reservoir. DDT and chlordane were detected at the mid-reservoir in 1994 and 2003 respectively (TVA 2018c).

Fish Consumption Advisories
Wheeler Reservoir is classified by the ADEM for use as public water supply, swimming and other whole-body water-contact sports, and fish and wildlife. Water quality is generally good in Wheeler Reservoir, but nutrient loads are a concern. The reservoir is on the 2020 Alabama 303(d) list as partially supporting its designated uses due to excess nutrients attributed to agricultural sources (ADEM 2020). In addition, the Alabama Department of Public Health (ADPH) issued fish consumption advisories for certain areas of the reservoir due to mercury and perfluorooctane sulfonate (PFOS) contamination (ADPH 2020). Mercury occurs naturally in rock and soils but can also originate from other sources, including atmospheric emissions from human activities (fossil fuel combustion, waste incinerations, steel mills) or from natural processes (forest fires, volcanoes). PFOS is a man-made compound used in a variety of industrial and commercial products. PFOS is no longer manufactured in the United States and its use is being phased out (USEPA 2021a).

Thermophilic Microorganisms
Some thermophilic (heat adapted) microorganisms are pathogens and have the potential to affect public health. Nuclear power plants typically discharge cooling water into a reservoir system, which heats water downstream of the plant. It is necessary to determine whether discharge characteristics promote survival and reproduction of pathogenic thermophilic microorganisms. Organisms of concern include enteric pathogens *Salmonella* and *Shigella*, *Pseudomonas aeruginosa* bacterium, *Actinomycetes* (thermophilic fungi), *Legionella* bacteria, and pathogenic strains of the free-living *Naegleria* and *Acanthamoeba* amoeba (NRC 2013).

Bacteria pathogenic to humans usually thrive at temperatures above 30 degrees Celsius (ºC; 86 degrees Fahrenheit [ºF]) and are ubiquitous in the environment. During the summer months temperatures in Wheeler Reservoir are at their highest, which is when there is the most concern for human pathogens. In terms of hydrothermal impacts on Wheeler Reservoir, operation of the circulating water system is regulated by the State of Alabama under the NPDES permit number AL0022080 (ADEM 2018). The permit specifies that the river ambient temperature is measured by an upstream monitor located at about TRM 297.8, and that impacts relative to the ambient are measured by three downstream monitors located at about TRM 293.5. The upstream monitor is about 3.8 miles upstream of the diffusers, whereas the downstream monitors are located near the end of a mixing zone, which extends 2,400 feet (0.45 miles) below the diffusers (ADEM 2018). The current NPDES permit specifies that at the downstream end of the mixing zone, the operation of the plant may not cause:

- The measured 1-hour average temperature to exceed 93 °F,
- The measured daily average temperature to exceed 90°F, and
- The measured daily average temperature rise (relative to ambient) to exceed 10°F.

3.3.1.2. Environmental Consequences – Surface Water Hydrology and Water Quality

Alternative A – No Action Alternative
Under the No Action Alternative, BFN would continue to operate until all three current plant operating licenses expire by 2036. Following plant shutdown, heated water from the condenser circulating water (CCW) system would cease to be discharged to Wheeler Reservoir and water quality impacts would be limited to those associated with plant closure and decommissioning. The rate of consumptive water use would decrease by 6.73 million gallons per day (MGD). Stormwater discharges would continue to be controlled under an NPDES permit associated with discharges for these activities. The method of decommissioning has not been determined, but may include use of surface water for dust control. If so, the amount of water to be used would likely be minimal, and the duration would be temporary. Overall, impacts to surface water quality

in association with the shutdown and decommissioning of BFN under the No Action Alternative would be small, and potentially beneficial.

Additionally, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. For a replacement SMR plant(s) at an alternate site, new intake and discharge structures would need to be constructed to provide water needs for the facility. The impact would depend on the volume of water withdrawn for makeup, relative to the amount available from the intake source. The characteristics of the surface water impacts would be expected to be small because they would be controlled under an NPDES permit that would be regulated by the state in which the plant(s) is located. There is a potential that some erosion and sedimentation may occur during construction; however, construction would be temporary, and the implementation of best management practices (BMP) should limit any potential impacts to surface water quality.

Water quality impacts for a new SMR plant(s), depending on the technology chosen and the location, would be bounded by the current discharge at BFN. If the source of water for the new nuclear power plant were different than the source for BFN, the impact of shutting down BFN might reduce the effects on the Wheeler Reservoir, but would transfer impacts to the other waterbody. In addition, maintaining compliance with the plants NPDES permit would limit potential impacts.

Cooling water at any other alternate generation site would likely be withdrawn from a surface waterbody, if needed, and its discharge would be regulated by permit as appropriate. Depending on the water source, the impacts on water quality caused by plant discharge could have noticeable impacts. The impacts of a new gas-fired plant utilizing a closed-cycle cooling system at an alternate site are considered small, because the plant would have to maintain compliance with the plant’s NPDES permit. Water quality impact from sedimentation during construction is categorized as small. Operation water quality impacts would be similar to, or less than, those from other centralized generating technologies. Surface water impacts would remain small.

Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. The type and level of impact would vary depending upon proximity, mitigation measures, and general construction and operation practices. Impacts, including cumulative impacts, could range from small to moderate.

Alternative B – Proposed Action

Under Alternative B, there would be no major construction activity. Current plant water withdrawal and discharge water quality would remain the same during the proposed subsequent period of extended operation. As presented in Section 3.3.4.2, treatment chemicals are largely consumed or diluted, leaving very small concentrations by the time they are discharged. The BFN NPDES permit would assure continued compliance with applicable water quality standards and criteria. Therefore, there would be no change in impact from the current level of small impact. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation.

Spill prevention, containment, and countermeasure (SPCC) plan, and other permit conditions would avoid or minimize any impact on surface water resources from BFN operational and maintenance activities during the proposed subsequent period of extended operation. For these reasons, TVA concludes that impact on surface water, including cumulative impacts, would be small and no mitigation measures are required other than those already in place.

3.3.2. Surface Water Use and Trends

3.3.2.1. Affected Environment – Surface Water Use and Trends

The major public uses of the reservoir are for water supply, recreation, and waste disposal. There are six public water intakes on Wheeler Reservoir withdrawing a total of approximately 56 MGD for municipal use. There are 11 industrial plants within the same reach withdrawing approximately 1,458 MGD for primarily industrial and limited potable water use. The nearest upstream community surface water supply intake is at Decatur, Alabama, on Wheeler Reservoir 12 miles upstream from BFN which withdraws an average of 26.02 MGD. The first downstream water intake is the West Morgan-East Lawrence Water Authority 7.5 miles downstream from BFN which withdraws an average of 6.89 MGD.

There are also major industrial water users located both upstream and downstream within 15 miles of BFN. Upstream from BFN, Indorama Ventures Xylenes & PTA (5.5 miles upstream) withdraws an average of 9.76 MGD, 3M Company Decatur Facility (5.7 miles upstream) withdraws an average of 11.77 MGD, and Ascend Performance Materials (8 miles upstream) withdraws an average of 72.50 MGD. Downstream from BFN, International Paper Company (11.4 miles downstream) withdraws 0.01 MGD. These users withdraw water from Wheeler Reservoir each day for process and cooling needs. The majority of this water is subsequently returned to the reservoir.

In 2020, an average of 8,368 MGD (surface water and groundwater) were used for public supply, industrial water supply, irrigation, and thermoelectric power generation in the Tennessee River watershed. Only 4.8 percent of the total water withdrawn, or about 403 MGD, was used consumptively. By the year 2045, even though water demands from public water supply and irrigation are expected to increase, water withdrawals are projected to decline by 11 percent from 2020 levels, primarily due to the retirement of old power plants (Sharkey and Springston 2022).

3.3.2.2. Environmental Consequences – Surface Water Use and Trends

<u>Alternative A – No Action Alternative</u>

Under the No Action Alternative, the decision not to extend operation of the BFN units past the current expiration dates of the operating licenses would result in shutdown of the reactors and decommissioning of the BFN site. Once the plant shuts down, BFN would cease to draw cooling water from Wheeler Reservoir. The method of decommissioning has not been determined, but may include use of surface water for dust control. If so, the amount of water to be used would likely be minimal, and the duration would be temporary. Overall, impacts to surface water use in association with the shutdown of BFN under the No Action Alternative would be small, and potentially beneficial as overall consumption rates for Wheeler Reservoir would become a fraction of the rate of withdrawal of the operating plant.

Under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system.

Surface water use impacts would depend on the volume of water withdrawn for makeup water relative to the amount available from the intake source and the characteristics of the surface water. A SMR or natural gas-fired plant(s) would be built with a closed-cycle cooling system which would increase surface water consumption from operation of the cooling towers; however, the beneficial impact would be a reduction in the number of fish and shellfish entrained or impinged. The overall impacts could be small for water use impacts during normal flows and possibly large impacts during extreme low-flow conditions. Potential impacts can be mitigated by derating (reducing the thermal output of the plant by reducing its electrical power rating) during periods of thermal sensitivity. For other generation options, surface water use impacts would be expected to be similar but on a smaller scale than those described for new nuclear generation. The volume of water used would be expected to be smaller for a natural gas-fired plant if the waterbodies were of the same size and quality as for the SMR plant site, and the impact would be expected to be small. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

The largest withdrawal/discharge from Wheeler Reservoir is cooling water from BFN. Between 2016 and 2022, consumptive and offstream water use in Wheeler Reservoir has not resulted in significant use conflicts due to the large volume of reservoir water available, the high river flow rate, and the return of most of the water withdrawn. BFN withdraws 3,160 MGD on average, while consuming 6.73 MGD, or 0.21 percent of water withdrawn. Almost all of the water withdrawn is used for once-through cooling (open cycle or open mode).

Regulatory control of withdrawal rates and NPDES permit limits for return water quality also mitigate potential conflicts. Potential trade-offs can occur with instream water uses (e.g., instream use conflicts affect aquatic life, waste assimilation, navigation, power generation, flood control, and lake levels). These potential conflicts are addressed by operating procedures, legal requirements, and regulatory procedures. Impacts on the Tennessee River from operation of the circulating water system, are regulated by the State of Alabama under NPDES permit number AL0022080 (ADEM 2018). The permit (Outfalls DSN001, DSN0011 and DSN0012) requires that BFN report discharge water temperature, pH, chlorine, temperature differentials between upstream and downstream monitoring points, and flow (ADEM 2018).

Under Alternative B, BFN’s surface water withdrawal and discharge volumes during the proposed subsequent period of extended operation are expected to be consistent with the plant’s current water withdrawals and discharge volumes. Therefore, impacts to surface water use, including cumulative impacts, would remain unchanged and small.

3.3.3. Hydrothermal Effects of Plant Operation

A summary of the surface water hydrothermal effects of BFN operation including a discussion of alternatives and their impacts is presented in this subsection.

3.3.3.1. Affected Environment – Hydrothermal Effects of Plant Operation

Surface water runoff at BFN is derived from precipitation remaining after losses due to infiltration and evapotranspiration. It can generally be classified as local surface runoff or streamflow. Surface water runoff from the plant site is to Wheeler Reservoir. The Tennessee River drainage area at Wheeler Dam is approximately 29,590 square miles (TVA 2017).

Plant Surface Water Use

Wheeler Reservoir is the source for cooling water systems for BFN. BFN uses a once-through or open mode condenser circulating water (CCW) system to dissipate waste heat from the plant steam turbines. The water is withdrawn from Wheeler Reservoir by an intake structure located at about TRM 294.3. The CCW system is designed to provide a flow of approximately 675,000 gallons per minute (gpm) to the condensers, with a flow of approximately 25,000 gpm to each unit. When all three units are in operation, this water is pumped through the plant at the rate of about 4,400 cfs. Between 2016 and 2022, BFN withdrew approximately 3,160 million gallons per day (MGD). Most of the water withdrawn at the plant intake is returned to Wheeler Reservoir. Water losses by evaporation and drift occur for the CCW system when the helper cooling towers are in service. Between 2016 and 2022, losses were approximately 6.7 MGD, or0.21 percent of the total withdrawal.

Wheeler Reservoir water use by BFN is managed per the TVA Reservoir Operations Study published in 2004 (TVA 2004). Eleven major issues were evaluated, including reservoir and downstream water quality, environmental resources, reservoir pool levels, recreation flows, economic development, water supply, navigation, flood risk, power reliability, power costs, and capital costs. Discharges from the BFN are regulated by the ADEM NPDES Permit No. AL0022080. The permit (Outfalls DSN001, DSN0011 and DSN0012) requires that BFN report discharge water temperature, pH, chlorine, temperature differentials between upstream and downstream monitoring points, and flow (ADEM 2018).

Water withdrawals from the Wheeler Reservoir in 2022 by BFN for cooling water purposes averaged 105,686 million gallons per month with the highest withdrawal rates in August, and lowest in March. Return discharges in 2022 averaged 105,582 million gallons per month with May, July, and August having the highest discharge volume and with March having the lowest volume. In 2022, a total of 1,239 million gallons of water were consumed from Wheeler Reservoir, with the highest consumption in January (305 million gallons), and the lowest consumption occurred in July (16 million gallons). The average monthly consumption for 2022 was 103 million gallons per month.

Current NPDES Permit

In terms of hydrothermal impacts on Wheeler Reservoir, operation of the circulating water system is regulated by the State of Alabama under the National Pollutant Discharge Elimination System (NPDES) permit number AL0022080 (ADEM 2018). As described previously, the permit specifies that the river ambient temperature is measured by an upstream monitor located at about TRM 297.8, and that impacts relative to the ambient is measured by three downstream monitors located at about TRM 293.5. The upstream monitor is about 3.8 miles upstream of the diffusers, whereas the downstream monitors are located near the end of a mixing zone, which extends 2,400 feet (0.45 miles) below the diffusers (ADEM 2018). The current NPDES permit specifies that at the downstream end of the mixing zone, the operation of the plant may not cause:

- The measured 1-hour average temperature to exceed 93°F,
- The measured daily average temperature to exceed 90°F, and
- The measured daily average temperature rise (relative to ambient) to exceed 10°F.

Regulatory control of withdrawal rates and NPDES permit limits for return water quality also mitigate potential conflicts. Potential trade-offs can occur with instream water uses (e.g., instream use conflicts affect aquatic life, waste assimilation, navigation, power generation, flood control, and lake levels). These potential conflicts are addressed by operating procedures, legal requirements, and regulatory procedures. Impacts on the Tennessee River from operation of the circulating water system, are regulated by the State of Alabama under NPDES permit number AL0022080 (ADEM 2018). The permit (Outfalls DSN001, DSN0011 and DSN0012) requires that BFN report discharge water temperature, pH, chlorine, temperature differentials between upstream and downstream monitoring points, and flow (ADEM 2018)

3.3.3.2. Environmental Consequences – Hydrothermal Effects of Plant Operation

Alternative A – No Action Alternative

Under the No Action Alternative, the plant would continue to operate until all three current plant operating licenses expire by 2036. Following plant shutdown, the amount of water used and the release temperature of water returned to the reservoir would be reduced as the reactors shut down and less water is needed for cooling. The rate of consumptive water use would decrease by 6.73 million gallons per day (MGD)[1] which equates to approximately 0.21 percent consumption of the total water withdrawn. Any additional potential water quality impacts would be limited to those associated with plant closure and decommissioning. Overall, impacts to surface water temperatures, in association with the shutdown and decommissioning of BFN under the No Action Alternative would be small, and potentially beneficial.

Under the No Action Alternative however, the shutdown of BFN would also require construction of replacement power either at BFN or elsewhere within the TVA system.

Hydrothermal impacts on surface water from an SMR or gas-fired plant would be site specific, and dependent on the volume and temperature of water discharged. Either type of plant would be required to obtain and maintain an NDPES permit. Discharge would contain dissolved solids and be regulated by the state issuing the NDPES permit. There could be large impacts during low river flow conditions; however, the use of cooling towers and plant derate (reduced power) should mitigate this impact. Because the location of the plant has not been determined, any cumulative impacts would have to be evaluated during the plant licensing or permitting process. Overall, potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. Impacts could range from small to large.

Alternative B – Proposed Action

Under Alternative B, no refurbishment or plant modifications that would have effects on water resources are planned during the proposed subsequent period of extended operation. BFN would continue to operate within the thermal limits set by BFN's NPDES permit and without measurable adverse impact to the balanced indigenous population during the proposed subsequent period of extended operation. The effect on currents near the intake and discharge locations for BFN during the proposed subsequent period of extended operation is expected to be localized, as any previous problems would have been mitigated during the early operational period of the plant. The size of Wheeler Reservoir precludes significant current alterations except in a limited area in the vicinity of the intake and discharge structures. BFN is in compliance with current NRC and ADEM regulations related to thermal discharge evaluation requirements; therefore, no change regarding any potential impact from the current level of small impact would be anticipated, including to cumulative impacts.

3.3.4. Chemical Additives for Plant Operation

A summary of the chemical additives during BFN operation, including a discussion about alternatives and their impacts, is presented in this section.

3.3.4.1. Affected Environment – Chemical Additives for Plant Operation

Types of chemicals currently used in operating plant cooling water systems are described as follows:

[1] Consumptive water use average includes data from 2016-2022.

- Scale Inhibitors. Also called anti-scalants, these chemicals inhibit the formation of lime (calcium oxide) deposits that would otherwise tend to form on the high temperature surfaces of the heat exchanger tubes and limit the deposition of other chemical forms of oxide scale upon the heat exchanger tubes. Anti-scalants are organic (carbon-based) polymers containing phosphate attachments on the molecule.
- Corrosion Inhibitors. Corrosion inhibitors behave as “oxygen scavengers” and tend to draw up and chemically bind available oxygen, which makes less oxygen locally available to form rust compounds, which are metal oxides.
- Molluscicide. Ammonium chloride or a quaternary amine can be used for zebra mussel and Asiatic clam control.
- Dehalogenation Agent. Sodium bisulfite may be utilized to ensure that the oxidizing biocide (total residual oxidant) discharge limit as it pertains to the total residual halogen, usually chloride, is not exceeded.
- Detoxification Agent. Bentonite clay may be required to detoxify the molluscicide chemical from the water through absorption at a ratio of 5:1 to the quaternary amine.
- Biopenetrant. Non-ionic surfactant (a simple soap) may be applied to increase the efficacy of the oxidizing biocide by cleaning off the surfaces of the biota to make the chlorine-based (or other halogen such as bromine-based) biocide or molluscicide chemical penetrate more effectively into the biological material, or biota.

All chemicals are approved prior to use by the appropriate state regulatory agencies, and qualified TVA personnel who determine the best possible chemicals to use based on site-specific needs. TVA’s operational philosophy regarding chemical additives for plant operation reflects minimization of chemical use through an optimization program. The optimization program includes (1) monitoring operating plant parameters, (2) continually evaluating water chemistry, and (3) inspecting equipment to minimize the total amount of chemicals added. Prior to use in TVA plants, chemicals undergo an extensive toxicological review and comparison with maximum instream wastewater concentrations to ensure water quality standards are met.

BFN water treatment processes are controlled to comply with state water quality criteria and applicable NPDES permit conditions to ensure protection of the receiving waterbody. The standards and criteria applied by the state in establishing NPDES permit limits and requirements are to protect public health and water resources, as well as to maintain the designated uses for the receiving waterbody. BFN continues to operate in compliance with the NPDES permit requirements.

3.3.4.2. Environmental Consequences – Chemical Additives for Plant Operation

Alternative A – No Action Alternative

As a consequence of shutdown and decommissioning of BFN, impacts to surface water quality from chemical additives would decrease and eventually end. Therefore, under the No Action Alternative impacts would be small, and potentially beneficial.

However, additionally under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system.

The impacts of new SMR or new natural gas-fired generation generally are similar in that they depend largely upon the sites that would be chosen and the measures taken to reduce or avoid potential impacts. For a new SMR plant or gas turbine, the treatment chemicals added would be expected to be largely consumed, leaving very small concentrations by the time they are discharged. The amount of chemicals used for a gas turbine cooling operation would be less than for an SMR plant(s) based on the smaller scale of the individual units and components and less restrictive requirements on plant components. Plant discharges would be regulated by the state in which the plant is located. An NPDES permit would be required, and the plant would comply with applicable water quality standards and criteria. Therefore, when the new generation source commences operation, the direct, indirect, and cumulative effects of chemical discharges would be expected to be small.

Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. These separate analyses would investigate potential impacts to surface water quality. The type and level of impact would vary depending upon proximity, mitigation measures, and general construction and operation practices. Impacts could range from small to moderate.

Alternative B – Proposed Action

Under Alternative B, the volume of the cooling water discharge would continue to be small when compared to flow in Wheeler Reservoir, and the treatment chemicals added are largely consumed, leaving very small or non-detectable concentrations by the time they are discharged. The BFN NPDES permit would assure continued compliance with applicable water quality standards and criteria. Therefore, there would be no change in impact from the current level of small impact during the proposed subsequent period of extended operation.

3.3.5. Surface Water Resources Conclusion

Impacts from plant water discharges would be expected to be small for operating BFN during the proposed subsequent period of extended operation. Because water temperatures in Wheeler Reservoir are critical to both BFN operation and to resources within the reservoir, long-term increases in reservoir temperatures due to global warming may affect the ability to operate the plant in the future in the same way as it is currently operated. For operational purposes, TVA may be required to extend the duration of operation of the helper cooling towers, or modify their flow rates. The increases in ambient water temperature, and its effect on operations, would be considered by ADEM in establishing temperature limits in discharges during periodic renewals of the NPDES permit.

Surface water impacts would be small to moderate during construction of alternative new generation units under the No Action Alternative. Cumulative effects would also be expected to be small and would not warrant mitigation. This determination was arrived at by considering effects from existing water users with intakes on Wheeler Reservoir. The major public uses of the reservoir are for water supplies, recreation, and waste disposal. None of the proposed or in-progress projects in the vicinity discussed in Section 1.5.1.3 would impact water use beyond the TVA’s capacity to regulate it.

3.4. Groundwater Resources

A discussion of groundwater hydrology, groundwater use and trends, and groundwater quality for BFN is provided in this section.

3.4.1. Affected Environment – Groundwater

3.4.1.1. Groundwater Hydrology

Regional shallow groundwater flow is generally to the southwest towards the Tennessee River's Wheeler Reservoir (Arcadis 2021). Water level measurements collected at wells installed from 2014 through 2016 suggest that local groundwater flow is also generally to the southwest. However, groundwater flow is complicated due to the presence of building foundations set into bedrock and underground utility corridors located beneath the water table. There are three principal hydrogeologic units onsite: unconsolidated sediments (silty/sandy clays and coarse-grained backfill), the underlying Tuscumbia Limestone, and the Fort Payne Chert. The Tuscumbia Limestone weathers readily and can form solution features along some bedding planes or fractures (Arcadis 2021). Groundwater flow in the Fort Payne Chert is likely inhibited by the formation's resistance to chemical weathering and limited to fractures and partings. It should be noted that limited data exist relative to the Fort Payne Chert, but borings in the vicinity of the site indicate the area is less prone to weathering (Arcadis 2021). It is reasonable to assume that hydraulic connection exists between the bedrock formations and the overlying sediments.

Wheeler Reservoir is the primary discharge location for groundwater at BFN. There are also a number of artificial secondary surface water bodies associated with operations that could potentially influence groundwater flow on the site because they are unlined, including the hot water channel, cold water channel, intake channel, wastewater lagoons, and sediment ponds. However, the degree to which these artificially controlled water bodies affect groundwater flow has not been determined. Water level elevations of these secondary surface water features, particularly the hot water channel and cold water channel, are artificially controlled by site operations, depending on various plant operations and reservoir height. While the elevation of the intake channel is generally maintained at an elevation equivalent to Wheeler Reservoir, the elevations of the hot water and cold water channels are not known. Natural and artificial fluctuations in surface water elevations can vary greatly and impact groundwater flow at the site, although these rates are not well quantified. Seasonal groundwater fluctuation strongly correlates with the Wheeler Reservoir elevation, which suggests a high degree of surface water-groundwater communication in both hydrogeologic units (Arcadis 2021).

Shallow groundwater at BFN occurs within unconsolidated terrace deposits and residual soils, and along the epikarst, a relatively thin weathered horizon at the top of bedrock. Below the epikarst, groundwater occurs exclusively in fractures and solution features of the Tuscumbia limestone and Fort Payne chert. The Tuscumbia limestone and Fort Payne chert are collectively described as the Tuscumbia-Fort Payne aquifer system. This aquifer system is the primary water-bearing unit in the site vicinity from a regional perspective since it is a source of water for both wells and springs in the area (Arcadis 2021).

Recharge to the shallow groundwater system at the plant site is derived primarily from precipitation. As stated in the 2021 Site Conceptual Model, annual precipitation ranged from 39.48 inches in 2016 to 57.32 inches in 2020 (Arcadis 2021). Regional water balance studies show that approximately 10 to 13 inches of precipitation per year enters groundwater storage (USGS 1978).

Groundwater levels at the site are generally highest during the months of January through March. During September and October, water levels are usually at a minimum. Correlation between water levels in site wells and neighboring surface waters indicates that the Wheeler Reservoir and plant water channels exert some control on local groundwater elevations and hydraulic gradients through hydrostatic pressure in the subsurface. The direction of groundwater movement is generally west-southwest toward the Wheeler Reservoir. Exceptions to this directional flux occur at the plant site during dewatering operations (which can reverse gradient conditions), in the vicinity of leaking water lines serving the site, in areas of topographic highs/lows, and in the vicinity of the LLRW storage facility where more complex movement exists.

Within overburden soils at the site, groundwater movement is predominantly downward. Local areas of lateral flow likely occur near some streams, topographic lows, and where extensive root systems exist. The saturated hydraulic conductivity of site soils in the vicinity of the LLRW storage facility averages 3.7E-08 feet per second, which is typical of clay soil (Boggs 1982). Water supply wells developed within such low permeability soils are primarily of limited capacity. Based on aquifer testing in a similar setting, the cherty gravel horizon near bedrock (epikarst) can be significantly transmissive (TVA 1993). Measured transmissivity values suggest horizontal hydraulic conductivity values that are from one to two orders of magnitude greater than those measured in the shallow Tuscumbia limestone (TVA 1993). Observations of groundwater levels during early site borings also suggest that groundwater within the epikarst zone and Tuscumbia-Fort Payne aquifer might be confined (Arcadis 2021).

Groundwater flow in the Tuscumbia limestone occurs solely in fractured and weathered zones. The orientation of fractures and solution features within the Tuscumbia is coincident with a structurally controlled joint system (i.e., along strike and dip). Studies by TVA indicate that the transmissivities of bedrock fractures and solution features in the Tuscumbia may decrease with depth (TVA 1993). However, the interconnectivity of these features is equally important. Although fractured, the silty, siliceous nature of the Fort Payne chert inhibits the development of solution features. Therefore, the average permeability of the Fort Payne chert at the site is expected to be less than that of the Tuscumbia limestone (Arcadis 2021).

3.4.1.2. Groundwater Use and Trends

The Tuscumbia-Fort Payne aquifer system provides volumes of water sufficient for domestic supplies and some limited municipal and industrial supplies in the region. Groundwater in this carbonate aquifer system can generally be used without extensive treatment (DOI 1987). Groundwater supply wells within a 20-mile radius of BFN and privately owned groundwater wells within a 2-mile radius of the BFN site have been identified by TVA. The closest known public groundwater supply well (Limestone County Water System) is located approximately 2 miles north of BFN (Geosyntec 2013).

BFN does not use groundwater for plant operation, and site dewatering wells have been inactive since the 1980s. However, there are 33 existing groundwater monitoring wells and one dewatering well included in the well sampling program established in the 2021 Site Conceptual Model. These wells are used to delineate possible radiological discharges to the groundwater (Arcadis 2021).

A reservoir catchment area is a natural drainage area truncated by a dam. Because recharge to the shallow groundwater system at the plant site is derived primarily from precipitation, knowledge of the Wheeler Reservoir Catchment Area is pertinent. In 2020, groundwater withdrawal from Wheeler Reservoir Catchment Area (Figure 3.4-1) was 41.30 MGD. The majority of groundwater use was from public supply (30.88 MGD), followed by irrigation (10.41 MGD) and industries (0.01 MGD) (Bowen and Springston 2018). For the majority of years from 1995 to 2015, there was an overall decreasing trend in groundwater withdrawal, but groundwater only supplied 1.9 percent of the total water withdrawals. In 2020, groundwater supplied 2.2 percent of the total water withdrawals, and 97.8 percent came from surface water (Sharkey and Springston 2022). Based on current usage, it could be assumed that overall groundwater demand would remain fairly constant in the future.

3.4.1.3. Groundwater Quality

Tritium

In the early 2000s, BFN initiated the Tritium Releases to Groundwater study to identify the source of low-level tritium detected onsite (TVA 2020b). Results from a groundwater study conducted in 2006 suggested the source of tritiated groundwater was from historical leaks and spills associated with the Radwaste/Condensate Transfer Tunnel. Groundwater and surface water level measurements during that study indicated tritiated groundwater from the site would discharge to the return channel and subsequently Wheeler Reservoir. It was determined at the time that there were no groundwater wells onsite or within 2 miles of the site used as a source of drinking water. Groundwater movement in the area has been determined to be from the plant site toward the Reservoir (TVA 2020b).

As required by 10 Code of Federal Regulations (CFR) 50.75(g), BFN maintains records of spills involving radioactive contamination in and around the facility, equipment, and site. Between April 2000 and April 2016, there were 15 known historical releases of tritiated water. Most of these releases were associated with systems, structures, and components such as the Cable Tunnel, Condensate Transfer Tunnel, Auxiliary Decay Heat Removal System, Condensate Storage Tanks, and Condensate Head Tank. Other tritiated water releases resulted from spills or leaks from temporary storage containers and frac tanks (Arcadis 2016).

From 2016 to 2020, six additional accidental tritiated water releases occurred at BFN. Each of these leaks was estimated to be less than 100 gallons, and therefore were not subject to the voluntary reporting requirements outlined in NEI-07-07. Tritium activity for these spills ranged from trace amounts to 9,230,000 picocurie per liter (pCi/L) (Arcadis 2021). Figure 3.4-2 shows the locations of the historical releases of tritiated water from April 2000 through July 2020, and descriptions of the releases are provided in Table 3.4-1.

Onsite groundwater monitoring was performed as part of the Groundwater Protection Initiative in 2020. BFN monitored a total of 30 groundwater wells located in the protected area and the within TVA controlled areas during 2020. Normal sampling frequencies are quarterly and semiannually, and some wells were sampled monthly if certain criteria are met or for investigation purposes. Samples are routinely analyzed for environmental level tritium and principal gamma emitters with selected wells analyzed for Hard-to-Detect radionuclides (Gross Alpha, Iron-55, Nickel-63, Strontium-89, and Strontium-90). In support of the groundwater program, the site also monitors recapture and onsite storm drains, catch basins and surface water (TVA 2020b).

In 2020, low levels of tritium were detected in 13 onsite groundwater wells; no other plant-related radionuclides were detected in any groundwater well. Tritium concentrations in 2020 groundwater samples ranged from non-detect (less than 163 pCi/L) to 35,400 pCi/L (Dewat-A). BFN has been monitoring a legacy tritium plume in the vicinity of groundwater well Dewat-A located adjacent to the reactor building. This plume is the result of previous leaks in 2015 and 2016 (TVA 2020b).

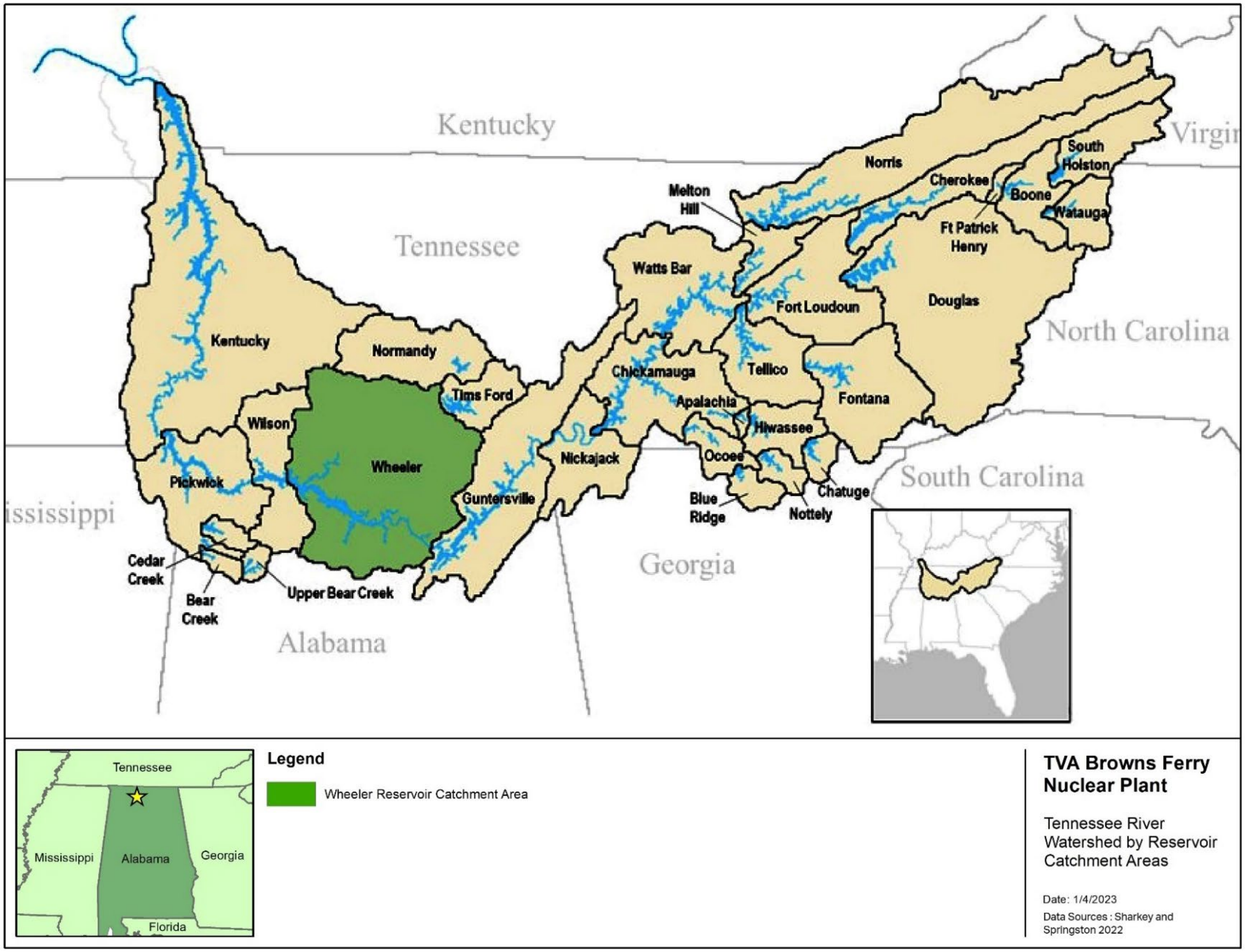
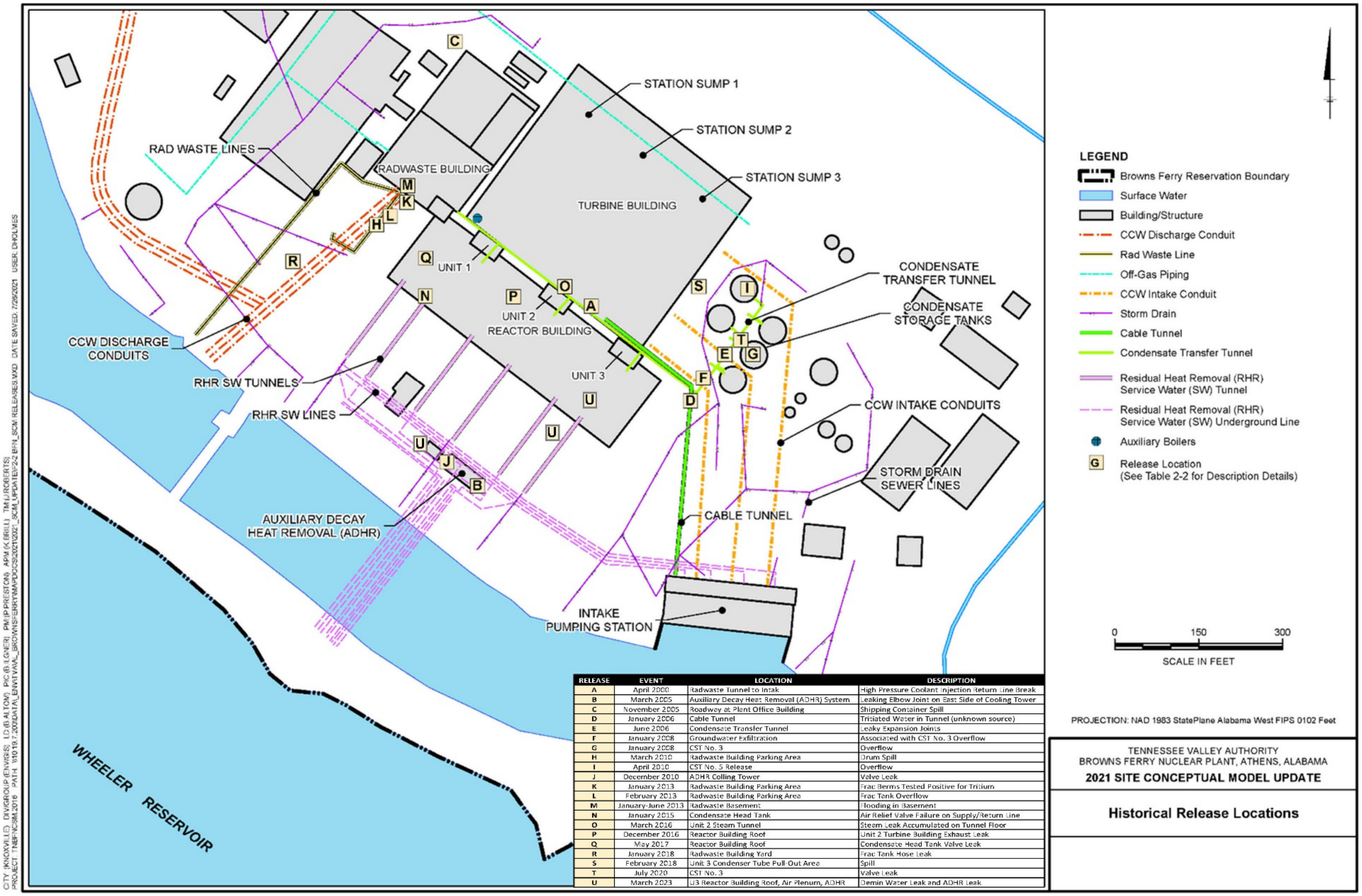


Figure 3.4-1. Wheeler Reserve Catchment Area



RELEASE	EVENT	LOCATION	DESCRIPTION
A	April 2000	Radwaste Tunnel to Intak	High Pressure Coolant Injection Return Line Break
B	March 2005	Auxiliary Decay Heat Removal (ADHR) System	Leaking Elbow Joint on East Side of Cooling Tower
C	November 2005	Roadway at Plant Office Building	Shipping Container Spill
D	January 2006	Cable Tunnel	Tritiated Water in Tunnel (unknown source)
E	June 2006	Condensate Transfer Tunnel	Leaky Expansion Joints
F	January 2008	Groundwater Exfiltration	Associated with CST No. 3 Overflow
G	January 2008	CST No. 3	Overflow
H	March 2010	Radwaste Building Parking Area	Drum Spill
I	April 2010	CST No. 5 Release	Overflow
J	December 2010	ADHR Colling Tower	Valve Leak
K	January 2013	Radwaste Building Parking Area	Frac Berms Tested Positive for Tritium
L	February 2013	Radwaste Building Parking Area	Frac Tank Overflow
M	January-June 2013	Radwaste Basement	Flooding in Basement
N	January 2015	Condensate Head Tank	Air Relief Valve Failure on Supply/Return Line
O	March 2016	Unit 2 Steam Tunnel	Steam Leak Accumulated on Tunnel Floor
P	December 2016	Reactor Building Roof	Unit 2 Turbine Building Exhaust Leak
Q	May 2017	Reactor Building Roof	Condensate Head Tank Valve Leak
R	January 2018	Radwaste Building Yard	Frac Tank Hose Leak
S	February 2018	Unit 3 Condenser Tube Pull-Out Area	Spill
T	July 2020	CST No. 3	Valve Leak
U	March 2023	U3 Reactor Building Roof, Air Plenum, ADHR	Demin Water Leak and ADHR Leak

Source: (Arcadis 2021)

Figure 3.4-2. Historical Release Locations at BFN

Table 3.4-1. Summary of Historical Releases at BFN from April 2000 through July 2020

Location	Release Date	Location	Description
A	April 2000 (Discovered October 2000)	Radwaste Tunnel to Intake	A break in the high-pressure core injection return line resulted in impacted water entering the Intake Pumping Station at the entrance to the Cable Tunnel. Radioactive contamination with trace amounts of Mn-54, Co-60, and Cs-137 were found in numerous locations such as the Pumping Station and Cable Tunnel, Waste Sump, CCW. The tunnel was decontaminated.
B	March 2005	Auxiliary Decay Heat Removal System	A leak occurred in an elbow on the east side of the Cooling Tower and at the overflow of the Cooling Tower Basin due to a malfunction of the system level indicators. Low-level radioactive water was released to the concrete pad and ground. Trace amounts of Co-60, Zn-65, Mn-54, Cs-134, Cs-137, Ag-110, and tritium were measured. Soil was excavated.
C	November 2005	Roadway at Plant Office Building	A shipping container carrying used Control Rod Drives leaked contaminated water onto the shipping trailer and the roadway, affecting a small (3-foot square) area. Based on hydrostatic testing of the container, the leak was apparently caused by handling activities.
D	January 2006	Cable Tunnel (between the Turbine Building and the Intake Pumping Station)	Water from an unknown source was discovered (containing tritium, Cs-137, Cs-134, and Co-60).
E	June 2006	Condensate Transfer Tunnel	Degraded expansion joints in the Condensate Transfer Tunnel may have allowed releases to groundwater. An evaluation of the tunnel noted that there was no liner, some joints were in poor shape, several inches of water are often present, and there was a floor drain and sump.
F	January 2008	Water Exfiltration	A leak from an unknown source, along with groundwater, was discovered bubbling out of the ground near the nitrogen tank. Samples were determined to contain low levels of tritium.
G	January 2008	CST No. 3 Overflow	Approximately 11,000 gallons of impacted water overflowed into the Condensate Transfer Tunnel, with the following constituents: tritium, Mn-54, Co-60, I-131, Cs-134, and Cs-137. The majority of the water was collected in sumps.
H	March 2010	Radwaste Building Parking Area	A drum was dropped while in transport via forklift, and the contents (containing tritium, Mn-54, Co-60, Co-58, and Cs-137) were spilled outside of the Radiologically Controlled Area but inside the Protected Area. The water was collected with absorbent media.
I	April 2010	CST No. 5 Release	Water was discovered to be flowing from an open test valve near the top of Condensate Storage Tank No. 3. Approximately 330 gallons were released (containing tritium, Mn-54, Co-60, Co-58, and Cs-137). Soil was excavated.
J	December 2010	Auxiliary Decay Heat Removal System Cooling Tower	A leak from a valve was identified and was believed to be due to system freezing. The leak rate was estimated at 0.5 gpm, with an affected are of approximately 100 square feet. The valve was replaced, and dirt from the area was excavated.
K	January 2013	Radwaste Building Parking Area	Frac berms tested positive for tritium. Water from berms was pumped back to Frac 1 and tested when dry. Smears taken once dry showed no contamination.

Location	Release Date	Location	Description
L	February 2013	Radwaste Building Parking Area	Frac #1 tank overflow due to heavy rain. The puddle outside the berm was pumped back into Frac #1 and ponded water on asphalt was absorbed.
M	January-June 2013	Radwaste Basement	CST-grade, tritiated water flooded the basement floor of Radwaste Building for a 6-month period. It is not known whether tritium was released to the environment during this period.
N	January 2015	Condensate Head Tank	A 0.5-gpm leak from an air release valve was identified, with water (containing tritium) accumulating on the concrete-lined reactor/refuel air zone intake and on the ground.
O	March 2016	Unit 2 Steam Tunnel	A leak within the Unit 2 Turbine Building Steam Tunnel was found, and tritiated water reached groundwater through degraded expansion joints within the tunnel room. A blockage in a floor drain allowed contaminated water to pool on the floor and reach the degraded expansion joints. The expansion joints were repaired via coating application.
P	December 2016	Reactor Building Roof	A leak was observed from the Unit 2 steam exhaust on the Reactor Building Roof, resulting in approximately 80 gallons of tritiated water leaking from the exhaust. It is unclear if tritiated water reached the ground before the leak was repaired.
Q	May 2017	Reactor Building Roof	A leak occurred at the Unit 1 Condensate Head Tank when the vacuum relief valve became stuck open. The leak volume was estimated to be less than 50 gallons before the leak was repaired. The tritiated water overflowed the tank and ran down the side of the Reactor Building onto the ground.
R	January 2018	Radwaste Building Yard	Multiple leaks were observed from hose connections attached to a steel frac tank. A small volume of tritiated water (less than 2 gallons) was released to the ground. The water was frozen when found and the impacted soil was excavated.
S	February 2018	Unit 3 Condenser Tube Pull-Out Area	A leak of less than 100 gallons of tritiated water occurred while rigging the 3A4 Feed Water Heater from the Unit 3 condenser bay to the Unit 3 Condenser Tube Pull-Out Area. Most of the spill was contained within the Pull-Out Area, but some volume may have entered a nearby storm drain or the surrounding ground.
T	July 2020	CST No. 3	A leak was observed at the Unit 3 CST due to severe corrosion to the piping and valve. Approximately 88 gallons of tritiated water was released to the surrounding concrete and soil. Some of the release was routed to the Condensate Transfer Tunnel before the leak was repaired.
U[1]	March 2, 2023	Water Storage Tank	A leak was observed from a demineralized water storage tank and cooling coil. Per 10 CFR 50.72(b)(2)(xi) BFN initiated voluntary communication to the NRC, state of Alabama, and local officials after receiving analysis activity results above the Nuclear Energy Institute Groundwater Protection Initiative threshold.

Source: (Arcadis 2021)
[1] Source: (NRC 2023)
Element Isotopes Listed: Cesium: Cs-134 and Cs-137; Cobalt: Co-60; Manganese: Mn-54; Silver: Ag-110; Zinc: Zn-65
CST: condensate storage tank

Elevated concentrations of tritium have only been observed at monitoring wells located between the Wheeler Reservoir and the reactor building. Tritium transport in shallow groundwater primarily occurs along two pathways, advective flow through primary porosity and preferential flow along underground utilities, or, essentially, flow through the weaker sections of rock with preferential flow along the pathway created by underground utility structures. Since the Wheeler Reservoir surface elevation is equivalent to the Intake Channel surface elevation, and they are almost always lower than the groundwater elevation, tritium transport via advective groundwater flow ultimately discharges to the Intake Channel. The second flow path for shallow groundwater is along underground utilities. The four utilities most likely to provide preferential transport of tritium are the cable tunnel, the condensate transfer tunnel, the CCW intake conduits, and the CCW discharge conduits. Preferential flow of groundwater through and/or along these utilities likely accounts for the majority of the tritium transport in shallow groundwater at BFN. Ultimately, the most likely tritium fate and transport pathway for tritiated groundwater in the intermediate bedrock is discharge through shallow groundwater into the Intake Channel. However, based on 2020 data, groundwater flow conditions and tritium fate and transport indicate that it is not likely that tritium concentrations exceeding the drinking water standard of 20,000 pCi/L would be measured at the Intake Channel. Furthermore, significant dilution is expected to occur when groundwater discharges to surface water (Arcadis 2021).

3.4.2. Environmental Consequences – Groundwater

This section addresses impacts to groundwater from site construction and operation of the No Action and Action Alternatives.

Alternative A – No Action Alternative

Under the No Action Alternative, the BFN operating licenses would not be extended, resulting in the shutdown of BFN. While there may be a small but temporary impact on groundwater quality during shutdown and decommissioning activities, any residual chemicals from past spills and discontinued industrial practices would degrade over time, leading to improvement in water quality. Overall, there would be no effects to the groundwater hydrology, groundwater use, or groundwater quality from shutdown and decommissioning of BFN.

During shutdown and decommissioning activities, gasoline, diesel fuel, hydraulic lubricants, and other similar products would be used for construction equipment and vehicles. Inadvertent spills of these fluids have the potential to contaminate groundwater. Pursuant to 40 CFR Part 112 and 40 CFR Part 9, TVA would implement a Stormwater Pollution Prevention Plan which would include the use of BMPs to minimize the occurrence of spills and limit their effects. These BMPs include actions such as proper vehicle and equipment maintenance, spill precautions such as use of absorbent pads under equipment, containment for fuel or oil storage tanks, and the maintenance of spill response equipment and materials. Use of these BMPs would minimize the potential for impacts to groundwater quality.

However, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system.

Impacts on groundwater quality from radiological sources such as an SMR facility are expected to be small. TVA would comply with the NEIs groundwater protection initiative, NEI 07- 07 (NEI 2007). This initiative identifies actions to improve utilities management and response to instances where the inadvertent release of radioactive substances may result in low, but detectible, levels of plant-related radioactive materials in subsurface soils and water. Aspects addressed by the initiative include site hydrology and geology, site risk assessment, onsite groundwater monitoring, and remediation. TVA would provide an annual report related to the results of the groundwater monitoring program at the new nuclear plant as directed in NEI 07-07, as well as having the program peer reviewed by industry experts. Actions taken as a result of the groundwater protection initiative would include an increase in monitoring locations, increased number of samples taken, and the review of programs and procedures for best industry practices. The goal of the groundwater protection initiative would be to reduce any impacts on groundwater from the accidental release of radioactive effluents.

Groundwater impacts for new generation resources would depend on the use of groundwater and construction activities required to build the plant. Dewatering activities would likely be needed during foundation construction. If groundwater resources were used for sanitary and potable water use, there would normally be a small impact because the amount of withdrawal would be minimal. Although it is unlikely that groundwater would be used for makeup and/or cooling water, it would depend on site-specific conditions and therefore the impacts could be moderate to large. Overall, groundwater impacts on the aquifer from an alternate generation facility would be site-specific, and dependent on aquifer recharge and other withdrawals. Under both alternatives, chemicals used during construction would be managed using BMPs, thereby limiting the likelihood of chemical contamination of surface water as well as groundwater. With the adoption of either alternative, non-radiological impacts on groundwater quality are expected to be small. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

Under Alternative B, there is no groundwater use onsite, nor is the use of groundwater proposed during the proposed subsequent period of extended operation; therefore, no change in impact is anticipated from the current level of small impact. Gasoline, diesel fuel, hydraulic lubricants, and other similar products would be used for equipment and vehicles during the proposed subsequent period of extended operation. Inadvertent spills of these fluids have the potential to contaminate groundwater. Pursuant to 40 CFR Part 112 and 40 CFR Part 9, TVA would implement a Stormwater Pollution Prevention Plan which would include the use of BMPs to minimize the occurrence of spills and limit their effects. These BMPs include actions such as proper vehicle and equipment maintenance, spill precautions such as use of absorbent pads under equipment, containment for fuel or oil storage tanks, and the maintenance of spill response equipment and materials. Use of these BMPs would minimize the potential for impacts to groundwater quality during the proposed subsequent period of extended operation.

Additionally, all local groundwater near BFN flows directly to Wheeler Reservoir and, therefore, it is improbable that any liquid released from the site would contaminate offsite sources of groundwater supply. Consequently, the potential for contamination of the public and industrial groundwater systems in the BFN area is not anticipated and BFN’s incremental contribution to cumulative groundwater use and quality would be small.

3.5. Floodplains and Flood Risk

A floodplain is the relatively level land area along a stream or river that is subject to periodic flooding. The area subject to a one 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.

NRC regulations concerning nuclear plant design with respect to flooding are provided in NRC, 10 CFR Part 50, Appendix A Criterion 2 – *Design Bases for Protection Against Natural Phenomena*. From the standpoint of nuclear plant design and licensing, floodplain and flood risk assessments conducted during the NRC licensing process ensure that nuclear facilities are sited to provide a reasonable level of protection from flooding.

3.5.1. Affected Environment – Floodplains and Flood Risk

BFN is situated on the north bank of Wheeler Reservoir at TRM 294, 55 miles downstream from Guntersville Dam and 19 miles upstream from Wheeler Dam. The 100- and 500-year flood elevations for the Tennessee River near BFN are provided in Table 3.5-1. Less than 15 acres of the BFN site are situated within either the 100- or 500-year floodplain (Figure 3.5-1).

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 another 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) and the TVA Flood Storage Loss Guideline. The FRP is the elevation of the 500-year flood that has been adjusted for surcharge at the dam. The FRP is equal to the 500-year flood elevation at BFN. The Flood Storage Loss Guideline is method used to evaluate the impacts of proposed projects on flood storage.

Table 3.5-1. Tennessee River Flood Elevations

Return Period (years)	Elevation at Tennessee River Mile 292.6 (feet NAVD 88)	Elevation at Tennessee River Mile 295.2 (feet NAVD 88)
100	557.3	557.3
500	557.3	557.3

NAVD 88 – North American Vertical Datum of 1988
Source: (FEMA 2018)

3.5.2. Environmental Consequences – Floodplains and Flood Risk

This section addresses the floodplain and flood risk-related impacts of the Action and No Action Alternatives.

As a federal agency, 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.

Figure 3.5-1. BFN 100-Year and 500-Year Floodplains

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 EO 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.

Alternative A – No Action Alternative

Under the No Action Alternative, the BFN operating licenses would not be extended, resulting in the shutdown of BFN when the existing licenses expire in 2033, 2034, and 2036. TVA would begin the process of evaluating and planning for the necessary decommissioning of all three BFN units. The shutdown and decommissioning of BFN under the No Action Alternative would have slight beneficial impacts on floodplains if shutdown and decommissioning result in removal of facilities and structures from the floodplain; otherwise, shutdown would have no impact on floodplains or flood risk.

The shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. Plans for replacement power are unknown at this time; however, some associated facilities, structures, and activities could potentially be located within 100-year floodplains.

Construction and operation of a new plant(s) would introduce construction impacts and new incremental operational impacts. New construction could also result in dredging. Consistent with EO 11988, dredging is considered to be a repetitive action in the 100-year floodplain that should result in only small impacts (TVA 1981). To minimize adverse impacts, dredged material would be disposed of on land lying and being outside the 500-year floodplain and above the 500-year flood elevation. By spoiling dredged material outside the 500-year floodplain, dredging in this manner would also comply with the TVA Flood Storage Loss Guideline.

In general, water-use and water-dependent structures and facilities would be located within 100-year floodplains, and flood-damageable equipment and facilities would be located at a minimum outside 100-year floodplains, and Critical Actions would be located at a minimum outside 500-year floodplains, which would be consistent with EO 11988. Should replacement generation be contemplated in the future, a detailed analysis of potential flood impacts would be undertaken at that time.

Alternative B – Proposed Action

Under Alternative B, no refurbishment or plant modifications that would change effects on floodplains in Wheeler Reservoir are planned as a result of SLR.

Because BFN has already been constructed and the major exterior accesses of existing safety-related structures are protected against flooding up to 578 feet, those accesses are above both the 100- and 500-year flood elevations (557.3 feet msl). No major refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would affect offsite land use. Continued maintenance and outages would not result in new impacts to floodplains or increase flood risk in Wheeler Reservoir beyond those previously considered. Therefore, the BFN SLR would be consistent with EO 11988 and the TVA Flood Storage Loss Guideline.

Continued operation of BFN during the proposed subsequent period of extended operation would not be anticipated to impact floodplains and, consequently, the incremental contribution to cumulative impacts to floodplains would also not be anticipated.

The current onsite ISFSI does not have sufficient capacity to support SLR. Spent fuel storage capacity would be expanded, under a separate action, by the addition of a separate additional concrete storage pad prior to exceeding onsite spent fuel storage capacity. The location of the new concrete pad has not been determined, but would be located outside of the 100-year floodplain and above the 500-year flood elevation, which would be consistent with EO 11988 and the TVA Flood Storage Loss Guideline. If SLR is approved, and additional fuel storage capacity is required, the expansion of spent fuel storage capacity would be designed to meet NRC requirements. The development of a new ISFSI would be evaluated in a future NEPA environmental review. Potential cumulative effects to flood risk associated with the implementation of Alternative B would be small.

3.6. Wetlands

3.6.1. Affected Environment – Wetlands

This section describes the onsite wetland resources that may be affected by the operation of BFN during the proposed subsequent period of extended operation. The wetlands that would be affected by the continued operation of BFN are those within the BFN site.

Wetlands are those areas inundated or saturated by surface or groundwater such that vegetation adapted to saturated soil conditions is prevalent (USACE 33 CFR Part 328(b); U.S. Environmental Protection Agency 40 CFR 230.3(t)). Examples include bottomland forests, swamps, wet meadows, isolated depressions, and shoreline fringe along watercourses or impoundments. Due to their landscape position, vegetation structure, and influence on downstream hydrology, wetlands provide a suite of benefits valued by society. These include toxin absorption and sediment retention for improved water quality, storm water impediment and attenuation for flood control, shoreline buffering for erosion protection, and provision of fish and wildlife habitat for commercial, recreational, and conservation purposes. Because of this, wetlands are protected under federal and state laws that mandate wetland avoidance, minimization of impacts, and compensation for loss of wetland function resulting from regulated activities.

The BFN site is located in the Upper Lake Wheeler watershed (HUC10 0603000211). The National Wetland Inventory (NWI) uses coarse aerial imagery to identify potential wetlands at a large scale. Within the Upper Lake Wheeler watershed, the NWI maps approximately 90,000 acres of wetland habitat, covering roughly 42 percent of the watershed's total acreage. The BFN site covers approximately 880 acres on the north side of the Tennessee River/Wheeler Reservoir. Nine wetlands, totaling 24.1 acres, were delineated and assessed across the BFN site during the field reconnaissance for the SLR (Table 3.6-1). Identified wetlands cover less than 3 percent of the BFN study area, which is a smaller percentage than that mapped by the NWI at the watershed scale (Buecker 2021).

Table 3.6-1. Wetlands on the BFN Site

Wetland Identifier	Wetland Type[1]	TVARAM Category[2]	Location on BFN Site	Total Wetland Acreage on BFN Site
Wetland 1	PEM1C	Low (24.5)	Southeast	1.45
Wetland 2	PEM1C	Low (24.5)	Southeast	0.46
Wetland 3	PEM1C	Low (24.5)	Southeast	0.40
Wetland 4	PEM1B	Low (29.5)	Central east	10.61
Wetland 5	PEM1C	Low (26.5)	Central south	0.58
Wetland 6	PSS1C	Moderate (39)	Central	1.33
Wetland 7	PEM1E	Low (28)	North	3.63
Wetland 8	PEM1E	Low (23)	Northeast	0.82
Wetland 9	PFO6E	Moderate (45)	Northeast	4.82
			Total	**24.1**

[1] Classification codes as defined in (Cowardin 1979): P = Palustrine; EM1 = emergent, persistent vegetation; FO6= forested, deciduous vegetation,seasonally flooded/saturated; SS1= scrub-shrub, broad-leaved deciduous vegetation; C = Seasonally flooded; B = Saturated; E = seasonally flooded/saturated
[2] TVARAM category definitions: low = low resource value, moderate = moderate resource value, exceptional = exceptional waters. Category based on wetland score (shown in parentheses).

As discussed in Section 3.3.1.1, field assessments were conducted in September 2021 to determine wetland presence, extent, and condition within the BFN site (TVA 2021c). Wetland determinations were performed according to the USACE standards, which require documentation of hydrophytic vegetation, hydric soil, and wetland hydrology (Environmental Laboratory 1987, USACE 2018, USACE 2012a). Wetland condition was evaluated using a TVA-developed modification of the Ohio Rapid Assessment Method (Mack 2001) specific to the TVA region, referred to as the TVA Rapid Assessment Method (TVARAM). Wetlands were evaluated by their functions and classified into three categories: low quality, moderate quality, and superior quality. Low-quality wetlands are degraded aquatic resources that may exhibit low species diversity, minimal hydrologic input and connectivity, recent or ongoing disturbance regimes, and/or a 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. High-quality wetlands include those wetlands that offer superior functions and values within a watershed or that are of regional/statewide concern. Characteristics of high-quality wetlands include the following: 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 high-quality wetlands often represent restoration goals for wetlands functioning at a lower capacity.

The nine delineated wetlands on the BFN site cover a total 24.1 acres (Table 3.6-1; see Figure 3.3-2 for locations). These wetlands are primarily located on the eastern portion of the BFN site and include emergent, scrub shrub, and forested wetland communities that exhibit a range of resource values. Each of these wetlands is described below.

Wetland 1 is an emergent wetland located adjacent to a stream in the southeast portion of the BFN site. Surface water, water table, and saturation were observed during field investigation.

Hydrophytic vegetation observed within the wetland included Virginia buttonweed (*Diodia virginiana*), soft rush (*Juncus effusus*), fox sedge (*Carex vulpinoidea*), and swamp smartweed (*Persicaria hydropiperoides*). Soil samples taken within the wetland exhibited hydric indicators, including F7 (depleted dark surface), F8 (redox depressions), and F12 (iron-manganese masses). This wetland scored as low quality using TVARAM, indicating poor provision of wetland functions.

Wetland 2 is an emergent wetland located in the southeast portion of the BFN site. Stormwater runoff from a roadside ditch and adjacent upland areas appears to be the primary water source for this wetland. Surface water, water table, and saturation were observed during field investigation. Hydrophytic vegetation observed within the wetland included Virginia buttonweed, soft rush, fox sedge, and swamp smartweed. Soil samples taken within the wetland area exhibited hydric indicators, including F7, F8, and F12. This wetland scored as low quality using TVARAM, indicating poor provision of wetland functions.

Wetland 3 is an emergent wetland located in the southeast portion of the BFN site. The wetland drains south through a culverted road crossing to a stream. Surface water, water table, and saturation were observed during field investigation. The primary source of hydrology is stormwater runoff from surrounding upland areas. Hydrophytic vegetation observed within the wetland area included smooth false buttonweed (*Spermacoce glabra)* and soft rush. This wetland is located within a drainage ditch lacking an ordinary high-water mark. Soil samples taken within the wetland exhibited hydric indicators including F7, F8, and F12. This wetland scored as low quality using TVARAM, indicating poor provision of wetland functions.

Wetland 4 is an emergent wetland located in the central eastern portion of the BFN site. Portions of the wetland have been channelized during past development of the property. Channelized portions of the wetland did not possess an ordinary high-water mark. The primary source of hydrology for this wetland appears to be concentrated stormwater runoff upstream of the wetland and sheet flow runoff from adjacent uplands. Hydrophytic vegetation observed within the wetland area included false buttonweed, swamp smartweed, soft rush, and southern cattail (*Typha domingensis*). Soil samples taken within the wetland exhibited hydric indicators, including F12. This wetland scored as low quality using TVARAM, indicating poor provision of wetland functions.

Wetland 5 is an emergent wetland located in the central portion of the BFN site. The primary source of hydrology for this wetland appears to be concentrated stormwater runoff upstream of the wetland and sheet flow runoff from adjacent uplands. The wetland is located within a drainage ditch lacking an ordinary high-water mark. Surface water, water table, and saturation were observed during field investigation. Hydrophytic vegetation observed within the wetland included java waterdropwort (*Oenanthe javanica*), fox sedge, and Virginia buttonweed. Soil samples taken within the wetland exhibited hydric indicators, including F7, F8, and F12. This wetland scored as low quality using TVARAM, indicating poor provision of wetland functions.

Wetland 6 is a scrub-shrub wetland located in the central portion of the BFN site. The primary source of hydrology for this wetland appears to be concentrated stormwater runoff upstream of the wetland and sheet flow runoff from adjacent uplands. The wetland is located within a drainage ditch lacking an ordinary high-water mark. Vegetation observed within the wetland included fox sedge, white morning-glory (*Ipomoea lacunose*), tufted lovegrass (*Eragrostis pectinacea*), and woody goldenrod (*Chrysoma pauciflosculosa*). Soil samples taken within the wetland exhibited hydric indicators, including F7 and F8. This wetland scored as moderate quality using TVARAM, indicating a healthy provision of wetland functions.

Wetland 7 is an emergent wetland located in the northern portion of the BFN site. Wetland 7 and Wetland 6 are divided by Shaw Road. Two culverts are installed under the roadway, connecting the two wetlands. The primary source of hydrology for this wetland appears to be concentrated stormwater runoff upstream of the wetland and sheet flow runoff from adjacent uplands. The wetland is located within a drainage ditch lacking an ordinary high-water mark. Vegetation observed within the wetland included fox sedge, white morning-glory, tufted lovegrass, and woody goldenrod. Soil samples taken within the wetland exhibited hydric indicators, including F7, F8, and F12. This wetland scored as low quality using TVARAM, indicating poor provision of wetland functions.

Wetland 8 is an emergent wetland located in the northeastern portion of the BFN site. A man-made berm separates Wetland 8 from Wetland 9. Saturated conditions were observed during field investigation. Hydrophytic vegetation observed within the wetland included marsh bristlegrass (*Setaria parviflora*), Virginia buttonweed, fox sedge, and swamp smartweed. Soil samples taken within the wetland exhibited hydric indicators including F6 (Redox Dark Surface), F8 and F12. This wetland scored as low quality using TVARAM, indicating a poor provision of wetland functions.

Wetland 9 is a forested wetland located in the northeastern portion of the BFN site. Much of the wetland is linear in shape, following excavated channels lacking an ordinary high-water mark. Saturated conditions were observed during field investigation. Vegetation observed within the wetland included swamp smartweed, woody goldenrod, and willow oak (*Quercus phellos*). Soil samples taken within the wetland exhibited hydric indicators, including F6, F8, and F12. This wetland scored as moderate quality using TVARAM, indicating a healthy provision of wetland functions.

The primary effects on wetlands occurred during BFN construction and from right-of-way (ROW) construction and maintenance. EO 11990, Protection of Wetlands, requires federal agencies to minimize impacts on wetlands, and activities in wetlands are regulated under Section 404 of the CWA. Activities that result in the discharge of dredge or fill material in wetlands require a permit from the USACE.

3.6.2. Environmental Consequences – Wetlands

This section addresses impacts to onsite wetlands from the No Action and Action Alternatives.

<u>Alternative A – No Action Alternative</u>

Under the No Action Alternative, the shutdown and decommissioning of BFN are not anticipated to affect wetlands on or in the vicinity of the site. However, TVA would also need to replace the BFN generation.

The impact to wetlands due to building new generation plants and associated transmission lines and pipeline ROWs would range from small to large depending on the physical location of the plant structures and the quantity and quality of wetlands within the potential plant footprint as well as along transmission line and pipeline corridors. A site-specific environmental review would be conducted to identify wetlands and measures to avoid, minimize, and mitigate impacts as appropriate once new generation construction project locations and technologies are specifically identified. TVA actions would comply with the CWA and EO 11990.

<u>Alternative B – Proposed Action</u>

Under the Proposed Action Alternative, no refurbishments or plant modifications that would affect wetlands are planned during the proposed subsequent period of extended operation, and no new and significant information was identified with regard to wetlands. Application of BFN's BMPs and compliance with NPDES regulatory requirements, SPCC plan, and other permit conditions would avoid or minimize any impact on wetland resources from BFN operational and maintenance activities during the proposed subsequent period of extended operation. For these reasons, the impacts on wetlands over the proposed subsequent period of extended operation would be small. No mitigation measures would be required beyond those already in place. The incremental contribution of BFN operations during the proposed subsequent period of extended operation to cumulative impacts on wetlands in the vicinity of BFN also would be small.

3.7. Aquatic Ecology

3.7.1. Affected Environment – Aquatic Ecology

This section describes the ecological resources of the aquatic communities that may be affected by the operation of BFN during the proposed subsequent period of extended operation. The aquatic community that would be affected by water withdrawals and discharges associated with the continued operation of BFN is that of Wheeler Reservoir.

3.7.1.1. Fish

TVA monitors the health of the aquatic communities in its reservoirs using a multi-metric Reservoir Fish Assemblage Index (RFAI). Characteristics of a balanced indigenous population are determined holistically 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 health rating (TVA 2021e). Total RFAI scores for Wheeler Reservoir for autumn 2020 were similar between downstream ("46-Good") and upstream ("49-Good") sites, and both were the highest observed at the respective reaches. With the exception of 2005 and 2019, RFAI scores at both reaches have not been statistically different (i.e., were "similar," or differed by six points or less). When compared between reaches, scores since 2000 have not been significantly different (P=0.13) (TVA 2021e).

Table 3.7-1 lists fish species collected by TVA in the vicinity of BFN from autumn 1993-1997, 1999-2011, 2013, 2015, 2017, 2019, and 2020. Sampling sites were nominally located at TRM 292.5 and 295.9. Electrofishing and gill netting locations ranged from 0.5 to 1.0 mile upstream and downstream from these river mile locations (TVA 2021d).

Table 3.7-1. Catch Rates in the Vicinity of Browns Ferry Nuclear Plant (Tennessee River Miles 292.5 and 295.9) from 1993 through 2020

Common Name	Scientific Name	Average CPUE	CPUE Range	Species Occurrence (No. of Samples)[1]
Mississippi silverside	*Menidia audens*	17.2	0.1 - 80.7	40
Gizzard shad	*Dorosoma cepedianum*	15.7	0.3 - 45.7	45
Emerald shiner	*Notropis atherinoides*	11.8	0.1 - 220.3	27
Threadfin shad	*Dorosoma petenense*	9.8	0.1 - 133.3	39
Bluegill	*Lepomis macrochirus*	5.4	0.2 - 19.1	45
Largemouth bass	*Micropterus salmoides*	3.6	0.4 - 13.0	45
Eastern sand darter	*Ammocrypta pellucida*	3.1	3.1 - 3.1	1
Channel catfish	*Ictalurus punctatus*	3.1	0.2 - 7.9	45
Longear sunfish	*Lepomis megalotis*	2.1	0.1 - 5.6	43
Skipjack herring	*Alosa chrysochloris*	2.0	0.1 - 8.0	45
Spotfin shiner	*Cyprinella spiloptera*	1.5	0.1 - 2.7	30
Redear sunfish	*Lepomis microlophus*	1.5	0.1 - 4.6	45

Common Name	Scientific Name	Average CPUE	CPUE Range	Species Occurrence (No. of Samples)[1]
Freshwater drum	*Aplodinotus grunniens*	1.5	0.3 - 3.3	45
Logperch	*Percina caprodes*	1.4	0.1 - 13.7	35
White bass	*Morone chrysops*	1.3	0.1 - 8.6	41
Smallmouth bass	*Micropterus dolomieu*	1.2	0.1 - 5.0	44
Yellow bass	*Morone mississippiensis*	1.1	0.1 - 5.0	44
Spotted sucker	*Minytrema melanops*	1.1	0.1 - 8.9	43
Green sunfish	*Lepomis cyanellus*	1.0	0.1 - 6.6	39
Brook silverside	*Labidesthes sicculus*	0.9	0.1 - 3.8	5
Smallmouth buffalo	*Ictiobus bubalus*	0.9	0.1 - 2.4	42
Blue catfish	*Ictalurus furcatus*	0.8	0.1 - 4.5	44
Sauger	*Sander canadensis*	0.8	0.1 - 4.1	37
Spotted bass	*Micropterus punctulatus*	0.7	0.1 - 2.7	42
Yellow bullhead	*Ameiurus natalis*	0.7	0.7- 0.7	1
Flathead catfish	*Pylodictis olivaris*	0.5	0.1 - 1.6	44
Longnose gar	*Lepisosteus osseus*	0.5	0.1 - 1.8	9
Spotted gar	*Lepisosteus oculatus*	0.5	0.1 - 1.8	33
Golden shiner	*Notemigonus crysoleuca*	0.4	0.1 - 1.8	29
Saddleback darter	*Percina vigil*	0.4	0.4 - 0.4	1
Hybrid striped x white bass	*Morone saxatilis x M. chrysops*	0.4	0.1 - 1.4	11
Striped bass	*Morone saxatilis*	0.3	0.1 - 1.3	21
Black buffalo	*Ictiobus niger*	0.3	0.1 - 1.6	17
Common carp	*Cyprinus carpio*	0.3	0.1 - 1.3	35
Walleye	*Sander vitreus*	0.3	0.1 - 0.5	4
Golden redhorse	*Moxostoma erythrurum*	0.2	0.1 - 1.3	20
Silver redhorse	*Moxostoma anisurum*	0.2	0.1 - 0.9	9
Lake sturgeon	*Acipenser fulvescens*	0.2	0.2 - 0.2	1
Orangespotted sunfish	*Lepomis humilis*	0.2	0.1 - 0.3	4
Striped shiner	*Luxilus chrysocephalus*	0.2	0.1 - 0.3	4
Yellow perch	*Perca flavescens*	0.2	0.1 - 0.7	15
Black redhorse	*Moxostoma duquesnei*	0.2	0.1 - 0.7	26
White crappie	*Pomoxis annularis*	0.2	0.1 - 0.8	24
Quillback	*Carpiodes cyprinus*	0.2	0.1 - 0.3	6
Bullhead minnow	*Pimephales vigilax*	0.1	0.1 - 0.5	20
Bluntnose minnow	*Pimephales notatus*	0.1	0.1 - 0.3	6
Black crappie	*Pomoxis nigromaculatus*	0.1	0.1 - 0.4	24
Warmouth	*Lepomis gulosus*	0.1	0.1 - 0.5	33
Blackside snubnose darter	*Etheostoma duryi*	0.1	0.1 - 0.1	1
Mooneye	*Hiodon tergisus*	0.1	0.1 - 0.2	3
Hybrid sunfish	*Lepomis sp*	0.1	0.1 - 0.2	6
Blackstripe topminnow	*Fundulus notatus*	0.1	0.1 - 0.1	2
River darter	*Percina shumardi*	0.1	0.1 - 0.1	2
River redhorse	*Moxostoma carinatum*	0.1	0.1 - 0.2	4
Shortnose gar	*Lepisosteus platostomus*	0.1	0.1 - 0.1	1
Smallmouth redhorse	*Moxostoma breviceps*	0.1	0.1 - 0.1	1
Stripetail darter	*Etheostoma kennicotti*	0.1	0.1 - 0.1	4
Northern hog sucker	*Hypentelium nigricans*	0.1	0.1 - 0.3	14
Largescale stoneroller	*Campostoma oligolepis*	0.1	0.1 - 0.2	10
Redbreast sunfish	*Lepomis auritus*	0.1	0.1 - 0.3	15
Bowfin	*Amia calva*	0.1	0.1 - 0.1	4
Bigmouth buffalo	*Ictiobus cyprinellus*	0.1	0.1 - 0.1	7

Common Name	Scientific Name	Average CPUE	CPUE Range	Species Occurrence (No. of Samples)[1]
Chestnut lamprey	*Ichthyomyzon castaneus*	0.1	0.1 - 0.1	7
Atlantic needlefish	*Strongylura marina*	0.1	0.1 - 0.1	1
Blackspotted topminnow	*Fundulus olivaceus*	0.1	0.1 - 0.1	1
Central stoneroller	*Campostoma anomalum*	0.1	0.1 - 0.1	1
Grass carp	*Ctenopharyngodon idella*	0.1	0.1 - 0.1	1
Hybrid bass	*Micropterus sp.*	0.1	0.1 - 0.1	2
Hybrid walleye x sauger	*Sander vitreus x S. canadensis*	0.1	0.1 - 0.1	1
Mimic shiner	*Notropis volucellus*	0.1	0.1 - 0.1	1
Rock bass	*Ambloplites rupestris*	0.1	0.1 - 0.1	1
Silver chub	*Macrhybopsis storeriana*	0.1	0.1 - 0.1	4
Snubnose darter	*Etheostoma simoterum*	0.1	0.1 - 0.1	1

Source: (TVA 2021e).
CPUE = catch per unit effort
[1] Number of samples in which species occurred collected by electrofishing and gill netting during 45 sampling events from 1993 through 2020.

Excluding four hybrid fish species, 69 species were collected. Mississippi silverside, gizzard shad, emerald shiner, and threadfin shad were most abundant, exhibiting the highest catch per unit effort (CPUE). Gizzard shad, bluegill, largemouth bass, channel catfish, skipjack herring, redear sunfish, and freshwater drum were the species most widespread in occurrence, having been collected in all samples, while 15 species were collected in only one sample.

Studies conducted in support of CWA Section 316(a) indicate that the fish community of Wheeler Reservoir in the vicinity of BFN does not show an increase or dominance of heat tolerant or invasive, non-native fish species as a result of the thermal component of the BFN discharge. Fish species were categorized as “heat tolerant” (upper incipient lethal temperatures [UILTs] of 95°F to 102°F) and “heat sensitive” (UILTs <91°F) using thermal sensitivity data from Yoder et al. (Yoder et al. 2006). Upstream samples included more heat tolerant species than downstream samples during 10 of 18 sampling events since 2000. Additionally, average numbers of heat tolerant species and the abundances of heat-tolerant individuals , as well as the relative abundances of heat tolerant species and heat sensitive species, were not statistically different between the reaches upstream and downstream of the thermal discharge.

Regarding invasive fish species, data indicate there are few present in the reservoir around BFN. A statistical test performed on the autumn 2020 dataset indicated that numbers of invasive species and abundances were not different between the reaches sampled upstream and downstream of the thermal discharge. On average since 2000, one more invasive fish species was collected at the thermally unaffected upstream reach, and abundance of invasive species has not been statistically different between reaches (TVA 2021e).

3.7.1.2. Mussels and Other Macroinvertebrates

TVA conducted a mussel survey at BFN on July 12-13, 2021, to assess the current freshwater mussel assemblage in Wheeler Reservoir immediately adjacent to BFN (Amaker 2021). Mussels were found only in the overbank habitat. The mussel community in this area is characterized by 11 common, widespread, silt-tolerant species. The most numerous species was the washboard (*Megalonaias nervosa*), which was common at most sites sampled and dominated the mussel biomass. All age classes from juveniles to large adults were present.

Four snail species also were observed during the survey. All species present during the survey are shown in Table 3.7-2.

Table 3.7-2. Mussel and Snail Species Present During the Survey July 12-13, 2021

Common Name	Scientific Name
Mussels	
Elephant ear	*Elliptio crassidens*
Fawnsfoot	*Truncilla donaciformes*
Fragile papershell	*Potamilis fragilis*
Mapleleaf	*Quadrula quadrula*
Pimpleback	*Cyclonaias pustulosa*
Pink heelsplitter	*Potamilis alatus*
Rock pocketbook	*Arcidens confragosus*
Southern mapleleaf	*Quadrula apiculata*
Threehorn wartyback	*Obliquaria reflexa*
Threeridge	*Amblema plicata*
Washboard	*Megalonaias nervosa*
Snails	
Noble hornsnail	*Pleurocera nobilis*
Olive mysterysnail	*Viviparus subpurpureus*
Pointed campeloma	*Campeloma decisum*
Silty hornsnail	*Pleurocera canaliculata*

Source: (Amaker 2021)

The survey was conducted at six downstream and five upstream stations in the immediate vicinity of BFN. The CPUE ranged from 0.13 to 1.93 mussels per minute at the downstream survey stations and from 0.86 to 3.4 mussels per minute at the upstream stations. Water depths ranged from 8 to 25 feet at downstream stations and from 13 to 18 feet at upstream stations. At various downstream stations, substrate consisted of silt, gravel, and artificial rock piles; Asian clam (*Corbicula fluminea*) and relict shells were present at two stations; and sparse to dense eelgrass (*Vallisneria americana*) was present at two stations. At various upstream stations, substrate consisted of silt, gravel, or rock; and relict *Corbicula* shell was present at two stations.

The results of macroinvertebrate assessments in Wheeler Reservoir have shown that the downstream reaches have scored in the “Excellent” range during eight of ten sample years, including the last four sampling years (TVA 2021e). The macroinvertebrate community structure demonstrates a seasonally abundant and diverse macroinvertebrate community present at both downstream and upstream reaches (Table 3.7-3).

Table 3.7-3. Results of Benthic Macroinvertebrate Functional Feeding Groups Upstream and Downstream of BFN for Sampling Years[1] between 2001 and 2020

Sampling Metric	Downstream Average[3]	Upstream Average[4]
Number of species	24	23
Total mean density (per square meters)	961	703
Percent composition by feeding group[2]		
CF	16	20
CG	43	37
PA	0	0
PR	33	31
SC	7	10

Sampling Metric	Downstream Average[3]	Upstream Average[4]
SH	1	2
PI	0	0

[1] Years sampled: 2001-2004, 2006, 2011, 2012, 2013, 2015, 2017, and 2020.
[2] CF = collector/filterer; CG = collector/gatherer; PA = parasitic; PR = predator; SC = scraper; SH = shredder; PI = piercer.
[3] River Miles 291.7, 290.4, 293.2
[4] River Mile 295.9
Source: (TVA 2021e)

In summary, ecological characteristics of benthic macroinvertebrate communities, when compared among the downstream and upstream reaches, have been “similar” since the initiation of sampling.

3.7.1.3. Aquatic Plants

TVA collects shoreline and river bottom habitat data upstream and downstream of BFN every 5 years. The data are used to characterize habitats important to fish and find comparable habitats at upstream and downstream sampling sites to minimize habitat differences that might bias interpretation of the results. Aquatic macrophytes are present in low abundance near BFN. Aquatic macrophytes were present in low percentages within both reaches during 2020 habitat surveys conducted by TVA (TVA 2021e). No aquatic macrophytes were observed at either the upstream or downstream reaches.

3.7.1.4. Invasive/Non-Native Aquatic Species

Invasive, non-native, aquatic species observed in the immediate vicinity of BFN are discussed below.

The redbreast sunfish can be found in creeks, rivers and streams with a balanced pH and vegetation (Texas Invasive Species Institute 2014). Adults feed on terrestrial insects, immature and adult aquatic insects, and crayfish. When introduced in non-native habitats, this fish can take over the habitat of native fish species.

The Mississippi silverside has been introduced to reservoirs on the Tennessee and Cumberland Rivers in Alabama, Tennessee, and Kentucky (Smithsonian Environmental Research Center 2022). This species apparently evolved from the estuarine fish, *M. beryllina*, and can tolerate a wide range of temperature and salinity. Mississippi silversides swim in large schools, and feed on zooplankton, insects, small benthic invertebrates, and small fishes.

The common carp is native to eastern Asia, but has been widely introduced, domesticated, and hybridized in the United States and elsewhere (Smithsonian Environmental Research Center 2022). This species feeds on aquatic vegetation and thrives in conditions not suitable for other fish, which made the common carp an attractive import. Common carp can impact native fish species.

Hybrid sunfish are cultured commercially for pond stocking and for fish food, and stocking hybrids is one strategy for controlling sunfish overpopulation (Mischke 2007). Various sunfish species interbreed readily, so hybrid production is relatively simple. Regulations against stocking hybrid sunfish in public waters vary among states.

Branchiura sowerbyi is a tubificid worm established sporadically and widely around the United States (Liebig et al. 2019). It is a benthic deposit bottom feeder that occurs in rivers and warmer waters.

Apocorophium lacustre is an amphipod crustacean that is a recent colonizer of freshwater systems in the United States and Europe (Keller et al. 2017). This species is native primarily in estuarine environments. It is believed to have the potential to alter food webs and may compete with native filter feeders for space and food.

Corbicula fluminea is a filter feeding, non-native, invasive clam species that causes biofouling of power plant and industrial water systems (USGS 2022). This species is consumed by fish and crayfish.

3.7.2. Environmental Consequences – Aquatic Ecology

This section addresses impacts to aquatic ecology from the No Action and Proposed Action Alternatives.

Alternative A – No Action Alternative

Under the No Action Alternative, closure of BFN would eliminate the effects on the aquatic community from current operation. After shutdown, the elimination of impingement and entrainment, thermal effects, non-cooling water discharge, maintenance dredging, and other operational effects generally would be expected to be small and beneficial for aquatic resources at BFN. However, TVA would need to replace the 3,900 MWe of BFN generation.

Effects to aquatic ecosystems associated with building a new SMR plant(s) would vary depending on the physical location of the plant, the location of the intake and discharge structures, and the type of cooling employed by the plant. Construction impacts to aquatic ecology are usually preventable by using industry-approved standards to contain sediment runoff and accidental spills. Construction along the banks or in a body of water can be mitigated by using BMPs. However, temporary and localized effects such as increases in turbidity would be expected. Should dredging be necessary, loss of the local benthic community and temporary increases in turbidity would be expected. Pre-dredge conditions should return as benthic communities re-colonize the area and suspended solids settle out of the water column. Effects from dredging would have only small direct and indirect effects on aquatic communities.

Effects of operation to aquatic habitat would depend on the nature of the source water quality. The source water for cooling in a plant using a closed-cycle cooling system is concentrated up to four times in the cooling tower operations before being discharged as wastewater blowdown, which concentrates the potential impurities already dissolved in the source water. However, the blowdown stream and all wastewater discharges would be regulated by and in compliance with the site-specific NPDES permit.

Impingement and entrainment effects of operation would also be dependent on the quality of the source water and organisms residing within the local habitat. Intake velocities are required to adhere to 316(b) of the CWA (33 USC Section 1326), which minimizes impingement and entrainment mortality of aquatic organisms. Intake and discharge volumes are lower from plants using a closed-cycle cooling system (as opposed to a once-through system), but the volume of water required increases as the source water quality decreases (as water quality decreases fewer cycles of concentration are possible), which may affect entrainment, impingement, and effects to organisms sensitive to a thermal plume. However, plants that use a closed-cycle cooling system consume more water through evaporation in the cooling towers than plants using a once-through cooling system.

Aquatic organisms susceptible to entrainment are usually planktonic, and thus quite small with limited swimming ability and subject to the motion of the water. The effects of entrainment would depend on local species residing in the source water and the percentage of source water being routed through the plant.

Cooling water discharge is at times warmer than ambient and causes a thermal plume within the receiving waters. Thermal plumes can impede migration of temperature-sensitive aquatic organisms. During winter months, a thermal plume might attract fish, which could increase predation or cause cold shock should the plant cease operation or the fish be chased out of the plume in an attempt to escape predation.

Additionally, discharge can contain contaminants associated with treatment of the intake water or normal plant operation. Depending on the contaminant load within the cooling tower blowdown stream, impacts could range from small to large. However, an NPDES permit would be required prior to discharge and would regulate toxic substances entering receiving waters.

Impacts to aquatic ecology from building a new SMR plant(s) could range from small to large depending on the plant design, organisms present, source water, and receiving water. Depending on the proximity of other industry affecting area ecology, cumulative effects may also be apparent.

Effects to aquatic ecosystems associated with building a different generation plant would range from small to large depending upon the physical location of the plant, the location of the intake and discharge structures, and the type of cooling employed by the plant. A natural gas-powered generation plant would employ a cooling system similar to that of a SMR generation facility. Although the intake demand associated with natural gas-fired generation is substantially less than that of a nuclear-powered plant, impacts associated with thermal and chemical discharge, and impingement/entrainment of organisms, would be similar.

Potential effects associated with any new generation resource would be evaluated in separate analyses once new generation construction project locations and technologies are specifically identified. Therefore, impacts on aquatic resources from construction and operation of these new sources of energy likely would be small to large.

Alternative B – Proposed Action

Under Alternative B, the Proposed Action, current operational activities at BFN would continue on the existing site, and Wheeler Reservoir would continue to be the source of cooling water and the focus of potential impacts on aquatic resources.

Section 316(b) of the CWA requires that the cooling water intake structure (CWIS) reflect the best technology available (BTA) for minimizing adverse environmental impacts (33 United States Code [U.S.C.] 1326) from entrainment and impingement of aquatic organisms (33 U.S.C. 1326(b). The location, design, construction, and capacity of the CWIS must reflect the BTA for minimizing such impacts. The NRC requires SLR applicants to demonstrate the significance level of impingement and entrainment impacts by providing current CWA Section 316(b) determinations and supporting documentation, or alternatively, by providing site-specific assessments of impingement and entrainment impacts. USEPA issued a final 316(b) rule effective October 2014 for existing power generating and industrial facilities (79 FR 48299; August 15, 2014). Under the rule, the BFN facility, as an existing facility that withdraws more than 125 million gallons of cooling water per day (actual intake flow), is required to provide an Entrainment Characterization Study (§ 122.21(r)(9)) that includes a minimum of 2 years of entrainment data collection. TVA conducted this study to demonstrate compliance with Section 316(b) (TVA 2020b).

The BFN units are cooled by pumping water from Wheeler Reservoir and discharging it back to the reservoir via three large, submerged, diffuser pipes that are perforated to maximize uniform mixing into the flow stream. This straight-through flow path is known as once-through, open cycle, or open mode operation. As originally designed, the maximum thermal discharge from the once-through cooling water system is directed into Wheeler Reservoir, with a temperature increase from the intake to the discharge of 13.9°C (25°F). The flow exits the diffusers and mixes with the reservoir flow. At the edge of the discharge mixing zone, the water temperature is required to be less than 5.6°C (10°F) above ambient water temperature. Some of this cooling water can also be directed through helper cooling towers prior to discharge to reduce its temperature as necessary to comply with environmental regulations. The helper cooling towers are operated only when necessary to meet thermal discharge temperature limits specified in the NPDES permit issued by the ADEM, typically a few months during the hottest part of the summer (usually July and August).

TVA assumes 100 percent mortality of all aquatic organisms that enter the plant. BFN entrains a low percentage of a small portion of the plankton transported past the site. The proportion of cooling water withdrawn from Wheeler Reservoir is small (8.9 percent) compared to the long-term average river flow of 48,300 cfs passing the intake structure (TVA 2020b). ADEM has determined that the cooling water intake structure represents the interim BTA to minimize adverse environmental impacts. BFN is required to operate and maintain the cooling water intake structure in a manner that minimizes entrainment levels.

Entrainment and Impingement Impacts

In accordance with CWA Section 316(b), § 122.21(r)(9), TVA conducted an entrainment characterization study with sampling over 2 years in 2018 and 2019. Ichthyoplankton sampling was conducted during the period from February 20-21, 2018, through December 17-19, 2019. Samples were collected weekly during February through August (expected period of fish spawning) and monthly from September through January. Samples were collected during day and night at all sampling locations. Samples were collected immediately outside the CCW intake channel located at TRM 294.3. To determine the number of fish eggs and larvae available for entrainment, samples were also collected from three equidistant locations along a river transect located at TRM 294.5, immediately upstream from the CCW intake and perpendicular to river flow (TVA 2020b).

During the entrainment characterization study, fish eggs and larvae collected were from 11 families: Clupeidae, Moronidae, Centrarchidae, Atherinopsidae, Sciaenidae, Cyprinidae, Catostomidae, Percidae, Ictaluridae, Fundulidae, and Poeciliidae. The remaining fish eggs and larvae were not identifiable. No species were collected that are currently protected under federal, state, or tribal law. No entrainable shellfish occur in the vicinity of the BFN intake (TVA 2020b).

Clupeids and freshwater drum eggs compose a high percentage of the total ichthyoplankton composition. Fish egg densities (mostly freshwater drum) tended to be lowest along the right descending bank and highest at the mid-channel station during both sampling years. Entrainment data demonstrated annual variations in the relative abundance and spatial-temporal distribution of fish, and fluctuations in river flow are common in the vicinity of BFN. The total annual percentage of all taxa of fish eggs and larvae in the river that were entrained at BFN's cooling water intake was similar between day (fish eggs 1.8 percent; larvae 4.2 percent) and night (fish eggs 4.2 percent; larvae 6.6 percent) during both sampling years combined (TVA 2020b). Fish egg densities in Wheeler Reservoir tended to be lowest along the right descending bank and highest at the mid-channel sampling station.

Based on study findings, BFN entrains a low percentage of a small portion of the ichthyoplankton population transported past the site. TVA assumes 100 percent mortality of all aquatic organisms that enter the plant. This entrainment affects only a small portion of the Tennessee River since fish eggs and larvae spawned below the plant are not subject to entrainment and many of those spawned above the plant become nonplanktonic before reaching the plant intake. Entrainment of fish eggs and larvae by BFN is not considered to be a significant adverse impact on the fisheries resources of Wheeler Reservoir. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would alter the impact from entrainment of ichthyoplankton, and no new and significant information on this issue was identified.

Existing facilities are required to meet BTA for impingement via one of several compliance alternatives. In freshwater, shellfish are limited to crayfish and freshwater mussels. TVA collected data to measure impingement on BFN intake screens during the period from 2007 through 2009. There are no occurrence records of federal listed species near the BFN intake, and only one crayfish has been collected in impingement samples at BFN (TVA 2021d).

Fish taxa collected in impingement samples were designated as forage, commercial, and/or recreational species. Forage fish were defined as those generally regarded as prey for top carnivore fish. Commercially valuable species were defined as those that may be harvested and sold commercially for food or bait in Alabama. Recreationally valuable species were those targeted by anglers or used as bait. During impingement monitoring, a total of 51 fish taxa were collected: 16 taxa were considered forage taxa, 18 commercially valuable, and 28 recreationally valuable, with some taxa included in more than one category (TVA 2021d).

Actual numbers of fish collected in impingement samples during the first year (2,810,778) were more than twice that of the second year (1,172,660), but total taxa were similar between years: 46 and 43 taxa during 2007-2008 and 2008-2009, respectively. The increase in total numbers was due to much higher numbers of threadfin shad. Thirty-eight species were collected during both years, and 13 were collected during only one year. Threadfin shad was the species most susceptible to impingement (TVA 2021d).

The estimated average annual impingement at the CCW intake during the 2007-2009 sampling was 13,942,033 fish; of these, 96 percent were fragile threadfin shad. Over 90 percent of fish impinged on cooling water intake screens at thermal power plants in the southeastern United States typically are threadfin shad and gizzard shad. The preamble to the Section 316(b) existing facilities rule acknowledges the susceptibility and fragility of these species to impingement and focuses impingement mortality requirements on non-fragile species unless additional measures are specified by ADEM. Of the non-clupeid species, yellow bass, bluegill, and freshwater drum were most susceptible to impingement. Peak impingement periods were during the cooler months (November-January), indicating shad impingement may be related to cold shock (TVA 2021d).

In accordance with CWA Section 316(b), § 122.21(r)(10), (11), and (12), TVA conducted a Comprehensive Technical Feasibility and Cost Evaluation Study, Benefits Valuation Study, and Non-Water Quality Environmental and Other Impacts Study to evaluate the potential implementation of closed-cycle cooling and fine mesh screens at BFN (TVA 2022g). The study concluded that the implementation of a closed-cycle cooling system and fine mesh screens at BFN would not be a prudent or practical measure for entrainment reduction due to the challenges, impacts, costs, schedule, and risks identified. ADEM has determined that the existing CWIS represents the interim BTA (40 CFR 125.98(b)(5)) to minimize adverse environmental impacts in accordance with Section 316(b) of the CWA (33 U.S.C. 1326). BFN is required to operate and maintain the CWIS in a manner that minimizes entrainment and impingement.

On January 28, 2022, TVA submitted to ADEM the aforementioned 316(b) studies, along with other information required at § 122.21(r). The purpose of these submittals was to provide the pertinent information to assist ADEM in making a final BTA determination for entrainment under the CWA Section 316(b) Rule. Once BFN receives this final determination in the subsequent NPDES permit, it is then required to select one of seven compliance methods for impingement mortality at § 125.94(c) and submit to ADEM the method and schedule for implementation. If the final determination is that BFN’s existing technology is BTA for entrainment, BFN's method of impingement compliance will be to operate modified traveling water screens with a fish return system. In selecting this method, BFN will also be required to undertake a 2-year Impingement Technology Performance Optimization Study (optimization study) after implementation, the purpose of which is to optimize performance of the system. The results of the optimization study will be used by ADEM to develop permit conditions that will ensure optimal performance of the traveling water screens and fish return system. The long-term data collected by TVA on the aquatic community of Wheeler Reservoir indicates that the communities downstream and upstream of BFN are similar based on RFAI scores. When compared to the 2000 to 2019 averages, the 2020 RFAI data indicate similarity or improvement in all 12 metrics. The RFAI index incorporates elements used in Section 316 for defining a balanced indigenous community, 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. Also, the repetitive sampling and scoring across many years provides a measure of sustainability and trends (TVA 2021e). No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would impact impingement and entrainment of aquatic organisms, and no new and significant information was identified regarding this issue. Based on long-term data from the period of operation of BFN, TVA concludes that the impacts of impingement and entrainment during the proposed subsequent period of extended operation would be small and would require no mitigation measures beyond those already in place.

Thermal Impacts

The BFN cooling water discharge would continue to be operated in compliance with the thermal limitations of the BFN NPDES permit. The discharge is not expected to affect the overall stability of aquatic populations or resources of Wheeler Reservoir. Thermal impacts on aquatic organisms that potentially can result from the operation of nuclear power plant cooling systems include cold shock and thermal barriers to fish migration.

Cold shock can occur when aquatic organisms that have become acclimated to the elevated temperatures of a thermal plume are abruptly exposed to decreased water temperatures when the artificial heat source stops. These effects are most likely to occur in winter. Cold shock events have only rarely occurred at nuclear plants, usually only a few fish were killed, and population-level effects did not result. Gradual shutdown of plant operations generally prevents cold shock events (NRC 2013).

At BFN, routine shutdowns (outages) of each reactor unit occur every other year for refueling, but only one unit is refueled at a time, and the shutdowns typically are scheduled to occur in spring or fall, which are seasons when cold shock is not a concern. Based on operational records for BFN, unplanned, rapid shutdowns also occur occasionally but are expected to be rare, and the occurrence of such an event during a cold period in winter is likely to be even more rare. Cold shock to threadfin shad, which are very sensitive to cold temperatures, has occurred in Wheeler Reservoir in the vicinity of BFN. However, these occurrences have been attributed to natural factors not associated with BFN, such as rapid drops in water temperature due to winter cold fronts. As discussed in Sections 3.6.2 and 4.6.2.1, TVA annual monitoring shows that there is a balanced indigenous aquatic community in the immediate vicinity of BFN, and populations of shad or other fish have not been impacted by cold shock. Thus, continued compliance with the thermal limitations of the BFN NPDES permit, and the practice of gradual shutdowns whenever possible are expected to prevent or minimize occurrences of cold shock events associated with the BFN discharge during the proposed subsequent period of extended operation.

Thermal plumes can create a barrier to fish migration if the mixing zone covers an extensive cross-sectional area of a water body and the plume temperature exceeds levels avoided by fish. However, substantial effects on fish passage from such a scenario have not been reported and would not be expected to occur at BFN given the limited area of the thermal plume compared to the width of Wheeler Reservoir.

No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would impact the thermal discharge, and no new and significant information was identified regarding this issue. Therefore, TVA finds that the thermal impacts of BFN on aquatic resources during the proposed subsequent period of extended operation would be small, and no additional mitigation would be needed.

Radiological Impacts

The 2021 Radiological Environmental Monitoring Program (REMP) compared the radioactive material content in environmental samples to control stations samples (USCB 2020b). There was no identified increase in Cs-137 levels attributed to BFN operation. The concentrations detected were typical of the levels expected to be present in the environment from past nuclear weapons testing and accidents such as fallout from the Chernobyl and Fukushima nuclear plants. Cs-137 was detected in one shoreline sediment sample at a level similar to other low-level detections during previous past monitoring; thus, it is not indicative of a new or ongoing release from BFN. Tritium was not detected in any surface water or sediment samples. No fission or activation products were detected in any of the environmental monitoring samples. No fission or activation products were detected in any of the game fish samples. Only naturally-occurring radioactivity was identified in fish and surface water samples as well as in air particulate samples. The TVA corrective action program database for the period from January 1, 2016, to July 8, 2021, which includes game and commercial fish, showed no condition reports related to exposure to radionuclides.

Measured levels of radioactivity in environmental samples were typical of expected background levels. There was no identified increase in exposure of aquatic organisms to radionuclides attributable to BFN operation from ingestion of fish or exposure to sediment. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would impact the exposure of aquatic organisms to radionuclides and no new and significant information was identified regarding this issue. Therefore, TVA concludes that the impact of radionuclides on aquatic organisms during the proposed subsequent period of extended operation would be small, and further mitigation would not be warranted.

Dredging Impacts

In the 2013 Generic Environmental Impact Statement (GEIS), the NRC expects that dredging at nuclear power plants would be infrequent and of relatively short duration and would affect relatively small areas. Dredging is regulated under permit from the USACE, and the NRC considers compliance with permits to be sufficient to mitigate potential impacts.

The BFN intake channel must occasionally be dredged for maintenance purposes to return the intake channel to design specifications. The intake channel has been dredged only once (in 2018), which was the first time in the 46-year operating history of BFN. TVA evaluates routine maintenance impacts using a National Environmental Policy Act (NEPA) categorical exclusion checklist. Generally, the dredged material would be dewatered using flocculent either in Geo Tubes at a location onsite or in a barge, with filtrate water being returned either to the cold water channel or directly to the river. The dewatered solids would either be deposited at an onsite spoils area or shipped offsite. Maintenance dredging is performed under USACE Mobile District General Permit ALGP-02 (TVA 2018b).

The 2017 and 2018 categorical exclusion checklist for the intake channel dredging did not indicate the need for permitting for aquatic resources or the need for mitigation commitments (TVA 2017a, TVA 2018b). No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would affect aquatic resources with respect to dredging, and no new and significant information was identified regarding this issue. Therefore, TVA concludes that the impact of dredging on aquatic organisms during the proposed subsequent period of extended operation would be small, and further mitigation would not be warranted.

Water Use Impacts

Consumptive water use at BFN includes evaporation through the power generation and cooling systems, including evaporation and drift from the helper cooling towers when the helper cooling towers are in operation, and evaporation of water withdrawn from Wheeler Reservoir due to the thermal loading from water discharged from the facility. This consumptive water use represents a small percentage of the average annual flow in Wheeler Reservoir. During the 7-year period from 2016 through 2022, BFN withdrew cooling water from Wheeler Reservoir at an average annual rate of approximately 3,160 MGD, with average losses due to evaporation and drift of approximately6.73 MGD, or 0.21 percent of the total withdrawal. Thus, most of the water withdrawn at the plant intake (almost 99.8 percent) was returned to the reservoir. The water source at BFN for systems other than the cooling water system is municipal supply, i.e., domestic water and treated surface water are used for process water. Even when helper cooling towers are in operation, BFN operates in a once-through open cycle, returning nearly all of the water withdrawn back to the river. Water is not withdrawn from the river specifically for helper cooling tower makeup water, and the flow rate at the intake does not change due to helper cooling tower operation.

The water resources of Wheeler Reservoir are managed per the TVA *Reservoir Operations Plan*, in consultation with the U.S. Fish and Wildlife Service (USFWS) and USACE (TVA 2004). TVA controls releases from the upstream and downstream dams (Guntersville Dam and Wheeler Dam, respectively), to maintain required minimum flow in Wheeler Reservoir to meet specific system requirements for navigation, aquatic habitats, water quality, water supply, and waste assimilation (TVA 2004). Given that BFN consumptive water use averages only about 0.5 percent of the total withdrawal from the reservoir and that TVA controls these dam releases, neither water availability nor competing water demands in Wheeler Reservoir are adversely affected by BFN operation. Even in low-flow conditions, impacts on the aquatic community would be minimal, if discernible, because of the controls placed on water elevation in Wheeler Reservoir. The aquatic community has adapted to the normally fluctuating water levels and flow conditions of the reservoir. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would affect surface water use conflicts, and no new and significant information was identified. Therefore, TVA finds that impacts of BFN operation on surface water use and related impacts on aquatic resources during the proposed subsequent period of extended operation would be small, and further mitigation would not be warranted.

Conclusion – Aquatic Ecological Resources
Effects of BFN operation on aquatic ecological resources during the proposed subsequent period of extended operation would be small. Current 316(b) data support this conclusion. A viable and balanced aquatic community is present in the vicinity of BFN. Impacts to aquatic biota associated with the intake and discharge of cooling water and non-cooling water are minor and are not expected to adversely affect the balanced, indigenous, aquatic populations that currently exist in the vicinity of BFN. Mitigation measures other than those already in place would not be required. The incremental contribution of BFN operations during the proposed subsequent period of extended operation to cumulative impacts on aquatic ecological resources in the vicinity of BFN also would be small.

3.8. Terrestrial Ecology

This section characterizes existing terrestrial plants and wildlife as well as invasive species onsite and in the general vicinity of BFN, and it assesses potential impacts that may result from the implementation of the No Action and Action Alternatives.

3.8.1. Affected Environment – Terrestrial Ecology

According to the USEPA, BFN is located in the Interior Plateau ecoregion (Griffith et al. 2001). This ecoregion is dominated by oak-hickory and mesophytic forests. The historic bottomland hardwood forests common to the Interior Plateau have been mostly inundated by the impounded waters of the Tennessee River (Wheeler Reservoir) and other natural streams that cross the region. Wetlands in this ecoregion are most commonly associated with the floodplains of these streams and river systems; although springs and seepage wetlands occur as well. The Interior Plateau ecoregion has soils that are rich, deep, and intensively used for agriculture. The area surrounding BFN includes multiple fields that are used for row crop production. The BFN property includes approximately 2.5 miles of Wheeler Reservoir shoreline.

3.8.1.1. Plants

Fragments of forest remain scattered across the BFN site. Forest fragments are mixed deciduous-evergreen or deciduous. Herbaceous areas are primarily mowed grass with a small amount of more variable vegetation on a wet section of ROW.

TVA conducted a vegetation survey in forested areas of the BFN property over two days in April 2023. No uncommon plant communities or rare plant species were found on the BFN property. The forested survey areas were categorized as three zones (Figure 3.8-1). Zone 1 was a southeastern forest area in the southeast portion of the BFN property. It is adjacent to the shoreline of the river and covers 12.5 acres. Over 20 distinct woody plant species, and very few nonnative species, were observed in this area. Species present include willow oak (*Quercus phellos)*, black oak (*Quercus velutina)*, cherrybark oak (*Quercus pagoda*), Carolina buckthorn (*Frangula caroliniana)*, bitternut hickory (*Carya cordiformis)*, tulip poplar (*Liriodendron tulipifera)*, and yellow buckeye (*Aesculus flava)*. Herbaceous species present in the understory include seven true sedges (genus *Carex*) and three fern species.

Zone 2 includes 36.5 acres of forest with vegetation diversity similar to that in Zone 1, but with an increase in nonnative plants. Multiflora rose (*Rosa multiflora)*, Chinese privet (*Ligustrum* *sinense)*, Virginia pine (*Pinus virginiana)*, broomsedge (*Andropogon virginicus)*, poison ivy (*Toxicodendron radicans)*, and Japanese honeysuckle (*Lonicera japonica)* were more prevalent than in Zone 1, and the forest structure was much more condensed, providing less habitat for some of the herbaceous ground cover species found in Zone 1.

Zone 3 includes two other woody areas covering a total of 47.8 acres. There was a marked drop off in vegetation quality within this zone. The dominant species in these areas include Bradford pear (*Pyrus calleryana)*, black locust (*Robinia pseudoacacia)*, Japanese honeysuckle, poison ivy, trumpet vine (*Campsis radicans)*, and Virginia creeper (*Parthenium quinquefolia)*. Overall, these Zone 3 areas were the densest and had the lowest overall species diversity among the forested areas surveyed at BFN.

Figure 3.8-1. Forest Zones Surveyed at the BFN Site

The riparian zone along the shoreline near the nuclear facility and helper cooling towers is stabilized with riprap and vegetated mainly by scattered plants such as black willow (*Salix nigra*), hackberry (*Celtis occidentalis*), sumac (*Rhus* spp.), privet (*Ligustrum* spp.), Japanese honeysuckle (*Lonicera japonica*), and trumpet creeper (*Campsis radicans*). There are no uncommon or unusual plant communities on the property. To the northeast of BFN, the area is dominated by regularly maintained grassy areas as well as fields used for agricultural production of row crops.

The BFN site was and continues to be a highly altered and managed environment. With the construction and development of the facility, the introduction of non-native and potentially invasive species has occurred. Native plant communities have been converted to and are maintained as herbaceous, field habitats on much of the site. Among the non-native plant species likely to be present in these disturbed habitats are Chinese lespedeza (*Lespedeza cuneata*), Japanese honeysuckle, and multiflora rose (*Rosa multiflora*).

3.8.1.2. Wildlife

Mowed grass fields, which cover most of the undeveloped BFN property, generally offer limited habitat for wildlife species. Small, fragmented, forest areas such as those on the BFN property also are less likely to provide habitat for rare species than larger, interconnected forests. As most areas on BFN have been previously disturbed and provide limited wildlife habitat, the terrestrial wildlife species found at BFN are common and have widespread distributions. No uncommon wildlife communities or important terrestrial habitats are known to occur within or immediately adjacent to BFN.

Developed areas and areas otherwise previously disturbed by human activity, including the large areas of mowed fields, provide habitat that may be used by a number of common wildlife species, including the American robin (*Turdus migratorius*), American crow (*Corvus brachyrhynchos*), Canada goose (*Branta canadensis*), Carolina chickadee (*Poecile carolinensis*), European starling (*Sturnus vulgaris*), house finch (*Haemorhous mexicanus*), house sparrow (*Passer domesticus*), mourning dove (*Zenaida macroura*), Carolina wren (*Thryothorus ludovicianus*), northern cardinal (*Cardinalis cardinalis),* northern mockingbird (*Mimus polyglottos*), black vulture (*Coragyps atratus*), and turkey vulture (*Cathartes aura*) (National Geographic 2002). During a field survey, a colony of cliff swallow nests was observed around the outside of the reactor building. Mammals found in the disturbed community include the eastern gray squirrel (*Sciurus carolinensis*), striped skunk (*Mephitis mephitis*), and raccoon (*Procyon lotor*) (Whitaker 1996). Road-side ditches provide potential habitat for amphibians such as the American toad (*Anaxyrus americanus*) and upland chorus frog (*Pseudacris feriarum*). Reptiles potentially present include the eastern black kingsnake (*Lampropeltis getula nigra*) and gray rat snake (*Elaphe obsoleta*) (Gibbons and Dorcas 2005, Powell et al. 2016). Emergent wetlands and saturated wet weather conveyances within field settings provide habitat for common amphibians. Amphibians likely to be present include the American bullfrog (*Lithobates catesbeianus*), American toad, southern leopard frog (*Lithobates sphenocephallus*), spring peeper (*Pseudacris crucifer*), and upland chorus frog (Powell et al. 2016).

Forest fragments on BFN property may provide habitat for common birds such as the American robin, barred owl (*Strix varia*), blue-gray gnatcatcher (*Polioptila caerulea caerulea*), blue jay (*Cyanocitta cristata*)*,* brown thrasher (*Taxostoma rufum*), Carolina wren, common yellowthroat (*Geothlypis trichas*), eastern bluebird (*Sialia sialis*), eastern phoebe (*Sayornis phoebe*), eastern towhee (*Pipilo erythrophthalmus*), eastern wood peewee (*Contopus virens*), gray catbird (*Dumetella carolinensis*), northern cardinal, northern flicker (*Colaptes auratus*), red-bellied woodpecker (*Melanerpes carolinus*), red-eyed vireo (*Vireo olivaceus*), red-shouldered hawk (*Buteo lineatus*), ruby-throated hummingbird (*Archilochus colubris*), scarlet tanager (*Piranga olivacea*), summer tanager (*Piranga rubra*), white-eyed vireo (*Vireo griseus*), and yellow-breasted chat (*Icteria virens*). Mammals likely to occur in these fragments include the nine-banded armadillo (*Dasypus novemcinctus*), raccoon, eastern chipmunk (*Tamias striatus*), eastern gray squirrel, Virginia opossum (*Didelphis virginiana*), and white-tailed deer (*Odocoileus virginianus*). Amphibians and reptiles likely to occur here include the eastern box turtle (*Terrapene carolina*), Fowler’s toad (*Anaxyrus fowleri*), gray treefrog (*Dryophytes versicolor*), and gray rat snake.

Constructed channels around the cooling units and riparian areas along Wheeler Reservoir provide habitat for wading birds and waterfowl. Species observed in this area include the American black duck (*Anas rubripes*), Canada goose, great blue heron (*Ardea herodias*), double-crested cormorant (*Phalacrocorax auratus*), and mallard (*Anas platyrhynchos*).

3.8.2. Environmental Consequences – Terrestrial Ecology

This section addresses impacts to terrestrial ecology from the No Action and Action Alternatives.

Alternative A – No Action Alternative

Closure of BFN would eliminate the effects on terrestrial ecological resources from current operation. After shutdown, the elimination of operational effects generally would be expected to be small and beneficial for terrestrial resources at BFN.

However, TVA would need to replace the 3,900 MWe of BFN generation. A replacement generation facility constructed at an alternate greenfield site would result in potentially large land-use impacts. If a brownfield site is selected, potential impacts would be similar; however, the impacts would be smaller, or less intense. In addition to the acreage required for the facility itself, land may also be needed to support water lines and the potential construction of a railroad spur or barge dock to transport equipment during construction and operation. In addition, new transmission lines, pipelines, and other associated ROWs would be required as part of this alternative. A generation facility would integrate into TVAs existing transmission line system with the construction of new transmission lines from the plant site to the power grid system.

Direct impacts would likely occur to terrestrial plants and wildlife as a result of clearing and construction operations. These impacts could affect important terrestrial habitats such as:

- Adjacent shorelines of open waters: ponds, lakes, and large bodies of water.
- Forests: hardwood, pine-hardwood, mixed hardwood, etc.
- Open fields: fallow fields, old fields, barren land, etc.
- Wetlands: forested, scrub shrub, emergent, etc.
- Riparian areas along streams.
- Native grass fields, pastures, agriculture, etc.

Impacts to terrestrial plants could be greater than impacts to wildlife because many wildlife species have the ability to relocate by their own means. Plant communities in the proposed construction footprint would be cleared to accommodate the new plant site, and wildlife would be displaced. Disturbed areas would be revegetated with native and/or non-invasive flora species to reduce the introduction and spread of exotic invasive plant species associated with ground disturbance and other construction activities. In addition, wildlife species that recolonize the area are expected to be suited for life in and around an industrial/urban environment.

Small indirect impacts would likely occur as a result of this alternative. Wildlife are expected to experience small indirect impacts due to displacement, local habitat loss, and fragmentation. Plant communities would also be expected to experience small indirect impacts due to habitat fragmentation and land-use conversion (e.g., forested and shrub areas converted into grassy areas, landscaped areas, or fields). Over time, these small changes may induce larger changes such as alterations in the pattern of land use in and around the new facility and human population density and growth rates that may affect terrestrial plants and wildlife and their habitats.

This alternative could result in small cumulative impacts to terrestrial plants and wildlife because of the potential collective habitat loss, habitat fragmentation, and decreased biological diversity. Construction of a new generation facility at an undetermined location along with associated transmission lines in the Tennessee Valley could result in small cumulative impacts to terrestrial vegetation and wildlife when combined with all of the past, present, and future construction in the region.

Potential effects would be evaluated in separate analyses once new generation construction project locations and technologies are specifically identified. Impacts on terrestrial resources from construction and operation of these new sources of energy likely would be small to moderate.

Alternative B – Proposed Action

Under Alternative B, the Proposed Action, current operational activities at BFN would continue on the existing site.

No refurbishment or changes to plant operational activities or in-scope transmission lines that would change effects on terrestrial resources would be expected to occur during the proposed subsequent period of extended operation. Wildlife and plant species on the developed parts of the BFN property are common species adapted to industrial sites and able to tolerate industrial noise and human activity. Any future activities that could impact the nesting colony of cliff swallows beyond their demonstrated level of tolerance would require coordination with state or federal agencies as appropriate. The characteristics of terrestrial communities on less intensively developed parts of the property have been influenced by years of BFN operations and maintenance activities occurring in close proximity.

No known sensitive terrestrial habitats currently exist within the BFN property boundaries, and operations and maintenance activities during the proposed subsequent period of extended operation would be expected to be similar to current activities. Furthermore, as a federal agency, TVA is subject to the requirements of federal laws and regulations, including NEPA and the Endangered Species Act (ESA), CWA, and Clean Air Act (CAA). Thus, environmental reviews under these and other regulations are carried out for all TVA actions in consultation and/or cooperation with other federal agencies. Pursuant to this process, applicable environmental requirements are identified for each proposed activity, and mitigation measures are considered. As a result, current operations and maintenance have had small impacts on terrestrial resources. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would alter impacts on terrestrial resources, and no new and significant information was identified. TVA concludes that continued operations and maintenance activities during the proposed subsequent period of extended operation would have small impacts on terrestrial resources and warrant no additional mitigation measures.

The 2021 REMP compared the radioactive material content in environmental monitoring samples to that in control station samples (USCB 2020b). Measured levels of radioactivity in the environmental samples at BFN were similar to expected background levels. There was no identified increase in exposure of terrestrial organisms to radionuclides from ingestion of plants or fish attributable to BFN operations. Doses to terrestrial organisms from continued operations and refurbishment associated with SLR are expected to be well below exposure guidelines developed to protect these organisms. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would impact terrestrial plants and animals, and no new and significant information was identified regarding this issue.

The helper cooling towers at BFN are normally operated only for a short period of time, mostly during the months of July and August, so fogging and icing have not been concerns. Because the helper cooling towers operate with fresh water, no salt deposition has been observed. Further, there have been no problems or complaints resulting from helper cooling tower operation. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would alter impacts on vegetation from the helper cooling towers, and no new and significant information was identified regarding this issue. TVA finds that the impacts on vegetation from helper cooling tower operation at BFN would be small.

Bird populations potentially could be impacted by collisions with structures at BFN. TVA currently complies with EO 13186: Responsibilities of Federal Agencies to Protect Migratory Birds, in accordance with the Migratory Bird Treaty Act (MBTA). Additionally, TVA is developing a memorandum of agreement with the USFWS that will include an Avian Protection Plan. The memorandum of agreement and Avian Protection Plan will be applicable TVA-wide, including at BFN. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would impact the potential for bird collisions with plant structures and transmission lines, and no new and significant information was identified regarding this issue.

The in-scope transmission lines are entirely within the BFN site. These lines run from the main transformers to the 500 kV and 161 kV switchyards located on the BFN site (Figure 1.2-4). There are no associated ROWs to be maintained onsite, and no refurbishment or other changes to plant structures or transmission lines are planned during the proposed subsequent period of extended operation. Most areas on the BFN site have been previously disturbed and provide limited terrestrial resources and negligible potential for exposure of biota to electric and magnetic fields in the vicinity of the in-scope transmission lines.

In conclusion, the impacts of BFN operation on terrestrial ecological resources during the proposed subsequent period of extended operation would be small. The evaluations above support this conclusion. Mitigation measures other than those already in place would not be required. The incremental contribution of BFN operations during the proposed subsequent period of extended operation to cumulative impacts on terrestrial ecological resources in the vicinity of BFN also would be small.

3.9. Endangered and Threatened Species

This section addresses species that have a status of endangered or threatened, or another special status, that provides them legal protection based on the following federal or state legislation:

Endangered Species Act (ESA) (16 U.S.C. 1531-1544, as amended): Section 7 of the federal ESA requires federal agencies to consider the effects of their actions on federally listed species and designated critical habitat, and to take steps to conserve and protect these species and habitats. The requirements of ESA Section 7 are administered by the USFWS, which principally has jurisdiction over terrestrial and freshwater aquatic species (as well as sea turtles when nesting onshore), and by National Oceanic and Atmospheric Administration (NOAA) Fisheries, which principally has jurisdiction over marine species (including sea turtles when in water).

Alabama Administrative Code, Alabama Department of Conservation and Natural Resources, Chapter 220-2-.92, Protected Nongame Species: This regulation makes it unlawful to take, capture, or kill any of the nongame wildlife species identified in the regulation, which include fish, amphibians, reptiles, birds, and mammals.

Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. Parts 668-668c): Although delisted under the federal ESA in 2007, the bald eagle (*Haliaeetus leucocephalus*) remains protected under the federal BGEPA. The BGEPA prohibits anyone, without a permit issued by the Secretary of the Interior, from “taking” bald eagles, which includes molesting or disturbing the birds or their nests or eggs.

Migratory Bird Treaty Act (MBTA): The federal MBTA makes illegal the killing, injury, or other taking of birds and their nests or eggs. It applies to essentially all native bird species that occur in the region, with the exception of certain non-migratory game birds that are managed by the states (e.g., quail, turkey, and grouse). Birds of conservation concern (BCC) are a subset of migratory birds identified by USFWS.

This section identifies species with a federal or state protected status and the potential to occur in the vicinity of BFN, and it evaluates potential impacts on those species from the alternatives.

3.9.1. Affected Environment – Endangered and Threatened Species

3.9.1.1. Terrestrial Species

Terrestrial species are considered to include those that are not obligately aquatic (i.e., breathe air rather than water). Their habitats may include uplands, wetlands, and water bodies.

Federal Status Species

Review of the TVA Natural Heritage Project Database indicated that one federal listed terrestrial animal species (gray bat) and one federal protected species (bald eagle) have reported occurrences within 3 miles of the BFN site in Limestone County, Alabama (TVA 2022i). In addition, based on the IPaC database query (USFWS 2022a), the USFWS has determined that the federal status Indiana bat, northern long-eared bat, tricolored bat, and monarch butterfly have the potential to occur in the vicinity of the BFN site (Table 3.9-1). No federal listed plant species have recorded occurrences within 5 miles of the BFN site, and critical habitat has not been designated for any federal listed species in the project vicinity (USFWS 2022a).

Table 3.9-1. Federal and State Status Terrestrial Animal Species with the Potential to Occur or Documented within 3 miles of the BFN Site

Common Name	Scientific Name	Federal Status[3]	State Status[3] (State Rank)[4]
Mammals			
Gray bat[2,5]	*Myotis grisescens*	E	SP(S2)
Indiana bat[2]	*Myotis sodalis*	E	SP(S2)
Northern long-eared bat[2]	*Myotis septentrionalis*	E	SP(S2)
Tricolored bat	*Perimyotis subflavus*	PE	--
Invertebrates			
Monarch butterfly[2,6]	*Danaus plexippus*	C	--

Common Name	Scientific Name	Federal Status[3]	State Status[3] (State Rank)[4]
Birds			
Bald eagle[5]	*Haliaeetus leucocephalus*	DM	SP(S4B)
Osprey[1]	*Pandion haliaetus*	--	SP(S4)

[1] Source: TVA Regional Natural Heritage Database, extracted Feb. 2022 (TVA 2022i) – 3-mile buffer query
[2] USFWS Information for Planning and Consultation (IPaC) query (USFWS 2022a)
[3] Status Codes: E = Endangered; PE = Proposed Endangered; C = Candidate species for federal listing; DM = Delisted, recovered, and still being monitored; SP = State Protected.
[4] Alabama Natural Heritage Program State Ranks: S2 = Imperiled; S4 = Apparently Secure; S#B = Rank of breeding population.
[5] Species known from Limestone County, Alabama but not within 3 miles of the BFN site.
[6] Historically this species has not been tracked by natural heritage databases.

Gray bats roost in caves year-round and migrate between summer and winter roosts during spring and fall (Brady et al. 1982, TVA 2019c). Bats disperse over bodies of water at dusk where they forage for insects emerging from the surface of the water (Tuttle 1976). Two hibernacula for the gray bat are known in Limestone County, the closest of which is approximately 8.7 miles away. No caves are known within 3 miles of BFN. No mines or other gray bat roosting habitat on BFN property are known. Foraging habitat and sources of drinking water exist over streams, channels and wetlands on BFN property and over Wheeler Reservoir.

Indiana bats hibernate in caves in winter and use areas around them for swarming (mating) in the fall and staging in the spring, prior to migration back to summer habitat. During the summer, Indiana bats roost under the exfoliating bark of dead snags and living trees in mature forests with an open understory and a nearby source of water (Kurta et al. 2002, Pruitt and TeWinkel 2007). Indiana bats are known to change roost trees frequently throughout the season, while still maintaining site fidelity, returning to the same summer roosting areas in subsequent years (Pruitt and TeWinkel 2007). No caves are known within 3 miles of BFN, and no records of Indiana bats are known from Limestone County. The closest known record of this species is a historical record from 9.4 miles away in Lauderdale County.

The northern long-eared bat predominantly overwinters in large hibernacula such as caves, abandoned mines, and cave-like structures. During the fall and spring, they utilize entrances of caves and the surrounding forested areas for swarming and staging. In the summer, northern long-eared bats roost individually or in colonies beneath exfoliating bark or in crevices of both live and dead trees (typically greater than 3 inches in diameter). Roost selection by northern long-eared bat is similar to that of the Indiana bat; however, northern long-eared bats are thought to be more opportunistic in roost site selection. This species also roosts in abandoned buildings and under bridges. Northern long-eared bats emerge at dusk to forage below the canopy of mature forests on hillsides and near roads, and occasionally over forest clearings and along riparian areas (USFWS 2014). No caves are known within 3 miles of BFN. The closest known record of the northern long-eared bat is from 25.6 miles away in Bankhead National Forest.

The tricolored bat was proposed for listing as endangered under the ESA in September 2022 (87 FR 56373; September 14, 2022). Designating critical habitat for this species is not prudent according to USFWS. These bats hibernate in caves, mines, and rock crevices during winter. Tricolored bats in Alabama are often found roosting in road culverts and will forage on warm, winter nights. During spring, summer, and fall, the tricolored bat utilizes forested habitats, where it roosts in live or recently dead deciduous trees, primarily among leaves, and occasionally in human structures. It forages around forest edges and over waterways. This species is known or believed to occur in Limestone County, Alabama (Outdoor Alabama 2022b, USFWS 2022b).

No suitable winter roosting structures for the Indiana bat, northern long-eared bat, or tricolored bat exist on the BFN property. Review of the TVA Regional Natural Heritage Program database in February 2022 indicated that no caves exist within 3 miles of BFN. Thus, there are no suitable hibernacula for bats near BFN. Moderately suitable summer roosting habitat occurs in some scattered forest fragments across the BFN property. The least disturbed forest remains along the shoreline in the southeastern corner of the property. Based on aerial photos, it appears most other forested areas are regrowth after being cleared sometime before 1998. Remaining suitable habitat fragments consist of mature forests and/or areas with trees that have suitable cracks and crevices. Suitable foraging habitat includes the forest and forest edges as well as wetlands and water bodies, including the adjacent Wheeler Reservoir. Surveys performed using the 2020-2021 USFWS Indiana Bat Survey Guidelines identified 111 acres of forest fragments scattered across the BFN property that may offer potential habitat for summer roosting by the Indiana bat, northern long-eared bat, or tricolored bat. The monarch butterfly is a candidate for listing under the ESA. It is a highly migratory species, with eastern United States populations overwintering in Mexico. Monarch populations typically return to the eastern United States in April (Davis and Howard 2005). Summer breeding habitat requires milkweed plant species, on which adults exclusively lay eggs for larvae to develop and feed on. Adults will drink nectar from other blooming wildflowers when milkweeds are not in bloom (Alabama Public Health 2022). The early successional fields within the BFN property include several species of wildflowers and other flowering plants that provide suitable foraging habitat for adult monarchs. The overwhelming majority of areas with herbaceous vegetation on the BFN property are mowed grass fields. It is possible that small patches of flowering herbaceous plants may persist on the edges of fields where mowing has been infrequent, though none were documented.

The bald eagle formerly was federally listed under the ESA but has been de-listed by USFWS as it is now considered recovered. However, it remains protected under the BGEPA. The bald eagle is associated with larger, mature trees capable of supporting its massive nests. Nests are usually found near larger waterways where the eagles forage (USFWS 2007). Three bald eagle nests are known from Limestone County, the closest of which is 5.4 miles away. Wheeler Reservoir provides foraging habitat for the bald eagle. Suitable nesting trees occur throughout the forest fragment along Wheeler Reservoir in the southeastern corner of BFN; however, no bald eagle nests have been documented on the BFN site.

Most bird species in the BFN area are protected by the MBTA. (federal and state listed birds, and the bald eagle, are also protected under the MBTA.) The MBTA is the primary legislation in the United States established to conserve migratory birds. The MBTA prohibits the intentional taking, killing, or possessing of migratory birds unless permitted by regulation. EO 13186 (66 FR 3853–3856), *Responsibilities of Federal Agencies to Protect Birds*, provides a specific framework for federal agencies to comply with their MBTA obligations and aids in incorporating bird conservation planning into agency programs. For the purposes of the MBTA and EO 13186, migratory birds have been defined to include all native birds in the United States, except certain non-migratory game species managed by the states (e.g., quail, turkey, grouse, and ptarmigan). The BFN area includes habitats that are used by a variety of birds protected under the MBTA.

Migratory BCC are species that are of particular concern to USFWS. The Information for Planning and Consultation (IPaC) report for the BFN site contains a list of BCC that potentially could occur in the vicinity (USFWS 2022a). It includes BCC that could occur in the area during breeding season, wintering season, or year-round. The list includes nine BCC that could occur in the area during the breeding season (bobolink, brown-headed nuthatch, chimney swift, field sparrow, Kentucky warbler, prairie warbler, prothonotary warbler, red-headed woodpecker, and wood thrush) and two species that breed elsewhere (lesser yellowlegs and rusty blackbird).

State Status Species

State-protected animal species with recorded occurrences within 3 miles of the BFN site are shown in Table 3.9-1. The three bat species also have federal listing status and are discussed above. The two bird species are the bald eagle and osprey. The bald eagle is not a federal listed species but has federal protection under the BGEPA and is state protected in Alabama. It is discussed above.

The osprey has a status of state protected. In inland areas, the osprey occupies riparian habitats along bodies of water such as rivers, lakes, and reservoirs. It builds nests of sticks on trees or a variety of man-made structures (e.g., power transmission line structures, lighting towers) near water (Alabama Public Health 2022). Two osprey nests were documented on the BFN reservation during field reviews in September 2021. Due to maintenance issues with the cell tower one of the nests was on, it was removed a few weeks after the field surveys. The nest was not active at the time of removal. The remaining nest is on a TVA transmission tower.

The Alabama Natural Heritage Program does not assign a state status to plants but does rank species of conservation concern. The TVA Natural Heritage database does not include recorded occurrences of plants with a state rank within 5 miles of BFN, but it does include from Limestone County eight flowering plants with a state rank of S1 or S2 assigned by the Alabama Natural Heritage Program, as shown in Table 3.9-2 (TVA 2022i). The ranking does not confer legal protection.

Table 3.9-2. Plants with a State Rank of Imperiled and Occurring in Limestone County, Alabama

Common Name	Scientific Name	State Rank[1]
Lake-cress	*Armoracia lacustris*	S1
Waterweed	*Elodea canadensis*	S1
Duck River bladderpod	*Paysonia densipila*	S1
Alabama snow-wreath	*Neviusia alabamensis*	S2
Ragged fringe orchid	*Platanthera lacera*	S2
Mohr's rosin-weed	*Silphium mohrii*	S1
Sessile trillium	*Trillium sessile*	S2
Northern prickly-ash	*Zanthoxylum americanum*	S1

Source: TVA Regional Natural Heritage Database, extracted Feb. 2022 (TVA 2022i) – recorded occurrences within Limestone County

[1] Alabama Natural Heritage Program ranking system:

S1 = Critically imperiled in Alabama because of extreme rarity (5 or fewer occurrences of very few remaining individuals or acres) or because of some factor(s) making it especially vulnerable to extirpation from Alabama.

S2 = Imperiled in Alabama because of rarity (6 to 20 occurrences or few remaining individuals or acres) or because of some factor(s) making it very vulnerable to extirpation from Alabama.

S3 = Rare or uncommon in Alabama (on the order of 21 to 100 occurrences)

3.9.1.2. Aquatic Species with Federal or State Status

Essential fish habitat (EFH) includes waters and substrate that are necessary for spawning, breeding, feeding, or growth to maturity of fish and shellfish that are federally managed species. EFH is identified and described by the National Marine Fisheries Service and regional fishery management councils, in accordance with the Magnuson-Stevens Act (16 U.S.C. 1801 et seq.). According to the National Marine Fisheries Service EFH Mapper, EFH has not been designated within Wheeler Reservoir (NOAA Fisheries 2022).

The hydrologic units that make up the Wheeler Reservoir watershed contain numerous records of federal and state listed species (Table 3.9-3). Numerous records of listed mussel species also occur within a 10-mile radius of BFN (Table 3.9-3). In 1982, 12 mussel species were collected in Wheeler Reservoir in the vicinity of BFN. None of the species had a federal listing status or state protected status (TVA 2021d). In 1999, a survey collected 16 native mussel species in the vicinity of BFN, none of which were federal listed species (TVA 2020b). In July 2021, a mussel survey was conducted by TVA, in conjunction with the Alabama Department of Conservation and Natural Resources, to assess the current assemblage of mussels present in the portion of Wheeler Reservoir immediately adjacent to BFN. In the portion of the reservoir near BFN, the mussel community is composed of 11 common, widespread, silt-tolerant species, and no species of mussels or snails with federal or state status were found (Amaker 2021). Therefore, federal and state listed mussel species are not expected to occur near BFN for the following reasons: they are presumed to be extinct, they are presumed to be extirpated from the region, there are no recent records for the species in the region, there are no collection records for the species from pertinent locations, and/or the area near the BFN site does not contain suitable habitat for the species. Species that are federal or state listed and persist in Wheeler Reservoir occupy more suitable habitat that is located much farther upstream of BFN in the more riverine portion of the Tennessee River downstream from Guntersville Dam.

Table 3.9-3. Federal and State Status Aquatic Animal Species with Documented Occurrences or the Potential to Occur within Wheeler Reservoir

Common Name	Scientific Name	Federal Status[4]	State Status[5]	State Rank[6]
Fish				
Spring pygmy sunfish[1, 2]	*Elassoma alabamae*	T	SP	S1
Slackwater darter[1]	*Etheostoma boschungi*	T	SP	
Tuscumbia darter[1, 2]	*Etheostoma tuscumbia*	--	SP	S2
Snail darter	*Percina tanasi*	--[7]	SP	S1
Paddlefish[2]	*Polyodon spathula*	--	SP	S3
Mussels				
Mucket[1]	*Actinonaias ligamentina*	--	PSM	S2
Spectaclecase[1]	*Cumberlandia monodonta*	E	SP	S1
Dromedary pearlymussel[1, 2]	*Dromus dromas*	E, XN	SP	SX
Cumberlandian combshell[2]	*Epioblasma brevidens*	E, XN	SP	S1
Acornshell[2]	*Epioblasma haysiana*	--	PSM	SX
Tuberculed blossom pearlymussel[1]	*Epioblasma torulosa torulosa*	E	SP	SX
Cracking pearlymussel[2]	*Hemistena lata*	E, XN	SP	S1
Pink mucket[1, 2, 3]	*Lampsilis abrupta*	E	SP	S1
Pocketbook[1]	*Lampsilis ovata*	--	PSM	S2
White heelsplitter[1, 2]	*Lasmigona complanata*	--	PSM	S2
Birdwing pearlymussel[2]	*Lemiox rimosus*	E, XN	SP	S1
Hickorynut[1]	*Obovaria olivaria*	--	PSM	SX

Common Name	Scientific Name	Federal Status[4]	State Status[5]	State Rank[6]
Ring pink[1]	*Obovaria retusa*	E, XN	SP	SH
Orange-foot pimpleback[1]	*Plethobasus cooperianus*	E, XN	SP	SX
Sheepnose[1]	*Plethobasus cyphyus*	E	SP	S1
Ohio pigtoe[1, 2]	*Pleurobema cordatum*	--	PSM	S2
Rough pigtoe[1, 2, 3]	*Pleurobema plenum*	E, XN	SP	S1
Tennessee pigtoe[1]	*Pleuronaia barnesiana*	--	PSM	S1
Pink papershell[1]	*Potamilus ohiensis*	--	PSM	S3
Kidneyshell[1]	*Ptychobranchus fasciolaris*	--	PSM	S2
Fluted kidneyshell[2]	*Ptychobranchus subtentum*	E	SP	SX
Purple lilliput[1]	*Toxolasma lividus*	--	PSM	S2
Painted creekshell[1]	*Villosa taeniata*	--	PSM	S2

[1] Source: TVA Natural Heritage Database (TVA 2022i) – hydrologic unit code query
[2] Source: TVA Natural Heritage Database (TVA 2022i) – 10-mile buffer query
[3] Source: USFWS IPaC query (USFWS 2022a)
[4] Federal Status: E = Endangered; T = Threatened; XN = experimental population, nonessential (experimental reintroduced population)
[5] State Status: SP = State Protected; PSM = Partial Status Mussels
[6] State Rank: S1 = Critically imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently secure; S5 = Secure; SH = Historical (possibly extirpated); SX = Presumed extirpated in Alabama
[7] Source: 87 FR 60298-60313; October 5, 2022 – Removing the Snail Darter From the List of Endangered and Threatened Wildlife

The other group of aquatic animals with federal or state status and recorded occurrences in Wheeler Reservoir and/or within 10 miles of BFN are fish (spring pygmy sunfish, slackwater darter, Tuscumbia darter, and paddlefish). In 21 years (since 1993) of fish entrainment sampling by TVA in the vicinity of BFN, the paddlefish was collected in only 1 year (TVA 2020b). The spring pygmy sunfish, slackwater darter, and Tuscumbia darter were never collected and would not be expected to be present because they do not occur in lacustrine habitat such as that available in this portion of Wheeler Reservoir.

The snail darter was listed as endangered under the ESA in 1975, and its status was later changed to threatened. It was removed from the federal list of endangered and threatened species effective November 4, 2022 (87 FR 60298-60313; October 5, 2022). Although the snail darter has been federally delisted under the ESA, it currently remains a state listed species in Alabama. TVA has monitored for the presence of this species and has found populations in tributaries to the Tennessee River and in Tennessee River reservoirs. TVA sampling in all mainstem Tennessee River reservoirs from 2017 – 2020 found this species in five reservoirs, including Wheeler Reservoir. It is possible that larvae and adults could be present in Wheeler Reservoir near BFN. However, snail darters prefer clean gravel substrates, and this habitat is most common on the opposite side of Wheeler Reservoir from BFN.

3.9.2. Environmental Consequences – Endangered and Threatened Species

This section addresses potential impacts to threatened and endangered species under the No Action Alternative and the Proposed Action Alternative.

Alternative A – No Action Alternative

Closure of BFN would eliminate the effects on threatened and endangered species from operation. After shutdown, the elimination of operational effects generally would be expected to be small and beneficial for threatened and endangered species at or in the vicinity of BFN.

However, TVA would need to replace the 3,900 MWe of BFN generation. A replacement generation facility constructed at an alternate greenfield site would result in potentially large land-use impacts. If a brownfield site is selected, potential impacts would be similar; however, the impacts would be smaller, or less intense. In addition to the acreage required for the facility itself, land may also be needed to support water lines and the potential construction of a railroad spur or barge dock to transport equipment during construction and operation. In addition, new transmission lines, pipelines, and other associated ROWs would be required as part of this alternative. A generation facility would integrate into TVAs existing transmission line system with the construction of new transmission lines from the plant site to the power grid system.

Direct impacts may occur to threatened or endangered species as a result of clearing and construction operations. Impacts could occur to important threatened or endangered species habitats such as:

- Open waters (e.g., ponds, lakes and large bodies of water)
- Forests (e.g., hardwood, pine-hardwood, mixed hardwood, etc.0
- Waters of the US.
    - Wetlands: forested, scrub shrub, emergent, etc.
    - Streams: perennial, intermittent, ephemeral.

Small indirect impacts may occur as a result of this alternative. Over time, the small changes may induce larger changes such as alterations in the pattern of land use in and around the new facility, and human population density and growth rates that could alter threatened or endangered species and their habitats.

Small to large cumulative impacts may also occur to threatened or endangered species as a result of this alternative because of the potential habitat loss, habitat fragmentation, and decreased biological diversity. Construction of a new plant at an undetermined location and associated power lines in the Tennessee Valley could result in cumulative impacts when combined with all of the past, present, and future construction in the region.

Potential effects would be evaluated in separate analyses once new generation construction project locations and technologies are specifically identified. Measures to avoid, minimize, or mitigate potential impacts would be evaluated. TVA would comply with the ESA by engaging in Section 7 consultation as needed and other applicable regulations pertaining to federally listed and state-listed species.

Alternative B – Proposed Action

Under Alternative B, the Proposed Action, current operational activities at BFN would continue on the existing site. In addition, compliance with the ESA requires consultation with appropriate federal agencies to determine whether threatened or endangered species are present and whether they would be adversely affected by the continued operation of BFN, or refurbishment of facilities, during the proposed subsequent period of extended operation. The potential impacts of Alternative B on animal species with federal or state listing status are discussed below for terrestrial species and aquatic species. Plants with federal or state status or rank have not been recorded in the vicinity of BFN and would not be affected.

Terrestrial Species
Section 3.9.1 describes the special status terrestrial species with a potential to occur in the vicinity of the BFN site. Under the proposed action, TVA would continue to operate BFN according to license requirements, and terrestrial habitats would continue to be managed as they are currently. The species with a federal listing status and/or a state protected status and the potential to occur at BFN are the gray bat, Indiana bat, northern long-eared bat, tricolored bat, monarch butterfly, bald eagle, and osprey.

The gray bat roosts in caves year-round and may occur on BFN property and over Wheeler Reservoir only when foraging. Continued operation of BFN during the proposed subsequent period of extended operation would have no effect on the gray bat.

The Indiana bat (ESA listed as endangered), northern long-eared bat (ESA listed as endangered), and tricolored bat (proposed for listing as endangered under the ESA) roost in trees during the summer. If tree removal became necessary on the BFN property, they could be affected though impacts would be minimized if removal occurred in winter. No refurbishment or other changes to plant structures or activities would be associated with the SLR for BFN, and consequently, no tree removal is planned. The SLR for BFN would not impact any winter or summer roosting habitat for Indiana bat, northern long-eared bat, or tricolored bat. Therefore, the proposed action would not affect Indiana bat, northern long-eared bat, or tricolored bat. Should any tree removal become necessary in the future, those proposed actions would undergo an environmental review process to determine if the trees offer potentially suitable summer roosting habitat for the Indiana bat, northern long-eared bat, or tricolored bat. If the trees to be affected are determined to potentially provide suitable habitat, consultation under Section 7 of the ESA would be required. If the proposed activities fall under TVA's programmatic consultation for routine actions that may impact federal listed bats (completed in 2018), actions and appropriate use of take under the ESA would be documented and reported annually to USFWS. If proposed activities during the proposed subsequent period of extended operation fall outside of those covered under the programmatic consultation, a separate Section 7 consultation would be initiated with the USFWS by TVA to address potential adverse effects on listed (or proposed for listing) bat species. With ongoing implementation of these procedures in conjunction with continued operation of BFN during the proposed subsequent period of extended operation, potential effects on listed bat species would not be significant. The monarch butterfly currently is a candidate for listing under the ESA. As such, it is not subject to ESA Section 7 consultation. The eastern monarch population breeds throughout eastern North America where milkweeds (*Asclepias* spp.) occur, including Alabama. Its breeding habitat is mainly prairies, meadows, and weedy fields with milkweeds. It is dependent on milkweeds for breeding habitat because they are the only food source for monarch larvae (caterpillars) (USFWS 2020a). Several species of milkweeds potentially could occur in field and wetland habitats at BFN. A wide variety of flowering plants that provide nectar for migrating monarchs also occur in the area. The SLR for BFN does not require any new construction or modifications beyond normal maintenance and minor refurbishment. Therefore, milkweed and nectar sources if present in these habitats would not be impacted by continued operation of BFN. Migrating adults are likely to transit the action area in the fall, but they are highly mobile and would not be affected by continued operation of BFN during the proposed subsequent period of extended operation. For these reasons, the proposed action would not significantly impact monarch populations, and its effects on the species would be small.

The bald eagle could forage in Wheeler Reservoir, and suitable nesting trees are present in the forest fragment along the reservoir in the southeastern corner of BFN, although no bald eagle nests have been documented on the BFN site. The National Bald Eagle Management

Guidelines require the maintenance of a 660-foot buffer around bald eagle nest sites and coordination with USFWS to determine if mitigation measures are adequate (USFWS 2007). Bald eagle nests if established within this distance of the BFN site would be protected in accordance with the guidelines. With ongoing implementation of these measures in conjunction with continued operation of BFN during the proposed subsequent period of extended operation, potential effects on the bald eagle would be small.

The osprey is a state protected species and one of many native birds that occur in the vicinity of BFN that are protected by the MBTA. To avoid take under the MBTA, BFN grounds management practices would continue during the proposed subsequent period of extended operation, and activities that must occur within 660 feet of migratory bird nests while nests are active would be limited to bush hogs, mowers, and selective herbicides. If other actions cannot be modified to avoid nesting seasons, coordination with U.S. Department of Agriculture (USDA) Wildlife Services would be required for guidance to ensure compliance with the MBTA and EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. With ongoing implementation of these procedures in conjunction with continued operation of BFN during the proposed subsequent period of extended operation, potential effects on the osprey and other migratory birds would be small.

Aquatic Species

Section 3.9.1 describes the special status aquatic species with a potential to occur in the vicinity of the BFN site. The TVA’s Regional Natural Heritage Database (queried February 2022) included current or historical records of 15 aquatic species with a federal listing status within a 10-mile radius of BFN and/or within the hydrologic units of the Wheeler Reservoir watershed (Table 3.6-8). These include 13 mussel species federally listed as endangered and two fish species listed as threatened (spring pygmy sunfish and slackwater darter). These species also have a state protected status. An additional 11 mussel species and two fish species (Tuscumbia darter and paddlefish) identified in the query have only a state protected status. As described in Section 3.9.1, the snail darter has been delisted as a federal threatened species, but it still has state protected status and has recently been found to occur in Wheeler Reservoir. The historical and current data (based on surveys conducted in 1982, 1999, and 2021) indicate that rare mussel species with federal or state status do not occur in the portion of Wheeler Reservoir adjacent to and potentially affected by BFN. Therefore, SLR of the BFN operating license would have no effect on mussel species with federal or state status.

As discussed in Section 3.6.2.4, in 21 years (since 1993) of fish entrainment sampling by TVA in the vicinity of BFN, the paddlefish was collected in only 1 year, and the spring pygmy sunfish, slackwater darter, and Tuscumbia darter were never collected (TVA 2020b). The historical and current data indicate that these fish with federal or state status do not occur in the portion of Wheeler Reservoir adjacent to and potentially affected by BFN, and they would not be expected to be present because they do not occur in lacustrine habitat such as that available in this portion of Wheeler Reservoir (NatureServe Explorer 2022). The snail darter has recently been detected in Wheeler Reservoir. However, the only suitable habitat for this species that may be present in the vicinity of BFN is on the opposite side of Wheeler Reservoir from BFN. The snail darter was never collected in the 21 years of fish entrainment sampling at BFN, so its occurrence there is unlikely. Therefore, SLR of the BFN operating license would have no effect on fish species with federal or state status.

3.10. Managed and Natural Areas

This section describes the managed and natural areas that may be affected by the operation of BFN during the proposed subsequent period of extended operation. The areas were identified as potentially affected if located within 6 miles of BFN (Figure 3.10-1). Natural areas include managed areas such as wildlife management areas (WMAs), national wildlife refuges and habitat protection areas, ecologically significant sites, and nationwide rivers inventory streams. Managed areas include lands held in public ownership that are managed by a governmental entity (e.g., TVA, National Park Service, U.S. Forest Service, state or county government) to protect and maintain certain ecological and/or recreational features, but they may or may not have an onsite staff or developed facilities. Properties held in trust or owned by a management entity are the main criteria for their identification as a natural area or managed area.

3.10.1. Affected Environment – Managed and Natural Areas

These managed and natural areas have been recognized and are protected, to varying degrees, because they contain unique natural resources, scenic values, or public use opportunities. These managed and natural areas within 6 miles of BFN are briefly described below.

Mallard-Fox Creek State WMA

Mallard-Fox Creek WMA is located about 2.5 miles south of BFN on the south shore of Wheeler Reservoir in Lawrence County. This WMA covers 1,483 acres and contains habitat types that include hardwood forests, wildlife openings, grasslands, and agricultural fields. This WMA offers bird watching, hunting, canoeing, and fishing opportunities (Alabama Birding Trails 2021).

Swan Creek State WMA

This WMA is located in Limestone County approximately 5 miles southeast of the BFN site and includes 8,870 acres of land and water. Swan Creek WMA is managed for waterfowl and small game (Alabama Birding Trails 2022). Activities open to the public include hiking, boating, canoeing, fishing, and hunting. This area is a stopover for migrating shorebirds in the fall and passerine birds in both spring and fall.

Wheeler Reservoir Public Land

In 2017, TVA developed a Multiple Reservoir Land Management Plan to guide resource management and administration decisions on land around 46 reservoirs and identify the most suitable uses for the land under TVA's control. Two TVA-managed parcels designated as Zone 6 Developed Recreation, are present with 6 miles of the BFN site. One parcel, the Round Island Creek Recreation Area, is located in Limestone County approximately 4 miles southeast of the BFN site on the south shore of Wheeler Reservoir; it includes the lower portions of the Round Island Creek embayment. Habitats in the area include hardwood forest, patches of planted loblolly pine, and wetlands. This area provides opportunities for fishing, picnicking, and primitive camping. Another parcel immediately west of the Round Island Creek embayment features a mixture of scrub forest, loblolly pine plantation, agricultural fields and wetlands (forested, scrub-shrub, and emergent) with opportunities for fishing, hunting, primitive camping, and wildlife observation (TVA 2017c). A second parcel is located immediately east of the southern portion of the Mallard-Fox Creek WMA in Morgan County approximately 3 miles southeast of the BFN site on the south shore of Wheeler Reservoir (TVA 2017c).

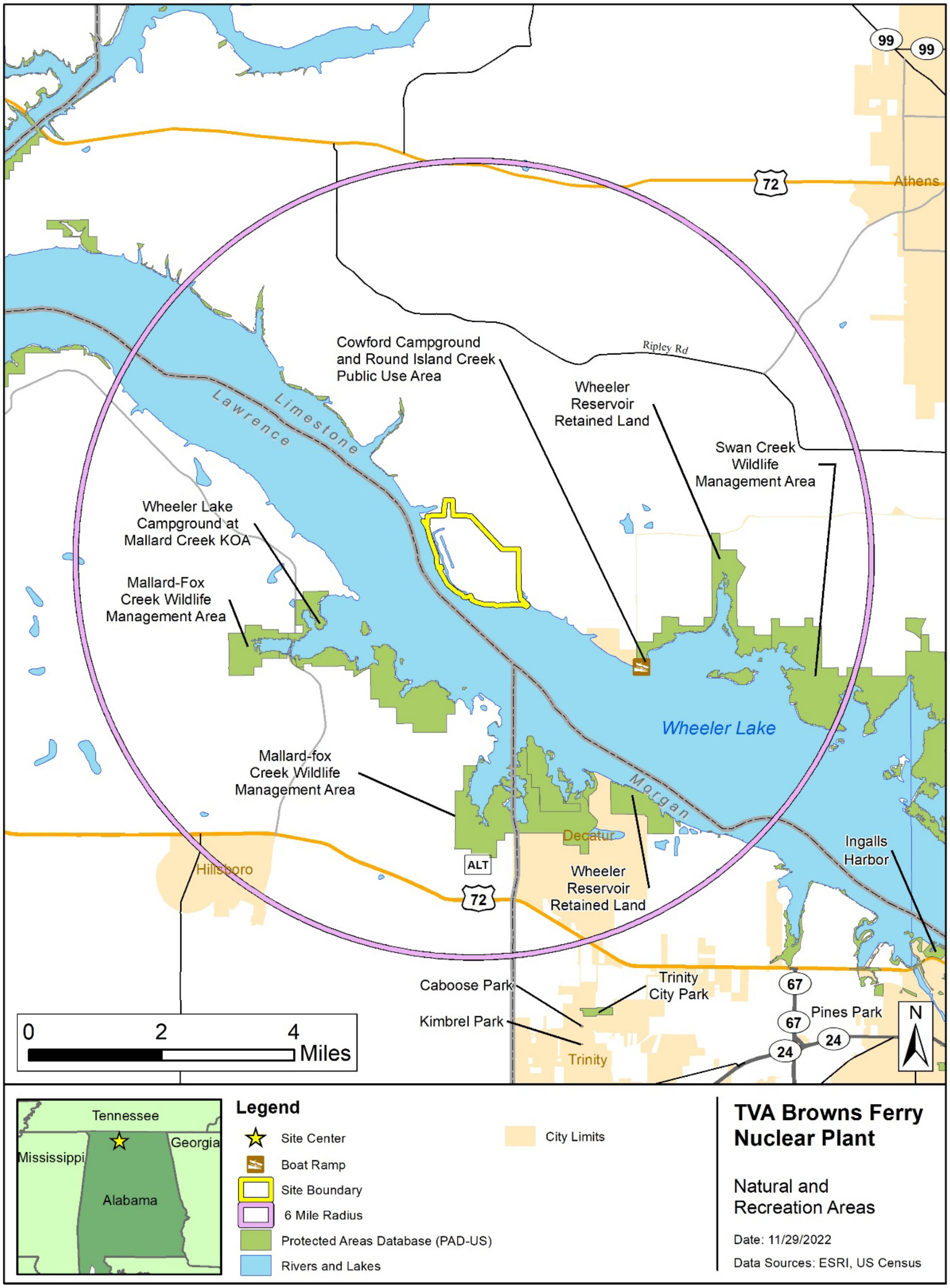


Figure 3.10-1. Managed and Natural Areas Within a 6-Mile Radius of BFN

3.10.2. Environmental Consequences – Managed and Natural Areas

This section addresses impacts to managed and natural areas from the No Action and Proposed Action Alternatives.

Alternative A – No Action Alternative

No impacts to managed and natural areas in the vicinity would be expected under this alternative. Closure of BFN would not directly affect managed and natural areas in the vicinity of BFN. However, TVA would need to replace the 3,900 MWe of BFN generation.

Under this alternative, land on greenfield, brownfield, or existing industrial sites would be improved to construct a generation facilities cumulatively equivalent to BFN. It is unlikely that direct impacts to natural areas would occur because of the importance of these resources to local city and county governments, the individual states, and the federal government. Avoidance planning would likely place any potential new generation plants at a safe distance from most natural areas. Small indirect impacts may occur as a result of this alternative. Some of the new generation options would require water for a cooling source as well as a plant discharge point. These typical power plant functions could potentially affect downstream aquatic natural areas with small changes in water flow, contamination, nutrient loads, etc. Over time, the small changes may induce larger changes such as alterations in the pattern of land use in and around the new facility, the population density, and population growth rates.

Small to large cumulative impacts may also occur to natural areas and any associated threatened or endangered species as a result of this alternative because of potential habitat loss, habitat fragmentation, and decreased biological diversity. Impacts of a new generation facility may occur at a considerable distance from many natural areas; however, the impacts could be compounded by other land improvements and development in the general area between the facility and any natural area. Construction of a new plant at an undetermined location and associated transmission lines in the Tennessee Valley could result in cumulative impacts when combined with all of the past, present, and future construction in the region.

Potential effects would be evaluated in separate analyses once new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

Under Alternative B, the Proposed Action, current activities would continue at the BFN site. No known managed or natural areas are immediately adjacent to the BFN site. The distance between existing managed areas and the BFN site provides ample buffer from any operational noise or other operational effects originating from BFN. The helper cooling tower plumes are temporary, seasonal, intermittent, and do not reach these managed areas. In addition, land-use changes in the vicinity would not occur as a result of this alternative. For these reasons, TVA concludes that the impacts on managed and natural areas during the proposed subsequent period of extended operation would be small and would require no mitigation measures beyond those already in place. Because impacts on these areas would be small, TVA concludes that the minor incremental contribution to cumulative impacts from the continued operation of BFN would also be small.

3.11. Recreation

This section describes recreation resources within the vicinity of BFN on the Wheeler Reservoir and in Limestone, Lawrence, and Morgan Counties. This section also addresses potential effects to recreation resources in association with the No Action Alterative and Proposed Action.

3.11.1. Affected Environment – Recreation

Wheeler Reservoir

TVA provides public lands for developed and dispersed recreational purposes through the reservoir. On Wheeler Reservoir, developed recreation opportunities include campgrounds, lodges, marinas, boat launches/ramps, parks, swimming pools, swimming beaches, fishing piers, and day use facilities. Dispersed recreation activities include picnicking, primitive camping, hiking, bank fishing, hunting, kayaking, and canoeing (TVA 2017c).

Wheeler Reservoir is an outdoor recreation resource attracting visitors from within and outside the region. Twenty-five parcels contain developed recreation areas on Wheeler Reservoir including public parks, commercial recreation operations and semi-private clubs. Many of these recreation areas are located on properties that TVA transferred, leased, or licensed for recreation development and use. Public parks developed on lands made available by TVA include Joe Wheeler State Park, Point Mallard Park, and Round Island Creek Recreation Area. Other public agencies, including the State of Alabama and Limestone County maintain boat-launching ramps at strategic locations on public land around the reservoir. Commercial recreation operations include the Ditto Landing Marina and Jay Landings Marina (TVA 2017c).

Stretching 60 miles from Guntersville Dam to Wheeler Dam, Wheeler Reservoir is home to quality fishing. While bass fishing is the most popular fishery in Wheeler Reservoir, the reservoir also provides excellent fishing opportunities for catfish, bream, crappie, and sauger. Part of the Alabama Bass Trail North Division and home to various bass fishing clubs and tournaments, Wheeler Reservoir provides a variety of fishing environments including stump flats, weed beds, creek channels, and steep banks. The return of the grass and a healthy bass population has produced a rebound in Wheeler Reservoir with largemouth bass, smallmouth bass, and spotted bass making the reservoir one of the best fisheries in Alabama (ABT 2022c). Reported catches for many teams during the Alabama Bass Trail May 2022 tournament ranged from 70 to 100 catches over the one-day event (ABT 2022a, ABT 2022b, ABT 2022c, Outdoor Alabama 2022a, Outdoor Alabama 2021).

Recreation Areas within a 6-mile radius of BFN are presented in Figure 3.10-1 and are discussed below.

Decatur/Wheeler Lake KOA Holiday

The Decatur/Wheeler Lake KOA Holiday is located in Lawrence County adjacent to Mallard-Fox Creek WMA approximately 2.2 miles west of BFN on the southern shore of Wheeler Reservoir. The KOA offers recreational vehicle (RV) and tent camping as well as boat rentals, playground, outdoor movie theater, a zipline and rope park, water activities, and biking (KOA 2021a, KOA 2021b, The Raptor Adventure 2021).

Round Island Recreation Area and Cowford Campground

Approximately 3.5 miles upstream of BFN is Round Island Recreation Area, developed and operated by TVA. It features facilities for camping, swimming, picnicking and boat launching. The reservoir in the vicinity of BFN is moderately utilized by recreational boaters and fishermen. Cowford Campground is located within Round Island Recreation Area. This site has 52 seasonal use campsites meant for RV and tent camping along with a boat ramp and fishing/boat pier (Limestone County 2021a). Cowford Campground is within the Round Island Creek Public use area and offers RV camping, swimming, fishing, and boating (Limestone County 2021a).

3.11.2. Environmental Consequences – Recreation

Alternative A – No Action Alternative

Under the No Action Alternative, cessation of BFN operation would not be anticipated to adversely affect recreational facilities or activities within 6 miles of BFN. Because shutdown of BFN would require construction of new replacement power either at BFN or elsewhere within the TVA system, potential effects to recreational resources could result from construction and operation. Those potential effects would be evaluated in separate analyses once new generation construction project locations and technologies are specifically identified. These separate analyses would investigate potential impacts to any national and state parks, public recreation, cultural and historic areas, and wild and scenic rivers. These locations would be assessed for potential adverse impacts that could result from construction and operation. Typically, these locations are considered avoidance areas; however, if a potential facility were sited near a recreational, scenic, or culturally significant area, then noise, dust, viewshed, and watershed impacts would be analyzed. Impacts could range from small to moderate. Some examples of potential mitigation methods could be the use of water to minimize dust, limiting noisy activities to specific times, and utilizing landscaping and painting techniques to limit viewshed impacts.

Alternative B – Proposed Action

Under Alternative B, the BFN SLR would result in no onsite or offsite changes that could potentially impact area recreation. In addition, no known reasonably foreseeable future actions are anticipated to result in land use or other changes within the 6-mile radius of BFN that would impact these recreation areas. Therefore, no cumulative impacts to recreational areas would be expected.

3.12. Air Quality, Greenhouse Gases, and Climate Change

3.12.1. Affected Environment –Air Quality, Greenhouse Gases, and Climate Change

This section describes the existing air quality, greenhouse gas, and climatic conditions at and in the vicinity of BFN.

3.12.1.1. Air Quality

Air quality condition at a given location can be described by the concentration levels of various pollutants in the atmosphere. Under the CAA, the USEPA has established National Ambient Air Quality Standards (NAAQS) (40 CFR Part 50) that specify maximum concentrations for carbon monoxide, particulate matter with aerodynamic diameters of 10 microns or less (PM_{10}), particulate matter with aerodynamic diameters of 2.5 microns or less ($PM_{2.5}$), ozone, sulfur dioxide, lead, and nitrogen dioxide. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have long-term and short-term standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects.

Areas of the United States that are and have historically been in compliance with the NAAQS are designated by the USEPA as attainment areas. Areas that violate a federal air quality standard are designated by the USEPA as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment. The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called de minimis levels. De minimis levels (in tons per year) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question. However, BFN is located in Limestone County, Alabama, which is an attainment area for all criteria pollutants, and therefore the general conformity rule does not apply.

In addition to the NAAQS for criteria pollutants, national standards exist for hazardous air pollutants (HAPs), which are regulated under Section 112 of the CAA. The *National Emission Standards for Hazardous Air Pollutants* regulate HAP emissions from stationary sources (40 CFR Parts 61 and 63).

The Title V of CAA requires states to administer a comprehensive permit program for the operation of stationary sources emitting air pollutants including HAPs. It applies to stationary sources of air pollution that exceed the major stationary source emission thresholds, as well as other non-major sources specified in a particular regulation. The air pollutant emission sources at BFN include the mechanical draft cooling towers, the auxiliary steam generators, the emergency diesel or propane fired generators, emergency pumps, and miscellaneous sources such as fuel storage facilities. BFN is not considered a major source of emissions and is therefore not required to obtain a Title V air permit (TVA 2020a). BFN operates under a synthetic minor source permit (Permit No. 708-0003-X005) issued on November 6, 2020 by ADEM (TVA 2020a). BFN tracks monthly operating hours for each equipment on a 12-month rolling basis. As of July 7, 2022, BFN has been operated in compliance of the synthetic minor source permit conditions.

The CAA, as amended, established Mandatory Class I Federal Areas where visibility is an important issue. No Class I areas exist within 62 miles of the BFN site (NPS 2021).

3.12.1.2. Greenhouse Gas Emissions

Certain gases in the earth's atmosphere, classified as GHGs, play a critical role in determining the earth's surface temperature. A portion of the solar radiation that enters the earth's atmosphere is absorbed by the earth's surface, and a smaller portion of this radiation is reflected back toward space. Infrared radiation (i.e., thermal heat) is absorbed by GHGs in the earth's atmosphere. As a result, infrared radiation reflected from the earth that otherwise would have escaped back into space is instead "trapped," resulting in a warming of the atmosphere. This phenomenon, known as the "greenhouse effect," is responsible for maintaining a habitable climate on the earth.

Some GHGs are present in the atmosphere naturally, some are released by natural processes and anthropogenic sources, and some are formed from secondary reactions taking place in the atmosphere. Natural sources of GHGs include the respiration of humans, animals, and plants; decomposition of organic matter; and evaporation from the oceans. Anthropogenic sources include the combustion of fossil fuels, waste treatment, and agricultural processes. The following are GHGs that are widely accepted as the principal contributors to human-induced global climate change:

- Carbon dioxide (CO_2)
- Methane (CH_4)
- Nitrous oxide (N_2O)
- Hydrofluorocarbons (HFCs)
- Perfluorocarbons (PFCs)

- Sulfur hexafluoride (SF_6)
- Other fluorinated gases

Global warming potential (GWP) is a concept developed to compare the ability of each GHG to trap heat in the atmosphere relative to CO_2. The GWP of a specific GHG is based on several factors, including the relative effectiveness of that gas in absorbing infrared radiation and length of time (i.e., lifetime) that the gas remains in the atmosphere ("atmospheric lifetime"). The reference gas for GWP is CO_2; therefore, CO_2 has a GWP of 1. The other main GHGs that have been attributed to human activity include CH_4, which has an estimated GWP of 27-30 over 100 years, and N_2O, which has a GWP of 273 for a 100-year timescale (USEPA 2023). For example, 1 ton of CH_4 has the same contribution to the greenhouse effect as approximately 27-30 tons of CO_2. GHGs with lower emissions rates than CO_2 may still contribute to climate change because they are more effective at absorbing outgoing infrared radiation than CO_2 (i.e., high GWP). The concept of CO_2 equivalents (CO_2e) is used to account for the different GWP potentials of GHGs to absorb infrared radiation.

A variety of regulations and guidance are in place to implement Federal policy with respect to GHG emissions. Under 40 CFR Part 98, Mandatory Reporting of Greenhouse Gases Rule, the USEPA requires mandatory reporting of GHG emissions for facilities that emit more than 25,000 metric tons per year (tpy) of CO_2e emissions. GHG emissions thresholds for permitting of stationary sources are an increase of 75,000 CO_2e tpy at existing major sources and facility-wide emissions of 100,000 CO_2e tpy for a new source or a modification of an existing minor source. The 100,000 CO_2e tpy threshold defines a major GHG source for both construction and operating permitting, respectively. However, USEPA will no longer apply or enforce federal regulatory provisions or provisions of the USEPA-approved Title V programs that require a stationary source to obtain a Title V permit solely because the source emits or has the potential to emit GHGs above the major source thresholds (77 Federal Register 41051).

GHG emissions from a nuclear power plant are typically very minor because nuclear plants, by their very nature, do not normally burn fossil fuels to generate electricity. Sources include stationary and mobile combustion sources, including diesel generators, pumps, diesel engines, boilers, worker vehicles, and delivery vehicles. Other GHG sources from nuclear power plants may include human-made fluorinated compounds such as hydrofluorocarbons and perfluorocarbons contained in refrigerants. SF_6 is used in electric power transmission and distribution applications. SF_6 can be found in substations, circuit breakers, and other switchgear. SF_6 has replaced flammable insulating oils in many applications and allows for more compact substations. Fugitive emissions of SF_6 can escape from gas-insulated substations and switchgear through seals, especially those in older equipment. SF_6 can also be released during equipment manufacturing, installation, servicing, and disposal.

The GHG emission sources at BFN include the auxiliary boilers, the emergency diesel or propane-fired generators, and miscellaneous sources such as fuel storage facilities. BFN tracks monthly operating hours for all equipment on a 12-month rolling basis. As of July 7, 2022, BFN generated a total of 17,593 tpy CO_2e. This amount represents approximately 0.02 percent of Alabama energy-related 2016 emission inventory for GHG in terms of CO_2 reported by U.S. Department of Energy (EIA 2019).

3.12.1.3. Climate Change

Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. Climate change refers to any significant change in measures of climate, such as temperature, precipitation, or wind lasting for an extended period (decades or longer). The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe. Climate change is primarily a function of excessive CO_2 in the atmosphere. CO_2 is the primary GHG emitted through human activities. The southeast region where BFN is located is predominantly powered by coal, natural gas, and nuclear power plants and contains extensive oil and gas infrastructure that is essential to the nation's energy supply. The majority of these generation sources, with the exception of nuclear energy, are significant producers of GHGs.

The Fourth National Climate Assessment concluded that global climate is projected to continue to change over this century and beyond (USGCRP 2018). Climate change has already been affecting the public health, natural resources, and infrastructure within all regions of the country. More frequent and intense extreme weather and climate-related events, as well as changes in average climate conditions, are expected to continue to damage infrastructure, ecosystems, and social systems that provide essential benefits to communities. As changes in the climate become more frequent and/or severe, it is anticipated that a variety of sectors will experience greater physical risks that result in infrastructure and environmental damage, as well as the loss of life. Climate change is likely to exacerbate existing challenges to prosperity posed by aging and deteriorating infrastructure, stressed ecosystems, and economic inequality. Physical climate risks often disproportionately impact disadvantaged communities, and the potential risks from climate change on the most vulnerable populations need to be considered. Climate change impacts in an area could include rising temperatures and heat waves, severe drought, intense rainfall, sea level rise, hurricanes, and wildfires.

Meteorology

The BFN site is adjacent to the Wheeler Reservoir impoundment of the Tennessee River which flows northwest at this location. There are no local physiographical features to cause significant climatological anomalies at the site, as the immediate terrain is flat or slightly undulating, with scattered 400- to 600-foot foothills and ridges located 20 to 25 miles to the east through south and southwest. At the BFN site, Wheeler Reservoir averages 1 to 1.5 miles in width. Normally, discontinuities in ambient thermal structure from differential surface heating between land and water should not cause detectable reservoir breeze circulation at the site area. Limited air mass modification may occur within the lower few hundred feet, particularly with southeast winds, when the over-water trajectory may approach 10 miles.

The climate at the BFN site is interchangeably continental and maritime in winter and spring, predominantly maritime in summer, and generally continental in fall. The mean annual temperature at Decatur, Alabama, is approximately 61.5 °F. In a typical year at Decatur, there are about 70 days with maximum temperatures equal to or greater than 90°F and about 57 days with minimum temperatures equal to or less than 32°F. The most extreme daily temperatures recorded occurred in June 1914 (108°F) and in February 1899 (-12°F).

Rainfall occurs relatively evenly throughout the year. The lowest monthly average is 3.0 inches in October. The highest monthly average is 5.1 inches in March. Major flood-producing storms are of two general types: the cool season, winter type and the warm season, hurricane type. Watershed snowfall is relatively light, averaging only about 14 inches annually. Individual snowfalls are normally light with an average of 13 snowfalls per year. Snowfall is not a factor in maximum flood determinations.

Much of the annual precipitation at BFN results from migratory storms in the winter and early spring (December through April). Most of the remaining precipitation is in June and July when air mass thundershower activity is common. Thunderstorms occur most frequently in July, August, June, and May.

BFN is located in an area occasionally traversed by cyclonic storms. Wind speeds in excess of 40 miles per hour (mph) are occasionally reported, but wind speeds in excess of 75 mph are rare. The estimated probability of a tornado occurrence at the BFN site in any one year is 6.979 x 10^{-4}, or about one occurrence in 1,433 years should be expected. In spite of the low probability, the plant is designed to withstand tornado forces.

Collection of onsite meteorological data at BFN commenced in February 1967 and continues at present. A BFN meteorological program has been developed to be consistent with the guidance given in NRC Regulatory Guide 1.23 (Revision 0) and the reporting procedures in Regulatory Guide 1.21 (Revision 1).

Temperature Trends

Average Annual Temperature

Temperatures in Alabama were relatively stable throughout the 1900s, the state is located in one of few areas across the globe that have experienced no net warming. Temperatures have been warming in the state in recent years, though they have not yet exceeded the peak temperatures recorded in the 1920s-1930s. The 5-year interval from 2016-2020 was the warmest consecutive interval. (Runkle et al. 2022).

Extreme Heat

In its Hazard Mitigation Plan, the State of Alabama defined extreme heat days as those when the maximum temperature exceeds 90°F. The National Weather Service began collecting information on extreme heat event data in 2008. Since 2008, local National Weather Service field offices in Alabama have reported 13 extreme heat episodes. That equates to about 1.4 extreme heat episodes per year. In the records for Alabama, such extreme heat events are generally localized affecting three or fewer counties; however, events in June 2009 and August 2010 affected seven and eight counties respectively. Both events affected Limestone and other surrounding counties. No deaths were reported for these extreme heat events in Alabama; however, several were reported to cause injuries and hospitalizations. The number of extreme heat days as well as heat waves (consecutive days exceeding 95°F) are both projected to increase throughout the 21st century (State of Alabama 2018).

Precipitation Trends

Average Annual Precipitation

Average annual precipitation has been increasing by about 30 percent during the fall season in the southeastern United States since 1901, the amount of precipitation in the region has increased by 30 percent during the fall months. However, at the same time, drought has been increasing by about 9 percent, with more moderate to extreme droughts in the spring and summer During this same time period, the extent of drought in the region increased by 9 percent. In the spring and summer, the region has experienced more moderate to severe droughts, with an increasing of by 12-14 percent since the mid-1970s. This contrast between wetter falls and drier spring and summer seasons is attributed to more intense storms, with longer periods of dryness between precipitation events (Janasie J.D. 2014). The annual variability in precipitation does not indicate an no overall trend. Notably, the 2005 to 2009 period had the second-driest (2007) and third-wettest (2009) years on record (Runkle et al. 2022).

Extreme Precipitation
Extreme precipitation events (those of 3 or more inches) have remained near or above average since 1995; no statistically significant long-term trends have been observed. It is projected that extreme precipitation events will eventually increase somewhat with time because it is assumed that atmospheric water vapor will increase along with temperatures (Runkle et al. 2022).

Acute Weather Trends
Though BFN is located inland, it is located close enough to the coastline that it can be affected by hurricanes and tropical storms. Effects can include flooding (from both storm surge on the coastline and increased precipitation) and wind damage (from hurricane-force winds and spawned tornadoes). In Alabama, the most extreme and deadliest weather hazards are tornadoes and hurricanes. Historic tornadic activity in the vicinity of BFN is described above. Between 1895 and 2019, an estimated 43 tornadoes, typically occurring in the spring and fall, touched down in Alabama each year. In 2011, a deadly tornado outbreak swept across the southern, midwestern, and northeastern United States. Alabama was one of the hardest-hit states, suffering an estimated 238 tornado-related deaths and millions of dollars in property and infrastructure damages (Runkle et al. 2022).

Since 2000, the state has been impacted by five hurricane (Runkle et al. 2022), with the biggest effects being storm surge related flooding (Strauss et al. 2015). While BFN is located far enough from shore that the immediate effects from hurricanes are not a factor, as the storms move inland, they can cause inland flooding, wind damage, and spawn tornadoes. On average from 1900 to 2020, Alabama is directly impacted by a hurricane about once every 6 years; however, there has been no long-term trend in hurricane occurrence affecting Alabama over the past century (Runkle et al. 2022).

3.12.2. Environmental Consequences – Air Quality, Greenhouse Gases, and Climate Change

This section addresses impacts to air quality, greenhouses gases, and climate change, and greenhouse gasses from the No Action and Action Alternatives.

Since January 2021, the Biden administration has issued Executive Orders and taken other actions to reinstate previous policies and guidance associated with GHG emissions and climate change. Specifically:

- Executive Order 13990, issued on January 25, 2021, stated the policy of the Federal government to take a variety of actions, including reducing GHG emissions, to protect public health and the environment. The Order required all agencies to review existing regulations, orders, guidance documents, policies, and other agency actions to ensure they conformed to the policy.

- Executive Order 13990 also rescinded the ‘Draft National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions” dated June 26, 2019, and directed the CEQ to review, revise, and update the previous ‘‘Final Guidance for Federal Departments and Agencies on Consideration of Greenhouse Gas Emissions and the Effects of Climate Change in National Environmental Policy Act Reviews” dated August 5, 2016. CEQ issued an interim National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change on January 9, 2023 to assist agencies in analyzing GHG and climate change effects. This interim guidance provides tools and specific guidance as to what these analyses should include, introduces social cost of GHG to provide a monetary metric for quantifying a project’s

GHG emissions that is easily understood by the public and used by agency in decision making, and explains that the analysis should consider (1) the potential effects of proposed action alternatives on climate change through assessing direct and indirect GHG emissions and (2) the effects of climate change on a proposed action.

The effects of a proposed action on climate change can be evaluated by quantifying the proposed action's GHG emissions. Therefore, the contribution to GHG emissions over the proposed subsequent period of operation serves as a proxy in assessing the impact from continued power plant operation on climate change. Changes in climate have broader implications for environmental resources (e.g., water resources, air quality, and ecosystems). For instance, changes in precipitation patterns and increase in air temperature can affect water availability and quality. As a consequence, climate change can have overlapping impacts on environmental resources by inducing changes in resource conditions that can also be affected by the proposed action. On the basis of these considerations, the following two issues are considered in this section.

- Greenhouse gas impacts on climate change
- Climate change impacts on environmental resources

Future global GHG emission concentrations (emission scenarios) and climate models are commonly used to project possible climate change. Climate models indicate that over the next few decades, temperature increases will continue due to current GHG emission concentrations in the atmosphere. If GHG concentrations were to stabilize at current levels, this would still result in at least an additional 1.1 °F of warming over this century (USGCRP 2018). Over the longer term, the magnitude of temperature increases and climate change related effects will depend on future global GHG emissions (IPCC 2023). Climate model simulations often use GHG emission scenarios to represent possible future social, economic, technological, and demographic development that, in turn, drive future emissions. Consequently, the GHG emission scenarios, their supporting assumptions, and the projections of possible climate change effects entail substantial uncertainty.

The Intergovernmental Panel on Climate Change (IPCC) is an international body that assesses, reports, and shares climate change science and policies. The synthesis report written by the IPCC contains their most comprehensive climate change work. The most recent report is the Synthesis Report of the IPCC Sixth Assessment Report, published in March 2023 (IPCC 2023).

The IPCC highlights four Representative Concentration Pathways (RCPs) which describe future global emission scenarios. RCPs are utilized for making projections on climate change impacts based on the likely emission scenarios that will occur. The IPCC Sixth Assessment Report defines four RCPs: immediate stringent mitigation to lower GHG emissions and limit global warming below 3.6 °F (RCP2.6), intermediate emissions mitigation to limit to 3.6 °F of global warming (RCP4.5), high-intermediate emissions with emissions peaking in 2060 and declining for the rest of the century (RCP6.0), and extremely high emissions consistent with no policy changes to reduce emissions (RCP8.5) (IPCC 2023).

RCP4.5 (lower) and RCP8.5 (higher) emissions scenarios are typically referenced in this document, as the RCP4.5 encompasses a scenario limiting global warming to 3.6°F and the RCP8.5 scenario encompasses one where there are increased physical risks due to extremely high emissions (IPCC 2023).

Projected climate change trends indicate the potential for future physical climate risks in the BFN area from increasing temperatures (both average annual and extreme heat events including more severe, frequent, and longer lasting heat waves), increasing precipitation (both average annual and extreme precipitation events), and unpredictable frequency and increasing intensity of tropical and extra-tropical storms, as well as the associated impacts to storm surge, flooding, and high wind events as a result of these predicted climate trends. Such climate change creates additional strain on the energy infrastructure; electricity demand for cooling rises with increasing air and water temperatures (DOE 2015). Section 3.12.1.3 provides discussions of historic and present climate data and trend for the region or state. This section discusses the potential effects of climate change on environmental resources and how climate change could affect BFN operations under each alternative.

3.12.2.1. Alternative A – No Action Alternative

Under the No Action Alternative, the impact on air quality from shutting down BFN would be slightly beneficial. BFN would start decreasing the work force, which would reduce the emissions from the workers' vehicles. There would be less mobile and stationary equipment in use, which would decrease emissions. BFN would cease test operation of backup diesel generators, and other carbon-fueled plant equipment and the current operating air permit would be rescinded. Once the destruction and recycling of site structures and facilities began, there would be a brief period of increased pollutant emissions from construction-type activities resulting in temporary adverse air quality impacts.

Under the No Action Alternative, termination of the BFN operating license and shutdown of the plant would have little or no impact on GHG emissions, as the plant emits relatively small quantities of GHG. Because uranium fuel would no longer be needed, the GHG associated with the uranium fuel cycle for BFN would not be emitted.

Should TVA select the No Action Alternative, it would be necessary to also replace the 3,900 MWe of BFN generation. Prior to construction of a new generating plant, local meteorological conditions would be evaluated to model dispersion characteristics as well as the potential impact on the local air quality from the operation of the new facility. No new generation facility would be expected to adversely affect local meteorological conditions.

Constructing a new generation plant is similar to many large construction projects. Construction impacts to air quality come from several sources such as fugitive dust emissions, vehicular traffic emissions, heavy equipment emissions, and concrete batch plant emissions. BMPs would be used to control the sources of emissions, and the impacts would be small and of short duration. There would be small indirect impacts off site and no cumulative impacts due to construction.

Construction of a new generation facility to replace BFN would having varying impacts on air quality and GHG depending on the type of facility and the quantity of generation produced.

Under this alternative, operation of a new natural gas-fired plant would increase some air pollutants. The amount of pollutants released is determined by the type of control equipment used in the plant design. Depending on the chosen location, typical combined-cycle combustion turbine gas-fired generation plants have small to moderate impacts on air quality but would be designed and operated to meet all air quality standards. New processes are being developed to continue the decrease in pollutants released or sequestered. The air emissions, including GHG emissions would meet all required regulations and would be expected to be small to moderate.

Under the No Action Alternative, operation of a new SMR or solar plant(s) would not create a significant source of pollutants including GHG. The primary GHG emissions from operation of a new SMR plant would be emitted from onsite combustion sources (diesel generators, boilers, pumps) and worker vehicles. GHG emissions would be intermittent and minor with the level less than or comparable to that from BFN. Sources of GHG emissions associated with solar facilities primarily include engine exhaust from worker vehicles and equipment associated with site inspections or maintenance activities. Therefore, the environmental impact of a new SMR or solar plant(s) on air quality, GHGs, and climate change would be small.

The vehicular traffic of personnel commuting to work to any new generation facility would produce small amounts of pollutants, and fugitive dust would occur from vehicles traveling on unpaved roads. With an operational work force of varying size depending on the nature of the new facility, the traffic due to commuting workers would be a small impact. Occasional trucks, diesel engines, and small-source engines would be used, but the impacts would be small. Fugitive dust would be a small impact during operations of a new facility.

Potential effects to air quality, GHGs, and climate change would be evaluated in separate analyses once new generation construction project locations and technologies are specifically identified.

3.12.2.2. Alternative B – Proposed Action

Air Quality and Greenhouse Gases

Under Alternative B, BFN would continue to operate under the current conditions. BFN is not a major source of pollutants and would continue to operate under a synthetic minor source air permit as the existing condition. Therefore, the impact of operation for an additional 20-year period would be small. The nuclear fission process produces substantially less air pollutants when compared to replacement fossil-fueled generation sources. The vehicular traffic of personnel commuting to work would produce small amounts of pollutants, and fugitive dust would occur from vehicles traveling on unpaved roads. SLR would support TVA meeting it’s carbon-free emissions goals and likely provide a positive air quality impact when compared with other alternatives utilizing combustion sources for power generation. By using nuclear power, the amount of pollutants released into the air would be substantially less than that which may be released from alternative fossil fueled sources as described earlier. It is anticipated that the minimal air quality impacts under Preferred Alternative would be comparable to the renewable energy generation options such as solar.

The only reasonably foreseeable local projects that could contribute with BFN to air quality impacts are transportation projects or development projects; however, construction and operation of these projects would be typically with potentially small negligible adverse impacts to air quality. The incremental contribution to cumulative impacts to air quality associated with the continued operation of BFN would be small.

Under Alternative B, the impacts from the climate change to Alternative B and GHG emissions from the BFN SLR would be expected to be small, similar to the existing condition. Because the duration of SLR is only 20 years, the permanent changes expected would be very small and for normal fluctuations in temperature of the water and air BFN would continue to operate within all thermal limits.

Impacts on climate change during normal operations at nuclear power plants can result from the release of GHGs from stationary combustion sources (e.g., diesel generators, pumps, diesel engines, oilers), refrigeration systems, electrical transmission and distribution systems, and mobile sources (worker vehicles and delivery vehicles). The GHG emissions from BFN are very minor because the plant does not normally combust fossil fuels to generate electricity. As discussed in Section 3.12.1.2, direct GHG emissions from operations at BFN do not exceed the 25,000 metric tons of CO_2e reporting threshold established by USEPA. Furthermore, when compared to State GHG emissions, GHG emissions from operating BFN are orders of magnitude lower. Therefore, the impact of GHG emissions on climate change from continued operations of BFN would be small.

Effects of Climate Change

Temperature and Precipitation Effects

Projected changes for 2006–2100 near surface air temperatures based global climate models show two possible futures for the state under higher GHG emissions scenario (RCP8.5) and lower GHG emissions scenario (RCP4.5), respectively. Although temperatures in Alabama have not risen since the beginning of the 20th century, recent years have been very warm, and the warmest consecutive 5-year interval was the most recent between 2016 and 2020. Less warming is expected under a lower emissions future (the coldest projections at 2100 being about as warm as the hottest year in the historical record) and more warming under a higher emissions future (the hottest 2100 projections being about 11°F warmer than the hottest year in the historical record (NOAA 2022).

Under the higher emissions pathway, historically unprecedented warming is projected during this century at 2100 that is 11°F warmer than the hottest year in the historical record. Even under a lower emissions pathway, annual average temperatures are projected to most likely exceed historical record levels by 2050. A large range of temperature increases is projected under both pathways.

The southeastern region, including Alabama, is in a transition zone between projected high latitude increases and subtropical decreases in precipitation, and as such, future projection of precipitation changes are uncertain (NOAA 2022).

Consequently, climate change is likely to result in higher temperatures within the BFN area and may result in unknown effects on precipitation. Higher air temperatures can result in higher water temperatures. Increasing air and water temperatures reduce the efficiency of thermoelectric power generation and could reduce available generation capacity. Natural gas, coal, nuclear, bioenergy, and geothermal power plants are all affected by elevated air temperatures. Warmer air and heat waves can increase ambient cooling water temperatures, which affects generation efficiency regardless of fuel source. Changes in precipitation can affect water availability.

In general, the increased frequency of days with extreme heat is one factor contributing to peak power demand. In contrast, technology advances such as improvements in air conditioning efficiency could help reduce the projected increases in electricity demand. In addition, because air conditioning use is greatest during the same periods of extremely high temperatures that can lead to transmission losses and reduced thermal efficiencies at electric generation facilities, increased cooling demand may increase the occurrence of peak loads coinciding with periods when generation efficiencies are lowest. Therefore, climate change may have a small impact on BFN operations by affecting efficiencies and increasing demand during SLR. Because current climate change patterns in the southeast do not indicate a trend toward drought, climate change impacts on water availability in Wheeler Reservoir are also anticipated to be small.

Acute Weather Effects
As discussed in Section 3.12.1.3, even though Alabama is directly impacted by a hurricane about once every 6 years, there has been no long-term trend over the past century in the number of hurricane events (Runkle et al. 2022). Thus, the future projection of such events is uncertain.

However, the future flooding risk projection indicates there are 1,741 properties in the BFN neighborhood that have greater than a 26 percent chance of being severely affected by flooding over the next 30 years. This represents 14 percent of all properties in the BFN neighborhood. Overall, the BFN neighborhood has a moderate risk of flooding over the next 30 years, which means flooding is likely to impact day-to-day life within the community. If a low-likelihood storm resulting in severe flooding (a 1-in-100 flood event) occurred today, it could affect 1,706 properties. This type of event has a 26 percent chance of occurring at least once over the next 30 years (First Street Foundation 2023).

Public infrastructure and other public services already experience impacts from climate change, and climate change is expected to add stress to any existing infrastructure that is already aging and near the end of its service life. High wind events can damage power lines leading to electrical outages, down trees, and cause flying debris that can disrupt transportation and telecommunication infrastructure, and cause damage to buildings, structures, and vehicles.

While BFN SLR is not expected to contribute to climate-related impacts on public infrastructure and services, infrastructure damage from extreme weather events and flooding may impact the ability of workers to reach BFN, could disrupt shipments of materials arriving via roadway, or could disrupt transmission system infrastructure thus affecting BFN's ability to deliver power. Overall, acute weather effects associated with climate change would be anticipated to have a small impact on BFN SLR.

Public Health Effects
Current and projected climate change conditions could have impacts to public health. Health impacts from climate change vary across communities and depend on social, socioeconomic, demographic, and other societal factors, as well as community adaptation efforts and the underlying vulnerability of individuals. Climate change related impacts have already begun affecting the health and well-being of residents throughout Alabama. In 2011, a deadly tornado outbreak swept across the southern, midwestern, and northeastern United States. Alabama was one of the hardest-hit states, suffering an estimated 238 tornado-related deaths and millions of dollars in property and infrastructure damages (Runkle et al. 2022). From mid-July, through mid-September, 1980, a sustained period of extreme heat and high humidity took its toll on the state. The month of July alone saw an estimated 120 heat related deaths, the loss of more than 200,000 chickens, and the loss of half the state's corn crop. The hottest day of the summer was July 17th, when over 80 percent of the state reached 100°F, and nearly one quarter of the state reached 105°F (State of Alabama 2018).

The southeast region of the United States is projected to experience the country's highest increase in heat index, which is a measure of comfort that combines relative humidity and temperature. Because the Southeast is expected to experience the United States' greatest increase in heat index, the quality of life in the region could also decrease (Janasie J.D. 2014). A ridge of high pressure persisted over the State including Limestone County, on the 27th and 28th of June 2009, producing hot temperatures in the upper 90s to around 100°F. The heat combined with high humidity pushed heat index values into the 105 to 110°F range on both days (State of Alabama 2018).

BFN SLR would not be expected to contribute to climate change, and thus would not contribute to adverse impacts to public health due to climate change. However, climate change related impacts to public health could have indirect impacts to BFN if the increased demand for air conditioning places greater demands on the generation system or if individual workers and their families are affected. Therefore, overall public health related effects of climate change on BFN are anticipated to be small.

Changes in the temperature of the water driven by climate change could result in changes to the development of microbiological hazards within Wheeler Reservoir. The BFN NPDES permit limits the temperature of the ambient water downstream of the mixing zone of the submerged diffusers. At present risk of exposure of the public to N. fowleri is possible below the discharge structure; however, the probability of such exposure is low. Compliance with the NPDES permit would limit the effects of the BFN cooling water discharge on water temperatures in Wheeler Reservoir, regardless of natural increases in reservoir water temperatures that may result from short-term or long-term climate changes. Thus, TVA finds that the cumulative impact on public health from thermophilic organisms in Wheeler Reservoir during the proposed subsequent period of extended operation would be small.

Environmental Justice Effects

The 50-mile region around BFN is classified as Category 3 (having one or more cities with 100,000 people, and fewer than 190 persons per square mile within 50 miles of the plant). BFN falls within Category 4.3 of the GEIS Sparseness and Proximity Matrix which means it is in a high population area. Regardless, there are also areas within this 50-mile radius that are rural. These rural areas are important to the social and economic well-being of the region. Many in rural communities are maintaining connections to traditional livelihoods and relying on natural resources that are inherently vulnerable to climate change. The southeast region of the United States has the second highest number of farmworkers hired per year compared to other National Climate Assessment regions. Climate trends and possible climate futures show patterns that are already impacting—and are expected to further impact—rural sectors, from agriculture and forestry to human health and labor productivity. While adaptation and resilience can moderate climate change impacts, rural areas generally face other stressors, such as poverty and limited access to healthcare, which will make coping to climate-related challenges more difficult (Carter et al. 2018).

Minority populations are present within nine of 14 counties (64.3 percent) and in 131 of 692 block groups (18.9 percent) in Alabama. In Tennessee, minority populations are present in 2 out of 7 counties (28.6 percent) and 3 out of 93 block groups (3.2 percent) (USCB 2020b, USCB 2020i). Additionally, low-income populations were identified in 16.2 percent of blocks groups in Alabama and 15.1 percent of block groups in Tennessee (USCB 2020c, USCB 2020d). Limited subsistence populations and migrant workers are also present in the BFN 50-mile region. Section 3.17.2 presents the analysis that indicates that BFN SLR would not result in any disproportionately high and adverse effects on environmental justice populations and that overall impacts to these populations would be small.

As described above, climate change can result in impacts to public health. Impacts to public health may be disproportionate to environmental justice communities. For example, these communities may not have the resources to afford higher costs for indoor climate control that could result from overall higher temperatures. This could result in more heat-related health impacts to disadvantaged populations which also may not have the resources to provide for health care. Therefore, climate change impacts on environmental justice are expected to be small to moderate, however, BFN SLR would not contribute to those impacts.

3.13. Transportation

This section addresses non-radiological impacts to transportation in the vicinity of BFN. Transportation of nuclear fuel is discussed in Section 3.21.3.1.

3.13.1. Affected Environment – Transportation

3.13.1.1. Ground Transportation

BFN is located approximately 10 miles southwest of Athens, Alabama. The site is approximately 6 miles south of US Highway 72, which runs in an east-west direction passing through Huntsville, Athens, and Florence, Alabama. BFN is also approximately 9.3 miles and 10.5 miles west of US Highway 31 and Interstate 65, respectively, which both run in a north-south direction east of the site through Athens to the north and Decatur to the south (Figure 1.2-1). US Highway 72 and US Highway 31 are both high quality four-lane routes with good lane widths, alignments, turning lanes, and speed limits of 45 mph through Athens and increasing away from the city.

Employees commuting to and from BFN typically utilize the various paved, two-lane roads in the vicinity of the plant. Immediate road access to BFN is via County Road 20, which runs south from US Highway 72 as Shaw Road and continues east just north of BFN as Nuclear Plant Road, ultimately intersecting with US Highway 31. Browns Ferry Road is also a primary road to the site which runs northeast-southeast from Athens to Nuclear Plant Road near BFN (ALDOT 2022). Shaw Road, Nuclear Plant Road, and Browns Ferry Road are medium quality two lane roads with level alignment, some passing zones, and speed limits of 45 mph.

BFN currently has approximately 2,159 employees and is the primary traffic generator in the vicinity of the site. The employee population peaks at approximately 3,050 to 3,500 employees during refueling outages, which occur every 24 months (per unit) for approximately 45 days or less. Rural residences located along the county roads providing access to the site are also traffic generators in the area. As shown in Table 3.13-1, in 2021, the average daily traffic count on the roadways typically utilized by BFN employees ranged from 1,185 to 30,476 vehicles per day for Browns Ferry Road near BFN and for Interstate 65 near Athens, respectively (ALDOT 2022).

Table 3.13-1. Roadways in the BFN Vicinity and Average Number of Vehicles Per Day

Station ID	Road	2021 Average Daily Traffic Count
Limestone 916	Shaw Road	2,455
Limestone 917	Browns Ferry Rd	1,185
Limestone 119	Nuclear Plant Rd	2,302
Limestone 812	US Highway 72	15,746
Limestone 502	US Highway 31	18,871
Limestone 815	Interstate 65 (Athens)	30,476

Source: (ALDOT 2022)

3.13.1.2. Navigation

The Rivers and Harbors Act of 1899 (RHA) is the initial authority of the USACE regulatory permit program to protect navigable waters of the United States. Section 10 prohibits the unauthorized obstruction or alteration of any navigable water (USACE 2012b). Stretching from its mouth (TRM 0) to its head (TRM 651.1 and the confluence of the French Broad and Holston Rivers), the Tennessee River, which includes the Wheeler Reservoir, is an RHA Section 10 waterway. Regulatory control of Wheeler Reservoir is exercised by the USACE Nashville District (USACE 2022a, USACE 2022b).

Wheeler Reservoir is a navigable waterway used by commercial and recreational traffic. It is one of nine reservoirs that create a stairway of navigable water on the Tennessee River from Knoxville, Tennessee, to the mouth of the Tennessee River at the Ohio River in Paducah, Kentucky (TVA 2021k).

Barge traffic on Wheeler Reservoir has made it one of the major centers for shoreline industrial development on the Tennessee River system. Private industry has invested about $1.3 billion in the waterfront plants and terminals at Decatur, Alabama, the largest city on the Reservoir (TVA 2021k).

3.13.1.3. Air

The nearest airport, approximately 10-miles southeast of BFN is the Pryor Field Regional Airport in Decatur, a general aviation airport. Courtland Airport, a general aviation airport located approximately 13 miles southwest of the BFN, also serves the area. Huntsville International Airport is a full-service commercial airport located about 20 miles southeast of BFN. BFN has an onsite private-use helipad.

3.13.1.4. Railroad

There is an Amtrak station and a CSX Transportation, Inc (CSX) yard (CSX Oakworth Yard) in Decatur approximately 10 and 11 miles southeast of BFN, respectively. The Huntsville and Madison County Railroad Authority is a logistics service with Norfolk Southern (a Class I freight railroad) and CSX interchanges that operate on 13.25 miles of track (Huntsville and Madison County Railroad Authority 2021) 30 miles northeast of the site in Huntsville. The nearest Norfolk Southern station is about 10 miles south of BFN in Decatur.

3.13.2. Environmental Consequences – Transportation

This section addresses impacts to transportation from site construction and operation of the No Action and Proposed Action Alternatives.

Alternative A – No Action Alternative

Under the No Action Alternative, cessation of BFN operation would not adversely affect river navigation, railroad service, or air transportation in the vicinity of BFN. The loss of operation jobs would result in a decline of traffic on County Road 20 and other nearby roads. This could create an increase of available capacity for these area roads. While decommissioning efforts would provide moderate impacts to transportation, these impacts would be temporary. Repurposed use of the decommissioned site would probably provide transportation impacts similar to or less than impacts from the current BFN workforce. Overall, any decline in traffic due to plant closure would likely be partially offset should future housing subdivisions increase along these roads and should the anticipated population increases continue for Limestone County.

In addition, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system.

Construction and operation of a new generation facility would potentially impact the transportation infrastructure and traffic load on the roadways associated with a site. It is expected that a larger construction and operations work force would be required for a new SMR facility than would be required for a new solar facility. Factors that help determine transportation and traffic impacts from construction and operation of a new facility include:

- Number of construction and/or operational workers and expected vehicles on the road.
- Number of shift changes for construction and/or operational work force.
- Projected population growth rate in the region during the construction and operation period.
- Capacity and condition of existing roads.

Should a new power facility be constructed, the facility could be sited in a manner that would reduce or avoid transportation and traffic impacts. However, mitigation of potential transportation impacts due to the location of a facility may be necessary because of expected increases in construction and operation traffic. This mitigation may include need for extensive improvements to roadways and intersections (e.g., roadway widening, ramp improvements, and traffic signal installation) on state and local roads. Other mitigation actions could include employee carpooling or offsite parking with organized transportation, such as buses, to the site. Traffic generated as an outcome of construction activities would be temporary and short term. Scheduling for certain construction activities to occur during off-peak hours could also be an option to reduce conflict with normal traffic use on area roads. Traffic related to operation and maintenance at a potential site would utilize any mitigation improvements established during the construction phase. Impacts could range from small to moderate, depending on project and site-specific conditions.

Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action
Under Alternative B, the SLR would not require major new construction, alterations, or refurbishment to BFN to maintain consistency with the current licensing basis. In addition, no change to operation at the plant or addition of operation personnel is anticipated. No resulting impacts to transportation are anticipated due to this action. Additionally, none of the transportation projects described in Section 1.5.1.3 are expected to contribute to cumulative impacts with respect to BFN due to their relatively short construction schedules, distance from the facility, and relative size.

3.14. Visual Resources

3.14.1. Affected Environment – Visual Resources

The terrain on either side of Wheeler Reservoir is relatively flat. Overall, the area surrounding BFN is rural and agricultural with single lane roads and forested areas. For the most part, residences are sparse and generally associated with agricultural fields or are in small shoreline neighborhoods to the northwest and southeast of BFN.

The majority of the BFN facility is visible in daylight from Wheeler Reservoir and the surrounding area located to the south and west. BFN is also visible at night due to exterior night lighting. The largest structures onsite are the reactor building, turbine building, and Cooling Tower 7; the tallest structure on the site is the off-gas stack. Additional structures visible from the south and west of BFN (on or across Wheeler Reservoir) include transmission towers and lines, the switchyard, parking areas, and Cooling Towers 1-6. Paradise Shores, a residential area to the north of the helper cooling towers, is buffered by a wooded areas that blocks the view of the site. When the helper cooling towers are in operation, steam plumes may be present and visible from nearby residences, but helper cooling towers are only used during the summer months as needed. The helper cooling towers, which create the steam plumes, operate only when needed to cool the plant water discharge to comply with the NPDES permit limits (ADEM 2018). During the remainder of the year, when the helper cooling towers are not operating, no plumes would be present.

Views from the west would be the most imposing as the scale of the plant is more obvious from water level and across Wheeler Reservoir. Although the plant contrasts as an industrial feature in an otherwise rural setting, it is not a dominant feature from most views due to its distance from residences and the presence of wooded areas around BFN. The land on the southern side of Wheeler Reservoir is forested and includes Mallard-Fox Creek WMA. The forested areas help shield the view of the facility from observers across the reservoir.

3.14.2. Environmental Consequences – Visual Resources

This section addresses impacts to visual resources from site construction and operation of the Action and No Action Alternatives.

<u>Alternative A – No Action Alternative</u>

Under No Action Alternative, no adverse impacts to visual resources would occur from the shutdown of BFN and with the shutdown of the helper cooling towers, there would be no steam plume; thus providing a beneficial visual impact. During and after decommissioning, objects currently visible to offsite persons may no longer remain or be visible. Visual impacts from repurposed use of the decommissioned site are anticipated to be similar to or less than visual impacts of the BFN site.

In addition, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system.

Under these alternatives, the impact on the visual resources of an area would be dependent upon the physical, biological, and cultural characteristics of the potential new generation site. Topographical relief, vegetative cover, proximity to the public, rural or urban location, construction and operation practices, facility visual features, and atmospheric conditions are all factors that would influence the perception of how a new facility would impact the visual resources of an area.

During the construction phase, there would be the potential for small, temporary small impacts to visual aesthetics in an area due to the staging of construction materials and site preparation, the introduction of construction cranes, and an increase of dust from additional traffic on local dirt roads. More permanent impacts to the viewshed during the operation phase could result from the cumulative effects of introducing cooling towers or exhaust stacks to the skyline, water vapor plume release, transmission lines, and visibility of other prominent facility features. The level of impact anticipated during construction and operation would range from small to moderate and vary depending upon viewer distance from the site, the abundance of trees, hilly terrain, and mitigation measures used, such as utilizing landscape materials on site, and painting techniques applied to facility structures.

Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

<u>Alternative B – Proposed Action</u>

Under Alternative B, the BFN SLR would result in only small changes to the BFN site or operations, and to the landscape or area visual resources. In addition, land-use changes in the vicinity would not occur as a result of this alternative; therefore, no cumulative impacts to visual resources would be expected.

3.15. Noise and Vibration

3.15.1. Affected Environment – Noise and Vibration

Noise at BFN is generated by onsite equipment such as diesel generators, transformers, and helper cooling towers. The largest amount of noise from BFN which can periodically be heard offsite is from the helper cooling towers. The helper cooling towers operate most frequently during the summer months when neighborhood houses utilize air conditioning units, which would mask potential outside intrusive noise. Noise sources in the vicinity of BFN include river and lake traffic, road traffic, dogs barking, insects, and power line hum.

At high levels, noise can cause hearing loss, and at moderate levels, noise can interfere with communication, disrupt sleep, and cause stress. At relatively low levels, noise can cause annoyance. Noise is measured in decibels (dB), a logarithmic unit, so an increase of 3 dB is just noticeable, and an increase of 10 dB is perceived as a doubling of the sound level. Because not all noise frequencies are perceptible to the human ear, A-weighted decibels (dBA) that filter out sound in frequencies above and below human hearing are used for this assessment. Ambient environmental noise is usually assessed using the day-night sound level (DNL). The DNL is a weighted logarithmic 24-hour average with a 10-dB penalty added to noise between 10 p.m. and 7 a.m. to account for the potential for sleep disruption (USEPA 1974).

Community noise impacts are typically judged based on the magnitude of the increase above existing background sound levels. Although there are no federal, State of Alabama, or local municipal noise standards, regulations or ordinances that are applicable to the SLR, USEPA's noise control guideline recommended average annual equivalent DNL of 55 dBA to protect the health and well-being of the public can be used as a measure of annoyance from industrial noise in a noise sensitive neighborhood (USEPA 1974). Furthermore, as recommended by the Federal Interagency Committee on Noise (FICON), a 3-dBA or greater increase in DNL indicates a possible impact when the background is 60 dBA or less (FICON 1992).

A 24-hour ambient noise sample was collected at BFN on August 8, 2012, when six of the seven helper cooling towers were in operation and on September 6, 2012, when none of the helper cooling towers were operating (Ensafe 2012). The noise measurements on both dates were measured at the location of the nearest residence to BFN in the Paradise Shores Community, approximately 500 feet from the BFN property boundary. Based on the 24-hour noise measurements, the DNLs were calculated to be 61.9 dBA and 59.7 dBA with and without helper cooling towers operating, respectively (Ensafe 2012). Although the measured ambient background level without BFN helper cooling towers operating exceeded the EPA-defined 55 dBA threshold in DNL, the BFN helper cooling tower operations met the FICON guideline of an allowable 3-dBA or less increase in DNL at residences (FICON 1992).

A second 24-hour ambient noise assessment was conducted between July 30 and July 31, 2020 at the same sample location as in 2012, during which a DNL of 62.5 dBA was calculated (Cardno 2020). The most recent measurement collected at this location between August 1, 2022 and August 2 shows a 61.4 dBA in DNL (Cardno 2022) when helper cooling towers were in operation, which is slightly lower but comparable to the 2020 measurement. These measured sound levels were similar to the 2012 DNLs, indicating that ambient noise levels around the BFN have remained essentially unchanged over the years. Additionally, the USEPA noted that if a community is accustomed to the noise levels and the noise maker maintains a positive relationship with the community, then the day/night average sound level can be lowered by 5.0 dBA (USEPA 1974). After this correction, the average DNL measured most recently in August 2022 would be 57.5 dBA.

The results of these noise surveys, which focused on impacts to nearby residences (Cardno 2020, Ensafe 2012), indicate that the noise from the dominant sources at the BFN, i.e., operation of helper cooling tower(s) is barely noticeable by identified noise sensitive receptors in the vicinity.

3.15.2. Environmental Consequences – Noise and Vibration

This section addresses impacts to noise environment from the No Action and Action Alternatives.

Alternative A – No Action Alternative

Under the No Action Alternative, the shutdown of BFN and the resulting cessation of cooling tower operation, would ultimately result in a drop in industrial noise from the BFN site resulting in a small beneficial impact long-term. As the destruction and recycling of site structures and facilities began, there would be a brief period of noise increase from construction-type activities resulting in temporary and small noise impacts. In addition, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system.

Construction

The site of a new generation alternative is unknown. Noise impacts are dependent on the distance to the nearest critical receptor, so no specific dBA values for receptor locations can be determined. Noise for the construction of a new generation plant is expected to be small to moderate (depending on location and type of sensitive receptor) because most noise-producing construction activities are of short duration (minutes to hours per day) and the construction is temporary, likely being completed in approximately five to seven years (short-term), and there are numerous mitigation methods that can be implemented to limit the impact of noise.

Sources of noise in the construction of a new power generation facility are numerous and include large heavy equipment such as bulldozers, draglines, scrapers, and haulers to excavate earth, grade, and prepare for building placement. Other phases of construction would require the use of cranes, front loaders, graders, forklifts, man lifts, compressors, backhoes, dump trucks, a pier driller, and portable welding machines. It may also require the use of a concrete batch plant. These types of equipment would generate noise levels up to 98 dB at 50 feet (USDOT 1973). Construction noise of 98 dBA at 50 feet would be about 65 dBA at an approximate half-mile site boundary; a 6 dBA decrease each time the distance is doubled from the source (CERES 2009). This noise level would continue to decrease until reaching the nearest residence or noise-sensitive receptor location (hospital, library, nursing home, etc.). Noise at a sensitive receptor location at 1 mile would be below 60 dBA. Noise from construction equipment is expected to be audible over background noise levels, but it is not expected to cause a noticeable adverse impact. Mitigation measures might include noise shields around stationary equipment, limited hours of operation, properly maintained noise suppression equipment on machinery, and equipment operation limited to the day shift only.

Depending on site geology and soils, site preparation for the construction of a SMR or gas plant may require blasting, which would cause temporary noise impacts. Potential mitigation measures include, but are not limited to, the use of blasting blankets, notification of the surrounding receptors prior to blasting, and limiting blasting activities to daylight hours.

Traffic noise from the commuting of workers would be noticed and the impact would be small to moderate. Mitigation can be accomplished by using multiple shifts and encouraging car-pooling activities.

Construction noise associated with new transmission systems are expected to be small. The construction is usually of short duration, measured in days for each substation or tower location, while access roads and corridors may take a few weeks. The amount of heavy equipment needed to construct transmission systems is considerably less than a major construction site. Cranes and trucks are the major types of heavy equipment, whereas wood-clearing equipment such as chain saws and chippers may be used to clear vegetation. Out of safety concerns, construction activities for transmission systems are usually daytime-only projects, which helps limit the noise interfering with nighttime sleeping hours.

Based on projected noise levels and the temporary duration of construction activities, noise impacts from construction activities associated with this alternative are expected to be small for the surrounding communities, and small to moderate for the nearest residents. There is a direct impact on the construction site due to noise, but mitigation measures would be employed, and a formal worker hearing protection program would be implemented that would be similar to the current program in effect at BFN. Indirect impacts off site would be small and temporary during construction for surrounding animals. Some animals might avoid the area, but many would become accustomed to the noise.

<u>Operation</u>

The major noise source in the operation of a new SMR plant is normally the cooling tower, with noise level dependent on the type of cooling tower chosen. A reasonable expectation for a nuclear unit with mechanical draft cooling towers is approximately 85 dBA near the tower and 55 dBA at 1,000 feet from the towers. At the potential nearest residence (approximately 0.5 miles from the site boundary), noise from the cooling tower is expected to be well below 50 dBA, which is similar to rural background noise levels in a typical rural area. These levels would not exceed EPA's recommendation or HUD's guideline for residential areas.

The operational noise sources of motors, generators, pumps, trucks, and cars for any type of generation facility are typical of an operating industrial facility. The permanent work force would produce traffic noise during its commute to and from work. Offsite noise levels are in line with rural residential areas.

Based on the projected noise levels, noise impacts associated with the implementation of this alternative are expected to be small for the surrounding communities and the nearest residents. Direct impacts on site would require a formal hearing protection program as per Occupational Safety and Health Administration requirements (29 CFR Part 1910). There would not be any indirect impacts off site needing mitigation. Noise impacts are not normally cumulative and would not provide any cumulative impacts in the long term.

The operation of a new natural gas-fired plant would have noise sources similar to other large industrial facilities. Cooling towers, fans, pumps, compressors, boilers, etc. are usually on a smaller scale than nuclear or coal plants, but still produce noise as they are used to support plant operations. Natural gas-fired sites are usually smaller than coal or nuclear facilities, and may be located closer to residences or sensitive receptors due to the smaller area required to separate the site from the public. However, noise levels would still be expected to be within acceptable background noise levels at the nearest residence. Operational noise associated with a solar facility would be less than for a SMR or gas facility

Based on projected noise levels, noise impacts from the operation of this alternative are expected to be small for both the surrounding communities and for the nearest residents.

Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

Under Alternative B, no new sources of noise would be introduced during the proposed subsequent period of extended operation. There are no plans for changes to the facility, procedures, or programs that could increase the noise generated from the BFN facility. Noise impacts associated with operation of BFN are small, even with the operation of the helper cooling towers. The noise sources of motors, generators, pumps, trucks, and cars are typical of an industrial facility. Offsite noise levels are currently similar to the noise levels in a rural residential area and would be expected to remain at the current levels. Additionally, there are no cumulative projects in the vicinity of BFN as discussed in Section 1.5.1.3 that would contribute to noise in the project area due to their distance from the site. Therefore, the noise impacts due to the SLR are expected to be small with no change from the current conditions.

3.16. Socioeconomics

This section describes socioeconomic conditions and evaluates the impacts associated with the proposed action and no action alternative related to population, employment and income, housing, local government revenues, and community services and schools in the vicinity of BFN.

3.16.1. Population

3.16.1.1. Affected Environment – Population

The socioeconomics region of influence around a nuclear power plant is defined by the counties where plant employees and their families reside, spend their income, and use their benefits, thereby affecting the economic conditions of the region. Changes in nuclear power plant operations affect socioeconomic conditions in the regions surrounding them (NRC 2013).

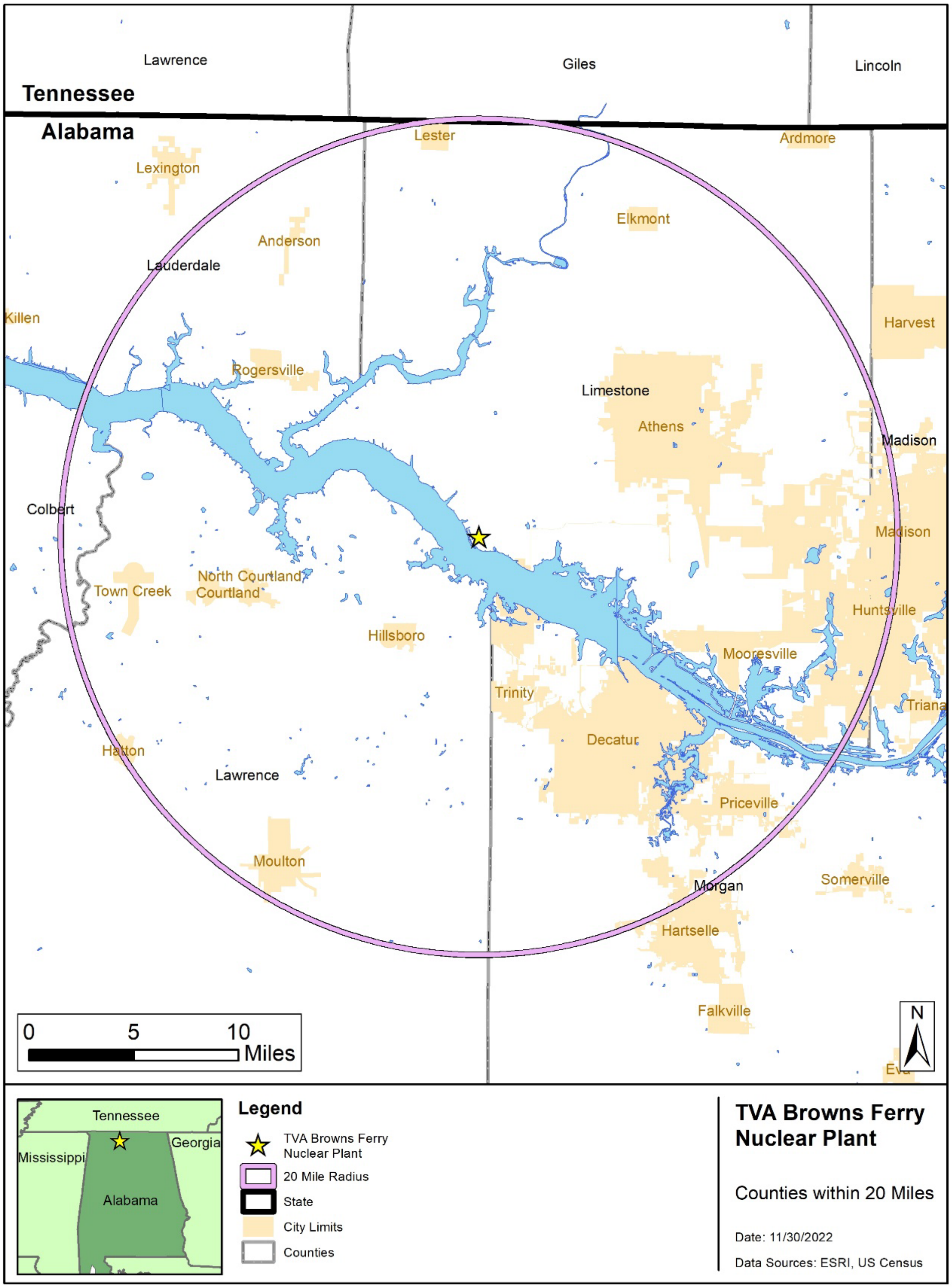
There are 21 counties within a 50-mile radius of the site, located in both Alabama and Tennessee (Figure 1.2-1). Of these, 14 counties are located in Alabama and seven counties are in Tennessee There are five cities in a 50-mile radius of BFN that have a population greater than 25,000. According to the 2020 decennial census, these cities are Athens city, Alabama (10.4 miles) with population of 25,406; Decatur city, Alabama (10.0 miles) with population of 57,938; Florence city, Alabama (32.6 miles) with population of 40,184; Huntsville city, Alabama (30.0 miles) with a population of 215,006; and Madison city, Alabama (20.8 miles) with a population of 56,933 (ArcGIS 2021, USCB 2020f). Three metropolitan areas are located largely or totally within the 50-mile zone: Decatur, Florence-Muscle Shoals, and Huntsville, all in Alabama (USCB 2021b).

As shown in Figure 3.16-1, there are seven counties within a 20-mile radius of the site. Six counties are located within Alabama (Colbert County, Lauderdale County, Lawrence County; Limestone County, Madison County and Morgan County) and one within Tennessee (Giles County). Three counties (Colbert, Madison and Giles) have only a very small edge or corner and very little population within the 20-mile zone (ArcGIS 2021).

Approximately 83.2 percent of the employees (contract workers and employees) live in Alabama, 7.0 percent live in Tennessee, and the remaining 9.8 percent is distributed across 35 other states. A majority of employees, approximately 1,681 (61.7 percent), live in three Alabama counties: Lauderdale (32.9 percent), Limestone (18.4 percent) and Colbert (10.4 percent). Thus, these three counties are considered the socioeconomic region of influence for this analysis and the following discussion specifically focuses on population growth in these three counties in relation to the State of Alabama.

As shown in Table 3.16-1, the population of Colbert, Lauderdale, and Limestone Counties, Alabama as reported in the 2020 decennial census was 57,227, 93,564 and 103,570 respectively (USCB 2020f). Population density per square mile in Colbert, Lauderdale and Limestone Counties was 96.5, 140.1 and 185.0 respectively (USCB 2022b).

Population projections for Alabama Counties were provided by the Alabama State Data Center, a partnership between the U.S. Census Bureau (USCB) and the State of Alabama. The projections, released in August 2022, utilized population data from the latest decennial census (2020) and provided a county population estimate every 5 years beginning with 2025 and ending in 2040. Because the proposed renewal of the BFN Units would extend plant operations to the year 2056 as described in Chapter 1, the population growth trend established in state-provided population projection data was extended out to include the years leading up to 2056. To project population to 2056, the actual growth rate of population change for each county was established for the years between 2020 and 2040 as presented by the state demographer. Those rates were then applied to the years 2041 through 2056 using a straight line method, as shown in Table 3.16-1 (ASDC 2022, USCB 2020f).



Source: (ArcGIS 2021)

Figure 3.16-1. Counties within 20 Miles of BFN

Table 3.16-1. Colbert, Lauderdale and Limestone County Projected Population Estimates and Growth Rates

	Colbert County		Lauderdale County		Limestone County	
Year	**Projected Population**	**Average Annual Growth Rate (percentage per year)**	**Projected Population**	**Average Annual Growth Rate (percentage per year)**	**Projected Population**	**Average Annual Growth Rate (percentage per year)**
2020[a]	57,227		93,564		103,570	
2025[b]	57,803	1.01	94,966	1.50	112,669	8.79
2030[b]	58,380	1.00	96,368	1.48	121,768	8.08
2035[b]	58,956	0.99	97,770	1.45	130,867	7.47
2040[b]	59,532	0.98	99,172	1.43	139,966	6.95
2041[c]	59,652	0.20	99,469	0.30	142,425	1.76
2042[c]	59,772	0.20	99,767	0.30	144,928	1.76
2043[c]	59,892	0.20	100,066	0.30	147,474	1.76
2044[c]	60,013	0.20	100,366	0.30	150,066	1.76
2045[c]	60,134	0.20	100,667	0.30	152,702	1.76
2046[c]	60,255	0.20	100,969	0.30	155,385	1.76
2047[c]	60,376	0.20	101,271	0.30	158,116	1.76
2048[c]	60,498	0.20	101,575	0.30	160,894	1.76
2049[c]	60,620	0.20	101,879	0.30	163,721	1.76
2050[c]	60,742	0.20	102,184	0.30	166,598	1.76
2051[c]	60,864	0.20	102,491	0.30	169,525	1.76
2052[c]	60,987	0.20	102,798	0.30	172,503	1.76
2053[c]	61,110	0.20	103,106	0.30	175,534	1.76
2054[c]	61,233	0.20	103,415	0.30	178,619	1.76
2055[c]	61,356	0.20	103,725	0.30	181,757	1.76
2056[c]	61,480	0.20	104,036	0.30	184,951	1.76

a USCB 2020 decennial census. Source: (USCB 2020f)
b Projected population values for 2025, 2030, 2035 and 2040. Source: (ASDC 2022)
c Projected population values for 2041 and thereafter are based on the extension of the population projection growth trend established from 2020 to 2040.

As shown in Table 3.16-1, the projection population for Colbert County is estimated to be 61,480 in the year 2056, a 3.3 percent increase from projected year 2040. The average projected annual growth rate between 2040 and 2056 is 0.20 percent per year. The projected population for Lauderdale County is estimated to be 104,036 in the year 2056, a 4.9 percent increase from projected year 2040. The average projected annual growth rate between 2040 and 2056 is 0.30 percent per year. The projected population for fast growing Limestone County is estimated to be 184,951, a 32.1 percent increase from projected year 2040. The average projected annual growth rate for this period is 1.76 percent. Projected population density per square mile in Colbert, Lauderdale and Limestone Counties for the year 2056 would be 103.7, 155.7 and 330.3 respectively (USCB 2022b).

Population was estimated from the BFN site out to 20-mile and 50-mile radii using the results of the USCB 2020 decennial census and geographic information system (GIS) software (ArcView) to determine demographic characteristics in the BFN vicinity. Block Groups not wholly within the area were allocated on the basis of the land area within the area. According to this analysis, 225,115 individuals live within 20 miles of the BFN site, for a population density of 179 persons per square mile (USCB 2020f). A total of 1,074,109 persons live within 50 miles of the site, for a population density of 136 persons per square mile (USCB 2022b).

3.16.1.2. Environmental Consequences – Population

Alternative A – No Action Alternative

Under the No Action Alternative, BFN operating licenses would not be extended, resulting in a shutdown of BFN and the resulting loss of jobs. The loss of employment for approximately 1,681 employees residing in Colbert, Lauderdale and Limestone Counties would have a negligible effect on the permanent population. As of 2020, the combined population of the Counties was greater than 250,000. These employees comprise less than one percent of the combined population. All counties project population growth; thus, any adverse impact to population as a result of plant shutdown would be short-term and small.

In addition, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. This may help offset the loss of jobs from BFN if some BFN employees were able to transfer to the new facility, it may also result in a corresponding small shift in population should the new facilities be constructed outside of the BFN vicinity. The level of impacts to population associated with construction and operation of a new generation facility would vary depending on the workforce requirements for that facility. During construction there may be a temporary influx of workers to the area. The operational workforce would likely relocate permanently to within commuter range of the new facility. Overall impacts to population associated with construction of a replacement generation facility would depend to a great extent on the size of the population around the site and the availability of housing and amenities. Potential effects from construction and operation of a new facility would be evaluated in separate analyses once the new power generation construction project locations and technologies are specifically identified. Impacts could range from small to moderate.

Alternative B – Proposed Action

With little or no change in employment at BFN during the proposed subsequent period of extended operation, no impacts to regional population would be anticipated as a result of continued power plant operations. Consequently, TVA concludes that there also would be no incremental contribution to cumulative impacts to population from the continued operation of BFN.

3.16.2. Employment and Income

3.16.2.1. Affected Environment – Employment and Income

Employment data by industry sector for 2020 are presented in Table 3.16-2. In 2020, total employment (number of jobs) in Alabama was 2,612,469. Lauderdale County had the highest number of jobs (42,760) which represented 1.6 percent of the total jobs in the state. Colbert and Limestone Counties had 30,948 (1.2 percent) and 38,080 (1.5 percent) respectively (BEA 2020).

Table 3.16-2. Top Employing NAICS Industry Categories

	Colbert, AL	Lauderdale, AL	Limestone, AL	Alabama
Total employment (number of jobs)	30,948	42,760	38,080	2,612,469
Farm employment	2.1%	3.1%	3.3%	1.6%
Construction	8.5%	6.5%	10.0%	5.8%
Manufacturing	18.5%	6.3%	11.1%	10.3%
Retail trade	11.7%	13.8%	12.9%	10.5%
Health care and social assistance	7.3%	12.1%	4.5%	9.6%
Accommodation and food services	5.5%	8.9%	5.2%	6.7%
Other services (except government and government enterprises)	6.4%	7.2%	7.5%	6.3%
Government and government enterprises	15.6%	13.3%	19.4%	15.5%

Source: (BEA 2020).

Generally, the dominant industry sectors in the Counties are similar to those of the state, which were Government and government enterprises (15.5 percent), retail trade (10.5 percent) and manufacturing (10.3 percent). The dominant industry sectors in Colbert County were manufacturing (18.5 percent), government and government enterprises (15.6 percent) and retail trade (11.7 percent). Lauderdale County had a greater percentage share of retail trade (13.8 percent) and health care and social assistance (12.1 percent) as compared to the state and the other counties but a smaller percentage of government and government enterprises (13.3 percent). The dominant industry sectors in Limestone County were government (19.4 percent), retail trade (12.9 percent) and manufacturing (11.1 percent) (BEA 2020). The Counties had a greater percentage share of farm employment as compared to the state.

In 2020, per capita income in the state was $46,479. Per capita income in Colbert and Lauderdale Counties was less than the state at $41,941 and $40,729 respectively. Per capita income in Limestone County ($47,695) was higher than the other Counties and the state (BEA 2022).

The 2020 unemployment rate for the Alabama was 6.5 percent. In comparison, Lauderdale, Limestone and Colbert Counties had 2020 unemployment rates of 5.5, 4.3, and 6.6 percent, respectively (BLS 2020a, BLS 2020b).

3.16.2.2. Environmental Consequences – Employment and Income

Alternative A – No Action Alternative

Under the No Action Alternative, BFN operating licenses would not be extended, resulting in a shutdown of operations and the resulting loss of jobs. As of 2020, there were over 110,000 jobs in the three-County area. BFN employment represents approximately 1.5 percent of employment in the three-County area. The level of impact to individual communities would depend on whether BFN employees would choose to continue to work within or near their current communities, or whether they would choose to find employment elsewhere. Therefore, any adverse impact to employment and income as a result of plant shutdown would be small.

In addition, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. The necessary construction workforce would likely come from local and regional sources, creating hundreds of new and indirect jobs for several years. The phasing out of construction personnel and phasing in of a smaller operational workforce has the potential to cause a boom and bust scenario, where a community might not only experience a subsequent drop in overall populations, but also the need for staffing certain indirect jobs. This could result in substantial employment impacts to local communities and counties near the new generation site(s). An incoming permanent workforce would help offset the loss of certain jobs and also create others. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. The overall impacts could range from small to moderate, depending on specific site conditions.

Alternative B – Proposed Action
With little or no change in employment at BFN expected during the proposed subsequent period of extended operation, employment and income would not be affected by continued power plant operations. Because no impacts are expected to employment and income, TVA concludes that there also would be no incremental contribution to cumulative impacts to employment and income from the continued operation of BFN.

3.16.3. Housing

3.16.3.1. Affected Environment – Housing
TVA refuels each nuclear unit on a 24-month cycle on a staggered basis. During these refueling outages, site employment increases by approximately 900 temporary workers for 28 to 45 days. Some temporary workers are from the BFN vicinity whereas others come into the area for temporary stays and may require accommodations which could impact the availability of housing.

Table 3.16-3 provides the number of housing units and housing unit vacancies for the years 2000, 2010 and 2020. Between 2010 and 2020 available housing units grew 7.4 percent in Colbert County (USCB 2000, USCB 2012, USCB 2020e). The 2020 vacancy rate was 11.7 percent. During the same period, available housing units grew 1.8 percent in Lauderdale County. The 2020 vacancy rate was 11.3 percent (USCB 2000, USCB 2012, USCB 2020e). Available housing units in fast growing Limestone County grew 22.1 percent. The 2020 vacancy rate was 7.8 percent (USCB 2000, USCB 2012, USCB 2020e, USCB 2020g).

Table 3.16-3. Housing Units and Housing Units Vacant (Available) by County – 2000, 2010 and 2020

	2000	2010	2020	Percent (%) Change 2000-2010	Percent (%) Change 2010-2020	Percent (%) Change 2000-2020
Lauderdale County						
Housing Units	40,424	43,791	44,585	8.3	1.8	10.3
Occupied Units	36,088	38,680	39,544	7.2	2.2	9.6
Vacant Units	4,336	5,111	5,041	17.9	-1.4	16.3
Vacant Units Percent (%) of Total Units	10.7	11.7	11.3	0.9	-0.4	0.6

	2000	2010	2020	Percent (%) Change 2000-2010	Percent (%) Change 2010-2020	Percent (%) Change 2000-2020
Limestone County						
Housing Units	26,897	34,977	42,692	30.0	22.1	58.7
Occupied Units	24,688	31,446	39,365	27.4	25.2	59.4
Vacant Units	2,209	3,531	3,327	59.8	-5.8	50.6
Vacant Units Percent (%) of Total Units	8.2	10.1	7.8	1.9	-2.3	-0.4
Colbert County						
Housing Units	24,980	25,758	27,666	3.1	7.4	10.8
Occupied Units	22,461	22,773	24,425	1.4	7.3	8.7
Vacant Units	2,519	2,985	3,241	18.5	8.6	28.7
Vacant Units Percent (%) of Total Units	10.1	11.6	11.7	1.5	0.1	1.6

Source: (USCB 2000, USCB 2012, USCB 2020e)

Each of these counties had vacancy rates greater than 5 percent in 2020, indicating the availability of housing. Available housing remained flat (decreased less than 1 percent) as compared to 2010 when approximately 11,627 units were available in those three counties combined (USCB 2000, USCB 2012, USCB 2020e).

3.16.3.2. Environmental Consequences – Housing

Alternative A – No Action Alternative

Under the No Action Alternative, the loss of operational jobs could have a dampening effect on the housing market. Housing costs may slightly decrease, as a result of additional available housing caused by the possible migration of operational workers to other locations. This migration and subsequent reduction in housing costs could have a small temporary impact, however, these effects would be short-lived in fast growing Limestone County and should also be of short duration in Colbert and Lauderdale counties as well.

In addition, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. Depending on a site's proximity to a large labor force and an area's economic characteristics, construction workers might choose to commute from their established residences, seek short-term rental facilities within commuter range, or acquire more permanent housing in a local area near a potential site. Operational workers would be expected to move into the area within a commuting distance from the site. Residential locations would depend on the availability of suitable housing facilities and local zoning codes and could be located anywhere within the labor market area. The strains on localized housing markets could lead to increased prices for some types of housing and/or a potential shortage of accommodations. The demand for housing would begin to diminish after the peak construction employment level is reached and essentially disappear by the end of the construction period. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. Impacts on housing would be expected to range from small to moderate if a facility were located in a sparsely populated area with readily available housing. Impacts could range to large if a potential site were located in a sparsely populated area with little or no available housing.

Alternative B – Proposed Action

With little or no change in employment at BFN expected during the proposed subsequent period of extended operation, and no impact expected to regional population, housing availability and values would not be affected by continued power plant operations. TVA concludes that there also would be no incremental contribution to cumulative housing impacts from the continued operation of BFN.

3.16.4. Local Government Revenues

3.16.4.1. Affected Environment – Local Government Revenues

TVA does not pay property taxes; however, in accordance with federal law, Section 13 of the TVA Act, 16 U.S.C. 8311, TVA makes payments in lieu of taxation to states and counties in which its power operations are carried on and in which it has acquired properties previously subject to state and local taxation. Under Section 13, TVA pays 5 percent of its gross power revenues to such states and counties. Only a very small share of the payments is paid directly by TVA to counties; most is paid to the states, which use their own formulas for redistribution of some or all of the payments to local governments. TVA's payments in lieu of taxes are apportioned among the states and counties according to a complex allocation formula, but in general, half of the money is apportioned based on power sales and half is apportioned based on the "book" value of TVA power property.

Title 40 Chapter 28 of the Alabama State Code, updated in 2010, specifies how the state of Alabama distributes TVA payments in lieu of taxes to its counties (Alabama Legislature 2012). The State of Alabama retains 17 percent for general fund purposes, allocates 78 percent to TVA-served counties based on a formula of TVA's book value of power property and power sales, and redistributes 5 percent to dry counties and municipalities that are not served by TVA (Alabama Legislature 2012). TVA-served counties share a portion of their payment with cities (based on a population ratio), school systems, and hospitals within their boundaries. In 2022, Alabama’s payment in lieu of taxes allocation from TVA was $82.6 million.

According to the Annual Report to the Tennessee General Assembly, Tennessee receives more than 67 percent of the total distributed by TVA’s formula based on gross power revenues. Title 67, Chapter 9, Part 1 of the Tennessee Code Annotated specifies how the payments in lieu of taxes are distributed to cities and counties with additional payments set aside for local governments in counties with TVA construction. Local governments receive more than 40 percent of the amount TVA allocates to Tennessee for distributes through the state’s formula (State of Tennessee 2022). Tennessee’s payments in lieu of taxes allocation from TVA was $341.7 million in 2022.

3.16.4.2. Environmental Consequences – Local Government Revenues

Alternative A – No Action Alternative

Under the No Action Alternative, there would be a small impact on local government revenues due to the consequent change in TVA’s payments in lieu of taxes. As described in Section 3.16.4.1, TVA's payments in lieu of taxes are apportioned among the states and counties according to a complex allocation formula, but in general, half of the money is apportioned based on power sales and half is apportioned based on the "book" value of TVA power property. Therefore, changes in power sales at BFN would affect TVA’s payments in lieu of taxes to Alabama and the counties around BFN.

Additionally, construction and operation of replacement generation sources would result in a beneficial impact if the total amount of TVA-managed land in any individual county increased and if there were a change in power sales and the value of TVA power property in different areas of the Tennessee Valley. Revenue increases would be proportionally small. Any in-lieu-of-tax payment distribution to the local government(s) would be apportioned based on the specific state's legislative decision. Whether the local government's existing tax base is small or large, the disbursement would have a beneficial impact.

Alternative B – Proposed Action

With little or no change in regional population, operating employment levels at BFN, and payments in lieu of tax expected during the proposed subsequent period of extended operation, local government revenues would not be affected by continued power plant operations. Therefore, TVA also concludes that there would be no incremental contribution to cumulative impacts to local government revenue from the continued operation of BFN.

3.16.5. Police, Fire, and Medical Services

This section addresses impacts to police, fire, and medical services in the socioeconomic region of influence (Limestone, Lauderdale, and Colbert counties) where the majority of the BFN workforce resides. Additionally, Lawrence and Morgan counties which are located within the 6-milde vicinity of BFN are included due to their proximity to the plant and the possible need for emergency response support from these counties.

3.16.5.1. Affected Environment – Police, Fire, and Medical Services

If a situation evolves where outside emergency support becomes necessary at BFN, the plant communicates its need to a number of local and state emergency service agencies. Limestone, Lawrence, and Morgan Counties have a wide array of public safety agencies providing services to its residents, including a number of municipal police departments, sheriff's departments, volunteer and career community fire departments, emergency medical services, and area hospitals. Advance plans and arrangements have been made in conjunction with state and local authorities, where applicable, for warning the local populace of an emergency and possible evacuation response. Emergency response activities can include evacuating the area around the plant site, preventing entry of the public to affected areas, medical care of injured or exposed personnel, surveying affected areas for radioactivity, and restricting use of water supplies and foods. The following sections describe the police, fire, and medical services within the socioeconomic region of influence as well as within the 6-mile vicinity of BFN since they may need to respond to the facility in the event of an emergency due to proximity.

Limestone County

Limestone County has three police stations, two of which are associated with Athens (Limestone County 2021b). There are 27 fire departments in Limestone County, serving a population of 91,695 people in an area of 560 square miles, which is approximately one fire department per 3,396 people and one fire department per 20 square miles (CountyOffice.org 2021b). Unincorporated areas within the county are policed by the Limestone County Sheriff's Office which has several divisions including patrol, animal control, aviation, court security, and investigations (Limestone County 2021e). Limestone County also has two hospitals in Athens: Athens-Limestone Hospital and North Alabama Specialty Hospital (ALHA 2021).

Lawrence County

Lawrence County has five police stations associated with incorporated towns (Lawrence County 2021). There are 11 fire departments serving a population of 33,288 people in an area of 691 square miles. This is approximately one fire department per 3,026 people and one fire department per 62 square miles (CountyOffice.org 2021a). Unincorporated areas are served by the Lawrence County Sherriff's Office, whose divisions include administration, special services, civil processes, search and rescue, and patrol (Lawrence County 2022). Lawrence County also has one hospital in Moulton: Lawrence Medical Center (ALHA 2021).

Morgan County

Within Morgan County, the City of Decatur has six police zones (City of Decatur Alabama 2018b). Additionally, the City of Priceville has its own police department (City of Priceville 2021). There are 46 fire departments in Morgan County, serving a population of 119,157 people in an area of 580 square miles. There is one fire department per 2,590 people and one fire department per 12 square miles (CountyOffice.org 2021c). The Morgan County Sheriff's Office duties include enforcement of all federal, state, and local laws; maintaining peace and order in the county; protecting property and personal safety; providing professional public safety dispatching services and generally assisting citizens in need. Other responsibilities include, providing a safe and secure jail, ensuring proper care, custody, treatment, supervision and discipline for all persons committed to the custody of the Sheriff, and to properly receive and execute any and all legal civil processes referred to the Office of the Sheriff (Morgan County Sheriff 2021). Morgan County also has three hospitals in Decatur: Decatur Morgan Hospital, Decatur Morgan Hospital – Parkway Campus, and Decatur Morgan West Behavioral Medical Center (ALHA 2021).

Colbert County

Colbert County has nine police departments including multiple stations in Muscle Shoals and Tuscumbia (CountyOffice.org 2022i). There are 22 fire departments in Colbert County serving a population of 54,435 people over an area of 593 square miles. With 15 volunteer fire departments and 7 dedicated fire departments, Colbert County has one fire department per 2,474 people or one per 26 square miles (CountyOffice.org 2022c). Headquartered in Tuscumbia, the Sheriff's Department includes 31 full-time sworn officers; providing patrol of unincorporated areas and areas not covered by municipal police as well as enforcing foreclosures and repossessions (CountyOffice.org 2022a). Colbert County has five hospitals with four in Sheffield and one in Muscle Shoals (Alabama Public Health 2022, CountyOffice.org 2022e).

Lauderdale County

Lauderdale County has 11 police departments including stations in Florence and Rogersville (CountyOffice.org 2022j). There are 32 fire departments in Lauderdale County serving a population of 92,590 people over an area of 668 square miles. With 18 volunteer fire departments and 14 dedicated fire departments, Lauderdale County has one fire department per 2,893 people or one per 20 square miles (CountyOffice.org 2022d). Headquartered in Florence, the Sheriff's Department includes 35 full-time sworn officers; providing patrol of unincorporated areas and areas not covered by municipal police as well as enforcing foreclosures and repossessions (CountyOffice.org 2022g). Lauderdale County has three hospitals, Shoals Hospital, Eliza Coffee Memorial Hospital, and North Alabama Medical Center a 263-bed general hospital, all located in Florence (Alabama Public Health 2022, CountyOffice.org 2022f).

3.16.5.2. Environmental Consequences – Police, Fire, and Medical Services

Alternative A – No Action Alternative

Shutdown of BFN would result in a phased reduction in the need for public safety services should operational staff relocate out of the country in the event of BFN shutdown. Additionally, the need for emergency personnel sourced from agencies and organizations that support emergency preparedness plans for BFN would be greatly reduced. As described in Sections 3.16.1 and 3.16.2, respectively, the counties in the vicinity of BFN have a growing population and a number of employment options. Therefore, it is likely that the reduced need for public safety services would be offset by continued growth in these counties.

Support from local emergency service providers would become a necessity during the construction and operation of new generation sources needed to replace BFN. Depending on the proximity to population centers and the availability of emergency services in the vicinity of these generation resources, the influx of construction workers could impact the ability of an area’s police, fire, and medical facilities to provide support requiring additional resources. With workers leaving at the end of the construction phase, permanent investments made in the expansion of public safety services would support incoming operational staff and families expected to permanently move to the area, as well as other further county population growth. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. Overall, impacts on police, fire, and medical services would be expected to range from small to moderate.

Alternative B – Proposed Action

Under Alternative B, BFN License Renewal, little change in regional population and operating employment levels is anticipated during the proposed subsequent period of extended operation; thus, the impact to area’s police, fire, and medical services would remain consistent with current impacts. Therefore, impacts of SLR to public safety would be small to moderate.

3.16.6. Schools

This section addresses impacts to schools most likely impacted by BFN. Because the bulk of BFN workers and their families reside in Lauderdale, Limestone, and Colbert Counties (approximately 33 percent, 18 percent, and 10 percent of workers, respectively), impacts to Lauderdale, Limestone, and Colbert Counties are addressed.

3.16.6.1. Affected Environment – Schools

Lauderdale County

Lauderdale County has 26 public schools and 4 private schools serving a population of 92,590 (CountyOffice.org 2022l, CountyOffice.org 2022n). Lauderdale County is also home to two universities, both in Florence, namely Heritage Christian University and the University of North Alabama. The former university, accredited by the Association for Biblical Higher Education, provides Associate, Baccalaureate, and Master’s level biblical studies to a student body of 90. The latter is a comprehensive regional state university offering undergraduate and graduate degree programs to a student body of almost 7,100 (CountyOffice.org 2022b, Heritage Christian University 2022, ReviewSchools.org 2022).

Limestone County

Limestone County has one public school district with 17 schools in the district (Limestone County Schools 2022). There are three private schools in Limestone County serving a population of 91,695 people in an area of 560 square miles, which is approximately one private school per 186 square miles (CountyOffice.org 2021d). Athens City Schools is a K-12 public school district with seven schools and low student-to-teacher ratios (Athens City Schools 2021).

Limestone County also has two colleges. Calhoun Community College is Alabama's largest two-year college approximately 11 miles south of Athens in Tanner. The college offers a wide variety of associate degree programs and career/certificate programs and currently has over 12,000 students. Athens State University is located in downtown Athens and serves almost 2,800 graduates of state junior, community, and technical colleges and institutes (City of Athens 2021).

Colbert County

Colbert County has 28 public schools and 2 private schools serving a population of 54,435 (CountyOffice.org 2022k, CountyOffice.org 2022m). Colbert County is also home to Northwest Shoals Community College in Tuscumbia, Alabama (CountyOffice.org 2022h).

3.16.6.2. Environmental Consequences – Schools

Alternative A – No Action Alternative

Under the No Action Alternative, the loss of operational jobs could result in a loss of population in the counties surrounding BFN where a large percentage of BFN operational workers live (Section 3.16.3). This could have a dampening effect on school attendance if it results in out-migration of workers and their families, particularly in Colbert, Lauderdale, and Limestone counties where the majority of BFN workers currently live. There could also be a corresponding reduction in tax revenues and plant equivalent payments. However, as some operation workers and families could remain in the area and the population in the county is expected to grow, the overall impact is likely to be small.

In association with construction and operation of new replacement generation sources, it is expected that workers with accompanying family members would access available school facilities. For construction workers, the ability to find adequate housing and length of employment are two factors that could dictate whether they opt to have family members present during the time period when construction work is phasing out. It is expected that operational workers migrating to an area would be more likely to bring their families, resulting in an increased demand for school facilities. If a site were located in proximity to a populated metropolitan area with numerous schools, an influx of students would most likely be absorbed into a school system or enrollment would be spread among a number of school systems, thus having little impact on resources. Should a new generation facility be sited in a less populated area with fewer educational resources, the influx of new students from construction and operational worker families could cause a strain on a community's educational infrastructures. The arrival of workers and the facility would bring new monies to a region through direct and indirect spending, and in the long run, the costs of providing education for additional students should be offset by the increase in tax revenues and plant equivalent payments, therefore impacts should be small.

Alternative B – Proposed Action

Under Alternative B, BFN SLR would result in no change to operating employment levels at the plant. No new impacts to schools would be anticipated through this action. Consequently, TVA concludes there also would be no incremental contribution to cumulative impacts to schools from the continued operation of BFN.

3.17. Environmental Justice

Regarding environmental justice, EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, issued on February 11, 1994, is designed to focus the attention of federal agencies on the human health and environmental effects of its programs, policies, and activities on minority and low-income communities (59 FR 7629). The intent of EO 12898, EO 14008 (Tackling the Climate Crisis at Home and Abroad), EO 14096 (Revitalizing our Nation's Commitment to Environmental Justice for All), and related directives and regulations is to ensure that low-income and minority populations can meaningfully participate in the NEPA decision making process and are fully protected from bearing a disproportionate burden of negative effects resulting from proposed Federal actions. TVA evaluates potential environmental justice impacts as a matter of TVA policy and in line with EO 12898, EO 14008, EO 14096, and all related directives. TVA's environmental justice efforts begin with identifying minority and low-income populations that may be affected by proposed actions and identifying ways to fairly and meaningfully involve those communities in TVA's decision-making process. TVA's environmental justice review continues with identification of potential environmental impacts, their geographic locations, the significance of such effects, and whether those impacts may be disproportionately high and adverse compared to the population at large within the geographic area. If disproportionate impacts might occur, TVA works with the affected communities to identify what mitigative measures are available, and which could be implemented to minimize impacts.

TVA used 2020 decennial census data from the USCB to determine the percentage of the total population within Alabama for each minority category and to identify the aggregate minority populations. Estimates from the 2016-2020 American Community Survey were used to identify the low-income population. TVA used ArcView® GIS software to combine 2020 USCB block group data with Environmental Systems Research Institute tract-boundary spatial data to determine the minority and low-income characteristics of populations in the 20-mile radius of BFN.

The Council on Environmental Quality (CEQ) guidance for performing environmental justice reviews defines a "minority" population as: Hispanic, Latino, or Spanish origin; American Indian or Alaskan Native; Asian; Black or African American; Native Hawaiian and Other Pacific Islander; or individuals who identified themselves on a census form as being a member of two or more races (CEQ 1997). The guidance indicates that a minority population exists if either of the two following conditions exists:

- Exceeds 50 Percent – the minority population of an impacted area exceeds 50 percent or
- Meaningfully Greater – the minority population percentage of the impacted area is meaningfully greater (for this analysis at least 10 percent) than the minority population percentage in the geographic area chosen for comparative analysis.

CEQ guidance defines "low-income" by using USCB statistical poverty thresholds (NRC 2013) The guidance indicates that a low-income population exists if either of the two following conditions exists:

- Exceeds 50 Percent – the low-income population of an impacted area exceeds 50 percent or
- Meaningfully Greater – the low-income population percentage of the impacted area is meaningfully greater (for this analysis at least 10 percent) than the low-income population percentage in the geographic area chosen for comparative analysis.

3.17.1. Affected Environment – Environmental Justice

This section describes minority and low-income populations within the 20-mile radius of BFN. As discussed in Socioeconomics (Section 3.16) and shown in Figure 3.16-1, there are seven counties within a 20-mile radius of the site. Six counties are located within Alabama (Colbert County, Lauderdale County, Lawrence County; Limestone County, Madison County and Morgan County) and one within Tennessee (Giles County) (ArcGIS 2021). This geographic area was chosen because of the influence of BFN activities and the BFN workforce on socioeconomic conditions in the surrounding vicinity. The geographic unit used in the analysis to identify environmental justice communities of concern is the census block group. The State (Alabama and Tennessee as applicable) is the geographic area chosen for comparative analysis. All block groups located wholly or partly within 20 miles of BFN were included in the analysis. The 20-mile radius includes 172 block groups. The following sections describe the minority and low-income populations found within the 20-mile radius.

3.17.1.1. Minority Population

Table 3.10-1 presents the number of census tracts within each county that exceed the threshold for determining the presence of a minority population. For each of the 172 census block groups within 20 miles of BFN, TVA calculated the percent of the population for the aggregate minority population as well for each minority group (Black, Latino, Asian, Native American, Native Hawaiian, other, multi-race) and compared the result to the corresponding threshold percent to determine whether a significant minority population exists. For Alabama, the presence of a significant minority population was found in four of six counties (66.7 percent) and in 52 of 169 block groups (30.8 percent). In Tennessee, only one county (Giles County) lies within the 20-mile radius, and contained no minority block groups (USCB 2020a, USCB 2020h).

The most prevalent minority population in Alabama was Black or African American. As shown in Table 3.10-1, Black or African American populations exist in 15 block groups. Hispanic minority populations are the second most common and exist in 31 block groups, all in Alabama(USCB 2020a, USCB 2020h). No minority block groups exist in Giles County, the only county in Tennessee included within the 20-mile radius.

Figure 3.17-1 shows the aggregate minority population block groups within 20 miles of BFN. Figure 3.17-2 shows the significant Hispanic and Black or African American Block Groups within a 20-mile radius of BFN which tend to be concentrated in urban areas.

3.17.1.2. Low-Income Population

Table 3.17-1 presents the number of census tracts within each state and county that exceed the threshold for determining the presence of low-income populations. The “meaningfully greater” threshold yields a more conservative estimate. Based on an analysis of U.S. Census Bureau ACS 2016-2020 population estimates, TVA determined the percent of low-income block groups within the 20-mile radius from BFN. In Alabama, 14.8 percent of blocks groups were low-income. In Tennessee, there were no low-income block groups within the 20-mile radius. Figure 3.17-3 shows the locations of significant low-income populations within the 20-mile radius (USCB 2020c).

3.17.2. Environmental Consequences – Environmental Justice

<u>Alternative A – No Action Alternative</u>

Under the No Action Alternative, the loss of operational jobs would not disproportionately impact the minority and low-income populations within the vicinity of BFN. As discussed in Section 3.16-2, the resulting loss of operational jobs would have a negligible effect on population, employment, and income. Housing costs may slightly decrease, as a result of additional available housing caused by the possible migration of operational workers to other locations. This migration and subsequent reduction in housing costs could have a small temporary beneficial impact, however, these effects would be short-lived in fast growing Limestone County and in other nearby growing counties. The overall, impact to socioeconomic resources is expected to be short-term and small, and therefore, will not have a disproportionate impact to potential environmental justice communities of concern.

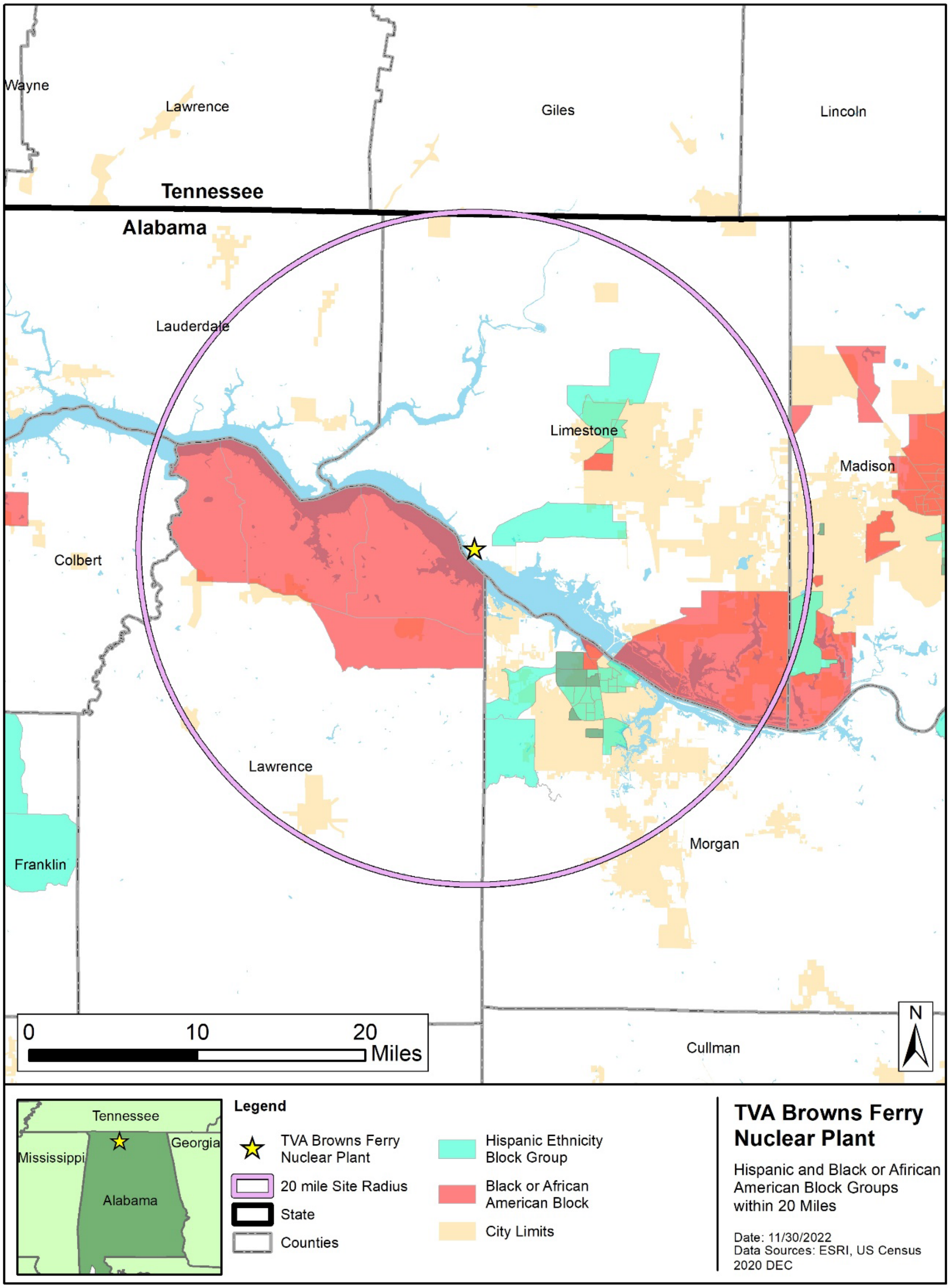


Figure 3.17-1. Minority Populations Within 20-Mile Radius of BFN

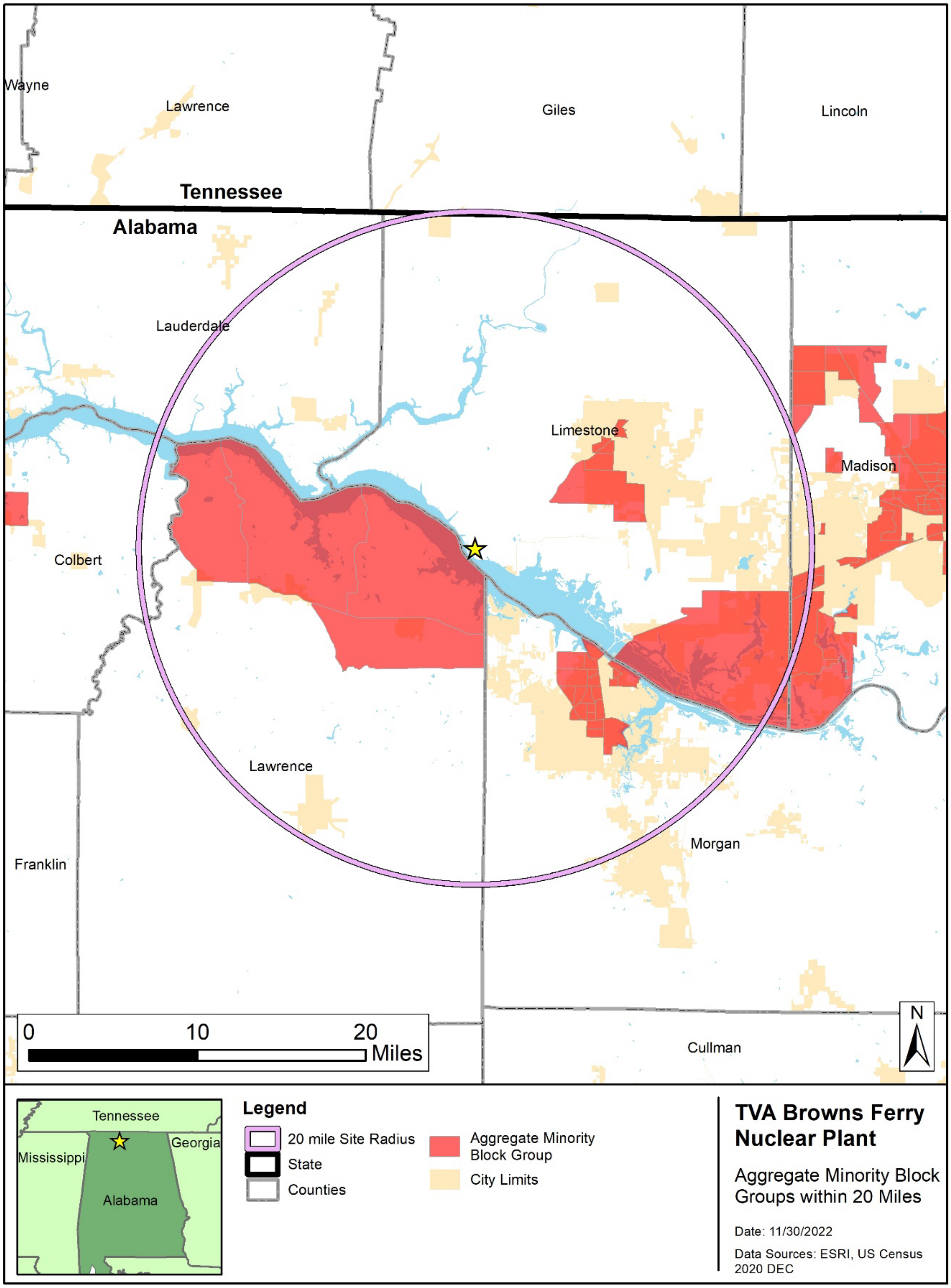


Figure 3.17-2. Aggregate Minority Populations Within 20-Mile Radius of BFN

Table 3.17-1. 2020 U.S. Census Race and Ethnicity Category and Low-Income Populations Within 20-Mile Radius

State / County	Total Number of Block Groups	Low-Income Block Groups	Minority Block Groups							
			Aggregate	Black or African American	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Multiracial	Hispanic
Alabama	**169**	**25**	**35**	**15**	**0**	**5**	**0**	**0**	**1**	**31**
Colbert	3	0	0	0	0	0	0	0	0	0
Lauderdale	10	0	0	0	0	0	0	0	0	0
Lawrence	27	4	4	4	0	0	0	0	1	0
Limestone	49	7	6	2	0	2	0	0	0	6
Madison	18	0	4	2	0	3	0	0	0	1
Morgan	62	14	21	7	0	0	0	0	0	24
Tennessee	**3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Giles	3	0	0	0	0	0	0	0	0	0

Source: (USCB 2020a, USCB 2020c, USCB 2020h)

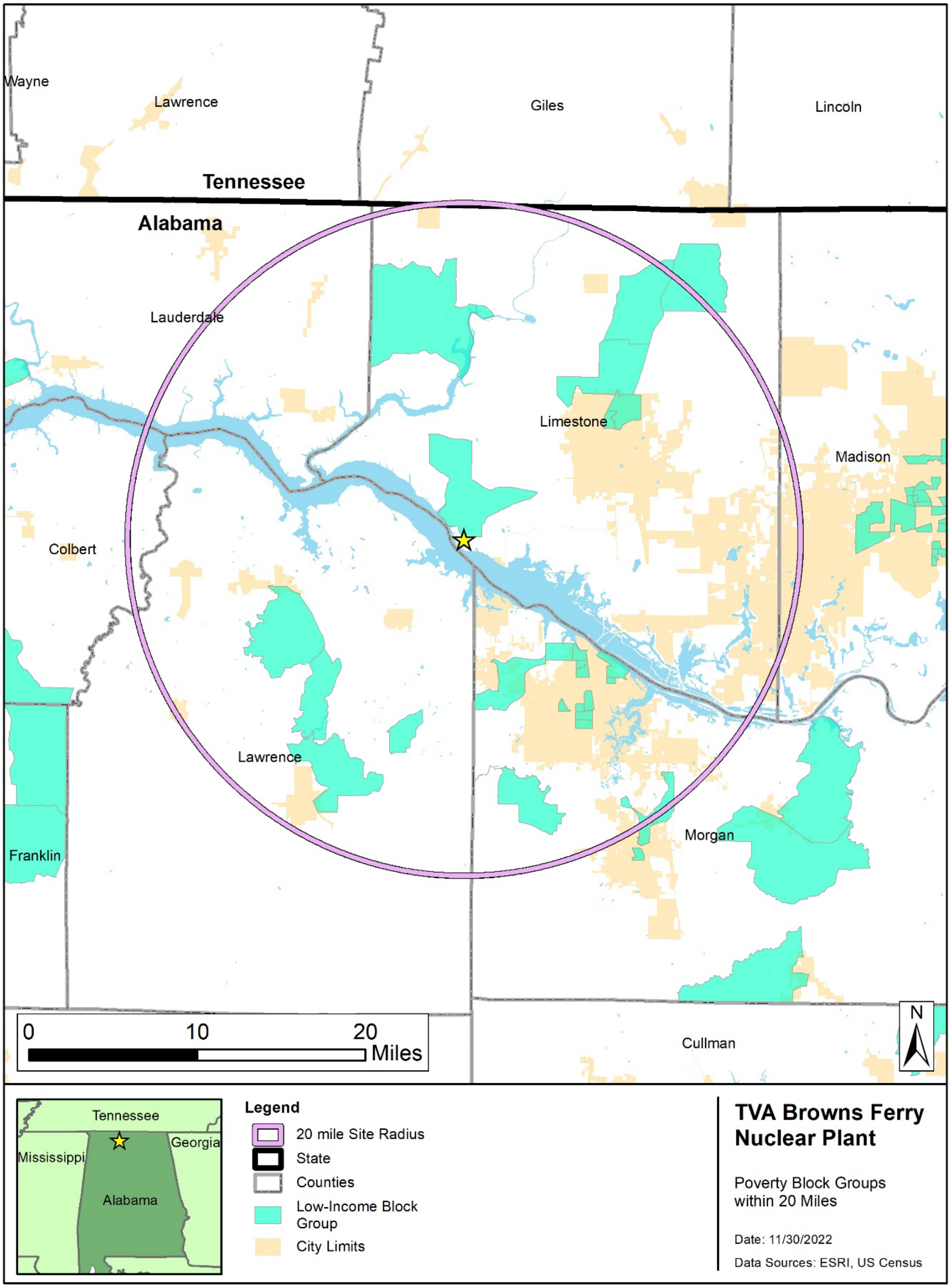


Figure 3.17-3. Low-Income Populations Within 20-Mile Radius of BFN

In addition, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. Environmental justice issues would depend on the proposed location. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. Potential impacts that might disproportionately impact minority or low-income communities include, for example, pressure on food and housing process, or increases in road congestion or noise near residential communities. The type and level of impact would vary depending upon proximity, mitigation measures, and general construction and operation practices. Impacts could range from small to moderate.

Alternative B – Proposed Action

The area of interest contains minority populations subject to consideration as potential environmental justice communities of concern. BFN SLR would result in no changes in operating employment levels at the plant. In its analysis of current conditions, TVA did not identify any location-dependent, disproportionately high and adverse impacts to minority and low-income populations resulting from continued operations of BFN. There would be beneficial impacts realized, such as sales taxes paid by TVA and BFN workers shopping in the vicinity of the plant. These in turn benefit local public services for the general population, including minority and low-income groups in the community. Based on the analysis of impacts for all resource areas presented, it is determined that there would be no significant adverse health impacts on members of the public or significant adverse environmental impacts on the physical environment (water, air, aquatic, and terrestrial resources) and socioeconomic conditions for continued plant operations. Therefore, there would be no disproportionately high and adverse environmental or economic effects on minority populations. Consequently, TVA concludes that there also would be no incremental contribution of the continued operation of BFN to the cumulative environmental justice conditions in the region during the proposed subsequent period of extended operation.

3.18. Archaeological and Historic Resources

As a federal agency TVA complies with Section 106 of the National Historic Preservation Act (NHPA) for TVA undertakings that have the potential to affect properties included or eligible for inclusion in the National Register of Historic Places (NRHP). As required by 36 CFR Part 800.1-13, TVA determines the undertaking's area of potential effects (APE), identifies appropriate consulting parties, and follows the processes for identifying historic properties, evaluating project effects, and resolving any adverse effects to historic properties. TVA follows these steps in consultation with the appropriate consulting parties including state historic preservation officers (SHPOs) and tribal governments. In addition, the Categorical Exclusion Checklist (for projects that do not require an Environmental Assessment [EA] or Environmental Impact Statement [EIS]) specifically includes consideration of actions which can potentially affect historic structures, historic sites, Native American religious or cultural properties, or archaeological sites.

BFN SLR qualifies as an undertaking with potential to affect historic properties (§800.16(y)) given that the project "may require maintenance actions or refurbishment to BFN to maintain consistency with the current licensing basis, as well as NRC and TVA requirements… [and that] plant improvements including intake structures, buried piping, and large external tanks would be expected upgrades for continued operation from 60 to 80 years." TVA has not yet identified plans for any such actions. However, if such actions were proposed in future, they could include modifications that have potential to alter the qualities that may lend historic significance to BFN, if BFN were determined eligible for inclusion in the NRHP, and could also include ground disturbing activities, which would have potential for effects to archaeological sites that may be eligible, or considered potentially-eligible, for inclusion in the NRHP. TVA determined the APE for the undertaking as BFN and all areas within the 880-acre reservation.

3.18.1. Affected Environment – Archaeological and Historic Resources

TVA has previously consulted with the Alabama SHPO regarding an undertaking that resulted in physical effects on BFN, the BFN Cooling Tower Additions Project, in 2010. TVA found that the cooling tower capacity upgrades would not appreciably alter the existing silhouette of BFN and would therefore have no visual effect (letter from Howard to Hathorn dated September 24, 2010). The Alabama SHPO agreed that the upgrades would not result in adverse effects to historic properties (letter from Brown to Howard dated October 25, 2010) but did not comment on BFN's NRHP eligibility. In informal email correspondence with AL SHPO in regards to the Thermal Performance Program EA, the SHPO clarified that "the 1974 cooling towers would not be National Register eligible due to age, the fact they were not part of the original design, and since they have lost their historic context" due to the replacement of five of BFN's six original cooling towers after 2010 (RE: TVA-Browns Ferry Nuclear Plant - Proposed cooling tower demo - section 106, email from Wofford to Cole dated March 6, 2020).

TVA completed an architectural assessment of the Browns Ferry Aquatic Research Facility (BFARF) in 2018 (Karpynec and Weaver 2018). Based on this assessment, TVA determined that the BFARF is eligible for the NRHP under the Secretary of the Interior's Criteria Consideration G of 36 CFR Part 60.4 ("A property achieving significance within the past 50 years if it is of exceptional importance") as a contributing resource to BFN, which although considered NRHP-eligible by TVA had not been determined eligible in consultation (Jones to Wofford May 21, 2018). The historic significance of the BFARF relates to TVA's efforts in the late twentieth century to study the environmental effects of heated water discharged from its nuclear-powered plants on regional aquatic life. The SHPO agreed by letter dated June 20, 2018. In consultation with SHPO, TVA proposed mitigation and prepared a draft Memorandum of Agreement (Jones to Wofford, September 19, 2018, October 12, 2018, and November 16, 2018), but TVA's plan to remove the BFARF was later cancelled, and the mitigation was not completed.

Because actions that may be completed by TVA in connection with the SLR could take place after BFN has reached or passed the 50-year age threshold for consideration as a historic property, TVA conducted a historic architectural inventory of BFN and assessment of BFN's eligibility for inclusion in the NRHP (Reynolds 2022) to identify historic properties in the APE as required by §800.4. Based on this study, TVA has determined that BFN currently is eligible for the NRHP under Criteria Consideration G as a historic district with a period of significance of 1966-1980. BFN will not meet the 50-year threshold for NRHP eligibility until 2023. However, given that the primary buildings and structures at BFN were completed between 1973 and 1976, they will soon meet the 50-year threshold to be eligible for the NRHP under Criteria A and C for their association with early nuclear energy development in Alabama and the TVA system, and as representative examples of nuclear energy engineering and architecture. The BFN historic district is comprised of 49 buildings and structures. The Unit 1, Unit 2, and Unit 3 Reactor Buildings are individually eligible, and 46 buildings/structures are eligible as contributing to the district. The contributing buildings/structures include, as examples: the Units 1-3 containment structures, multiple diesel generator buildings, the Intake Pumping Station, Turbine Buildings, Discharge Structure, BFARF, Meteorological Tower, Switchyard, and Warm Water Channel. Twenty structures within the boundaries of the district are considered non-contributing due to being built after 1980. The NRHP boundary is the BFN reservation boundary. Pursuant to the regulations implementing the NHPA, TVA provided this report (Reynolds 2022) to SHPO and invited their comments on the study and on the NRHP eligibility of BFN . The SHPO agreed with TVA's findings and eligibility determination (Wofford to Osborne, November 14, 2022). Based on this finding, BRF is considered a historic property and TVA must the consider potential effects on BFN from any future undertaking that has potential for effects on historic properties. This would include formal evaluation of potential effects and additional consultation with the SHPO.

In 2021, TVA conducted a Phase I archaeological survey (Dison et al. 2022) of undeveloped areas within the APE that had not been included in prior archaeological surveys meeting current survey standards, pursuant to Section 110 of the NHPA. The survey included systematic shovel testing and pedestrian survey of approximately 193 acres distributed across six separate areas. The survey revisited six previously-recorded archaeological sites (1LI24, 1LI284, 1LI286, 1LI287, 1LI856, and 1LI857) located within or adjacent to the survey area, and identified seven previously-unrecorded archaeological sites (1LI915, 1LI916, 1LI917, 1LI918, 1LI919, 1LI920, and 1LI921). Site 1LI24 is no longer extant, having been destroyed during construction of BFN. Site 1LI857 lacks intact deposits and is ineligible. Sites 1LI287 and 1LI856 have been combined into a single site (1LI287), and sites 1LI284 and 1LI286 also are combined into a single site (1LI284). TVA determined that sites 1LI284 and 1LI287 both have research potential and should be avoided by project activities, if possible. All seven newly recorded sites lack research potential and are ineligible for the NHRP. TVA consulted with the SHPO and federally-recognized Indian tribes who have an interest in Limestone County, Alabama ("Tribes") regarding the study and eligibility determinations. The SHPO agreed, and none of the Tribes disagreed or identified additional resources of concern in the APE. With the combined areas of this survey and prior archaeological surveys in the APE (Dison et al. 2022, Gage 2001, Gage and Hermann 2009, Marshall 2013, Stanton 2013) all areas within the APE that are not developed or subjected to heavy disturbance in the past (documented by construction drawings, historic photographs, or aerial imagery) have now been included in archaeological surveys meeting SHPO standards and TVA criteria for archaeological surveys. TVA has consulted with the SHPO and Tribes regarding each of these surveys, pursuant to §800.4. Besides sites 1LI284 and 1LI287, TVA and the SHPO have agreed that site 1LI535 also is potentially-eligible for the NRHP (Brown to Graham May 24, 2001).

When TVA acquired 880 acres of land in the 1960s for the construction of BFN, one historic cemetery, known as the Cox Cemetery, was located on the property. Soon after TVA's acquisition of the property TVA survey crews identified seven graves belonging to individuals with the family names Cox, Lang, and Madrey. Burial dates range from 1836 to 1908. In 1966 TVA relocated all seven graves to a new location within the BFN reservation (Gage 2001). TVA does not consider the cemetery eligible for inclusion in the NRHP. However, TVA does consider the cemetery to be a sensitive cultural resource and has complied with Alabama state statutes regarding the treatment of human remains.

In February 2023, a desktop cultural review was conducted to examine the extent of inventoried archaeological and historic resources present within a 6-mile buffer surrounding BFN. This review considered the data maintained by the Alabama Historical Commission (AHC), as well as the NRHP and National Historic Landmarks. This review indicated that a total of 10 cultural resources have been inventoried previously within or directly adjacent to the BFN, all of which represent archaeological sites. An additional five archaeological sites have been recorded within 1,000 feet of BFN. A total of 59 aboveground resources are situated within 6 miles of BFN inventoried previously with the AHC architectural survey. The closest resources to BFN, a pair of ca. 1925 houses (LA 0520 and LA 0519) are located approximately 2.5 miles to the west of BFN on the opposite side of the Wheeler Reservoir. Out of the 59 aboveground resources, 50 are identified as residential with the remaining nine consisting of a church and eight commercial/

stores. None of these resources are currently listed in either the NRHP or the Alabama Register; however the data obtained from the AHC note Determination of Eligibility status for all the resources. A total of 19 aboveground resources are noted as having a Determination of Eligibility of eligible with the remaining 40 classified as not eligible. Due to the modern land use and intervening topography, none of these resources appear to be directly visible from BFN.

3.18.2. Environmental Consequences – Archaeological and Historic Resources

Alternative A – No Action Alternative

The No Action Alternative would result in the shutdown and decommissioning of BFN. TVA would anticipate continuing operations at BFN until the end of the current license period (2033, 2034, and 2036 for Units 1, 2, and 3 respectively). As described above, BFN will be eligible for the NRHP by 2023. Therefore, any decommissioning activities, including but not limited to demolition could result in adverse effects to the NRHP-eligible BFN historic district and contributing structures. Once decommissioning plans are available, TVA will review the plans, identify whether any of the contributing resources to the BFN historic district or potentially-eligible archaeological sites would be affected, and consult further with the appropriate consulting parties regarding TVA's evaluation of effect. Should any activity related to decommissioning be proposed that would modify BFN or affect any of the potentially-eligible archaeological sites, TVA will follow the steps of §800.5 for assessing adverse effects and, if required, the steps of §800.6 for resolving adverse effects. Should future TVA plans have potential for adverse effects on any NRHP-eligible resources TVA will take the consulting parties' comments into consideration in developing ways to avoid, minimize, or mitigate any adverse effects. If adverse effects cannot be avoided, TVA will, in consultation with the appropriate consulting party(-ies), prepare a treatment plan including mitigation for the adverse effect, and will notify the Advisory Council on Historic Preservation. TVA will continue to avoid any activities that would disturb any of the graves in the relocated Cox Cemetery. Should TVA propose any activity that would physically affect the cemetery, TVA would voluntarily complete steps consistent with state statutes regarding cemeteries and human remains. With these mitigation measures and commitments, TVA finds there would be no effect to archaeological and historic resources at BFN as a result of the No Action Alternative.

Construction of new generation resources whether at BFN or elsewhere in the Tennessee Valley would constitute an undertaking under Section 106 of the NHPA. All lands involved in the undertaking would likely need an inventory and evaluation of cultural resources to identify historic properties and may require avoidance plans or other actions to mitigate adverse effects from proposed ground-disturbing actions and/or visual effects related to physical activities at the proposed site. The studies would likely be needed for all areas of potential disturbance at the proposed site(s) and along associated corridors where new construction would occur (e.g. roads, transmission and pipeline corridors, or other ROWs). The effects on cultural resources could, depending on the site, range from small to large. The anticipated NHPA Section 106 process would ensure that any historic properties would be properly identified and managed and that potential impacts would be considered and mitigation developed as appropriate. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

TVA has not identified specific actions with potential for effects on BFN or archaeological sites in the APE. Should such plans be developed in future, TVA will review the plans, identify whether any of the contributing resources to the BFN historic district or potentially-eligible archaeological sites would be affected, and consult further with the appropriate consulting parties regarding TVA's evaluation of effect. Should any activity related to SLR be proposed that would modify BFN or affect any of the potentially-eligible archaeological sites, TVA will follow the steps of §800.5 for assessing adverse effects and, if required, the steps of §800.6 for resolving adverse effects. Should future TVA plans have potential for adverse effects on any NRHP-eligible resources TVA will take the consulting parties' comments into consideration in developing ways to avoid, minimize, or mitigate any adverse effects. If adverse effects cannot be avoided, TVA will, in consultation with the appropriate consulting party(-ies), prepare a treatment plan including mitigation for the adverse effect, and will notify the Advisory Council on Historic Preservation. TVA will continue to avoid any activities that would disturb any of the graves in the relocated Cox Cemetery. Should TVA propose any activity that would physically affect the cemetery, TVA would voluntarily complete steps consistent with state statutes regarding cemeteries and human remains. With these mitigation measures and commitments, TVA finds there would be no effect to archaeological and historic resources at BFN as a result of the proposed period of subsequent operations.

3.19. Hazardous, Solid, and Low-Level Radioactive Wastes

Solid wastes generated in conjunction with operation of BFN include hazardous, non-hazardous, universal, and sanitary wastes. are managed in accordance with applicable federal and state regulations as implemented through corporate procedures. Spent nuclear fuel storage and disposal are discussed in Section 3.21.

3.19.1. Affected Environment – Hazardous, Solid, and Low-Level Radioactive Wastes

General Plant Trash

BFN generates municipal solid waste commonly known as "trash" or "garbage" consisting of food waste, plastic film, paper waste, and food product packaging waste. Solid wastes are disposed in permitted disposal facilities. General municipal solid waste is collected as part of routine plant operation activities and is contracted and managed through Republic Service. . Waste material is collected in dumpsters and transported to. Republic Service's Morris Farms Landfill in Lawrence County, Alabama. BFN has an active recycling program that segregates and recycles scrap metal; cardboard; white, mixed, and office paper; food cans; wood pallets; plastic, glass, and aluminum containers; and batteries. The segregated materials are accepted for recycling by TVA-approved vendors.

Construction and Demolition Debris

BFN disposes of construction and demolition (C&D) solid waste at Republic Service's Morris Farms Landfill in Lawrence County, Alabama. Produced directly or incidentally by construction and demolition at BFN, these C&D wastes include scrap lumber, bricks, sandblast grit, crushed metal drums, glass, wiring, non-asbestos insulation, roofing materials, building siding, scrap metal, concrete with reinforcing steel, nails, wood, electrical wiring, rebar, bricks, concrete, excavated dirt, tree stumps, and rubble.

Hazardous Waste

BFN generates small quantities of hazardous waste (including universal waste) during operation and refurbishment. Management of hazardous wastes generated, is strictly regulated by the USEPA or the responsible state agencies per the requirements of the Resource Conservation and Recovery Act (RCRA).

BFN maintains non-radioactive waste-related permits and licenses (ADEM NPDES Facility Permit No. AL0022080 and ADEM RCRA Regulated Waste Permit No. AL8640015410). A hazardous material coordinator ensures the proper sampling, packaging, storage, shipping analysis, and disposal of hazardous materials generated at BFN and is supported by corporate environmental services. BFN utilizes permitted and licensed vendors to transport and recycle or dispose of waste. Vendors and suppliers are managed and vetted at the corporate level.

Under RCRA standards, BFN is currently classified as a small quantity generator of hazardous waste with less than 2,200 pounds/month. BFN did not generate more than 1,323 pounds in any one month during the 2016 to 2022 period. As a result of two separate planned episodic generation events, BFN generated 6,376 and 3,468 pounds of hazardous waste in December 2020 and October 2021.

Hazardous and universal wastes are collected and recycled or disposed, as applicable, through firms listed on the Environmental Restricted Awards List. TVA has procedures in place for handling hazardous and universal wastes.

Used Oil

As defined in the RCRA regulations, used oil is not hazardous waste. Generated at BFN as a result of maintenance activities on plant equipment, all used oil at BFN is collected, stored on site, and shipped to an approved recycling center for energy recovery by an approved vendor.

Low-Level Radioactive Waste

LLRW and potentially radioactive wastes include spent resin material, filter sludges, contaminated rags, clothing, and paper products, contaminated reactor internal parts, and other processing media from the liquid radioactive waste disposal system. The contaminated reactor internal parts are removed from the core and either stored in an approved onsite storage facility or shipped offsite for storage and disposal. The spent resin materials and filter sludges are dewatered and temporarily stored onsite before being shipped offsite for storage and disposal based on radioactivity classification. The contaminated rags, clothing, and paper products are collected and packaged onsite before being shipped offsite for disposal.

BFN would continue to generate radioactive solid waste and ship it offsite for disposal during the proposed subsequent period of extended operation. BFN has sufficient existing capability to temporarily store all generated LLRW onsite. No additional construction of onsite storage facilities is necessary for LLRW storage during the proposed subsequent period of extended operation, as BFN has contracts in place with licensed waste haulers to transport LLRW offsite for disposal. It is processed and packaged for shipping, and subsequently shipped by truck in accordance with applicable U.S. Department of Transportation (DOT) regulations on county, state and federal roads and highways.

BFN ships LLRW to the following licensed disposal sites:

- EnergySolutions in Clive, Utah; and
- Waste Control Specialists in Andrews, Texas.

Routine plant operations, refueling outages, and maintenance activities that generate LLRW would continue during the proposed subsequent period of extended operation.

Mixed Waste

BFN infrequently generates small quantities of mixed waste [i.e., waste that contains both radioactive material and Toxic Substances Control Act-regulated items, e.g., PCBs, asbestos, and or RCRA-regulated items, e.g., listed or exhibits characteristic of hazardous wastes]. In accordance with TVA procedures, mixed waste generated at BFN is collected and stored based on its hazardous constituents and applicable RCRA waste storage time limits before being shipped offsite by trained and certified personnel to a permitted/licensed vendor. Environmental personnel ensure all applicable USEPA, state environmental agency, and DOT regulations are met.

3.19.2. Environmental Consequences – Hazardous, Solid, and Low-Level Radioactive Wastes

Alternative A – No Action Alternative

The decommissioning process would increase the volume of C&D and LLRW generated at BFN. All handling and disposal of non-radioactive and radioactive wastes during the decommissioning phase would be in accordance with applicable rules, regulations, and requirements of local, state, and federal laws. All waste would be properly disposed of in licensed landfills or processed by licensed vendors to recover as much waste as practicable. While the volumes of C&D waste and LLRW would increase during decommissioning, the total waste volumes from decommissioning of lands and structures contributes a small percentage of the filling up capacity at planned disposal sites. Special chemicals used for decontamination would be in accordance with all applicable permits, and personnel would be trained in handling hazardous materials. Therefore, the impact on the environment from waste generated during the period of decommissioning would be small.

The quantities and types of solid waste generated by the construction and operation of replacement generation resources would be determined primarily by the number of acres, the initial condition of the selected site(s), and the location and type of technology chosen. During construction, there would be large volumes of dirt, concrete, wood, metal, and packing materials to dispose of in appropriate landfills. Any construction and demolition wastes generated during the building and renovation process would be managed through the TVA waste disposal contracts to access the permitted disposal capacity or recycling facilities, as needed. Additionally, new generating capacity could require new, and potentially extensive, transmission lines. Construction of new transmission lines, structures, and development of ROWs has a potential to produce large volumes of solid waste; however, potential effects from construction and operation of replacement generation resources would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. Overall, impacts would be anticipated to be small.

Alternative B – Proposed Action

Under Alternative B , there would be no major construction activity and C&D waste generated as a result of normal plant operations would be minimal and would be disposed of in a state-approved landfill. Solid waste generation would continue as currently generated at BFN. BFN would keep its regulated waste permit for hazardous waste and retain its status as a small quantity generator. LLRW would continue to be generated during the proposed subsequent period of extended operation.

Waste would continue to be handled in accordance with TVA-approved procedures, which ensure that all federal regulations and limits pertaining to hazardous, solid, and LLRW are met. Therefore, impacts to the public and the environment resulting from processing, storage, and transportation of such waste are small, and would continue to be small during the proposed subsequent period of extended operation.

Waste generated from decommissioning would not be avoided under Alternative B; they would be delayed until the end of the proposed subsequent period of extended operation. As described for Alternative A, all decommissioning waste would be handled and disposed in accordance with all applicable rules, regulations, and requirements of local, state, and federal laws. Therefore, as under Alternative A, the impacts to the public and the environment from management of decommissioning derived waste would be small.

3.20. Radiological Effects of Normal Operations

This section discusses the potential radiological dose to the public during normal operations of BFN. To evaluate the radiological dose on the surrounding environment during normal operations of BFN, TVA has implemented a REMP in the vicinity of BFN since 1968 (CNS and GEL Labs 2022). Through this program, radiological impacts on non-radiological workers, the public and the environment are monitored, documented, and then compared to standards. The results from the REMP are reported in the Annual Radiological Environmental Operating Report (AREOR). BFN's 2021 AREOR documented that all doses to the public were within as low as reasonably achievable (ALARA) criteria established by 10 CFR Part 50, Appendix I. Additionally, there were no detectable increase in background direct radiation levels identified in areas surrounding BFN.

3.20.1. Affected Environment – Radiological Effects of Normal Operations

The estimated total natural background radiation dose to the public within 50 miles of BFN is approximately 332,000 person-rem/year. The natural background dose is based on an individual person dose of approximately 310 millirem per year (mrem/yr) (NRC 2020) and a population of 1,074,109 people within the 50 miles (USCB 2022b). Background radiation comes from a variety of sources such as cosmic radiation, soils and rocks, radon, weapons testing, medical x-rays, smoke detectors, and smoking. However, the specific estimate of 310 mrem/yr does not include medical or dental procedures such as x-rays.

3.20.1.1. Occupational

Occupational radiological impacts refer to radiation dose received by individuals in the course of their employment. Depending on work assignments, occupational radiation exposure is possible for workers who have received radiation safety training and are classified as radiological workers. NRC regulations in 10 CFR Part 20 require that occupational radiation exposures be kept ALARA with a limit on the annual total effective dose equivalent for individual radiation workers of 0.05 sieverts (5 rem) per year. Data from NRC indicate that BFN occupational radiation exposures fall within the range of those for other operating boiling water reactors with a 3-year average total effective dose equivalent per worker for 2018 through 2020 of 1.36 millisieverts (0.136 rem) (NRC 2022).

3.20.1.2. Public

Commercial nuclear power reactors, under controlled conditions, release small amounts of radioactive materials to the environment during normal operation. These releases result in radiation doses to humans that are small relative to doses from natural radioactivity. Nuclear power plant licensees must comply with NRC regulations (e.g., 10 CFR Part 20, Appendix I to 10 CFR Part 50, 10 CFR 50.36a, and 40 CFR Part 190) and conditions specified in the operating license. Radiation doses to the public from continued operations would be expected to continue at current levels and would be well below regulatory limits during the proposed subsequent period of extended operation. The BFN Annual Radioactive Effluent Release Reports for 2020 and 2021 were reviewed and the results indicated that the annual public dose is a fraction (less than one percent) of the regulatory limits and were in accordance with radiation protection standards identified (TVA 2021b, TVA 2022b).

<u>Radiation Doses to Members of the Public</u>

The ODCM reports the estimated doses to the maximally exposed individual and the general population during routine operations for both the radioactive liquid and gaseous effluent pathways. The maximally exposed individual is a hypothetical individual member of the public who would live continuously at the location that would allow him to receive the maximum dose by being exposed to the plant radioactive effluents.

Estimated doses to the maximally exposed member of the public due to radiological effluent releases from BFN are calculated on an annual basis. These dose values have consistently been very low, typically only a small fraction of applicable limits. For example, the maximum calculated whole-body dose for liquid releases in 2021 was 0.00263 mrem/year, or <1 percent of the applicable limit (10 CFR Part 50 Appendix I, 3 mrem/year) (TVA 2022b). The maximum calculated whole-body dose for gaseous releases in 2021 was 0.0431 mrem/year which represented 0.29 percent of the limit (10 CFR Part 50 Appendix I, 15 mrem/year) (TVA 2022b). The calculated annual total quantity dose from the pathway Beta Air for gaseous releases in 2021 was 2.81E-05 mrad or <1 percent of the applicable limit (10 CFR Part 50 Appendix I, 20 mrad/year for beta radiation). The calculated annual total quantity dose from the pathway Gamma Air for gaseous releases in 2021 was 0.0002 mrad or <1 percent of the applicable limit (10 CFR Part 50 Appendix I, 10 mrad/year for gamma radiation).

Exposure Pathways

Evaluation of the potential impacts to the public from normal operational releases is based upon the probable pathways to individuals, populations, and biota near BFN. The exposure pathways are described in federal regulations of the NRC Regulatory Guides 1.109 and 1.111. There are two critical pathways by which radioactive materials can move through the environment to humans: air and water. The air pathway can be separated into two components: the direct (airborne) pathway and the indirect (ground or terrestrial) pathway. Human exposure through the water pathway may result from liquid effluents and from drinking water, eating fish, or by direct exposure at the shoreline.

The BFN Offsite Dose Calculation Manual (ODCM) specifies the requirements for monitoring specific exposure pathways. The ODCM is based on current conditions at the site and in the surrounding community so that monitoring and sampling can be altered as necessary. Dose calculations to members of the public are based on the guidance of the ODCM. The ODCM can be modified to include new pathways if needed or to exclude pathways if the conditions warrant.

TVA has monitored environmental impacts from BFN operations on the surrounding environs and the general public by implementing its REMP since 1968 (CNS and GEL Labs 2022). The REMP conducted for BFN is designed to monitor the primary pathways for exposure to humans. The BFN REMP includes measurement of direct radiation levels and collection and analysis of various sample types. Monitoring for the liquid pathway includes samples of fish, shoreline sediment and water from Wheeler Reservoir. The airborne pathway is monitored by direct sampling for air particulates and gaseous radioiodine and sampling of milk, soil, and food crops that could be affected by the deposition of airborne radionuclides.

The results from the REMP are reported in the AREOR. The data reported in the BFN AREOR demonstrate that the small amounts of radiological effluents released to the environment due to the operation of BFN have had no measurable impact on the environs around BFN. For example, the 2021 REMP states, “Only naturally occurring radioactivity was identified in all fish and local crop samples, as well air particulate, surface water and shoreline sediment samples” (CNS and GEL Labs 2022).

Exclusion Area Boundary

As defined in federal regulations of the NRC (10 CFR Part 100), the Exclusion Area Boundary (EAB) is the area surrounding the reactor in which TVA has the authority to determine all activities, including exclusion or removal of personnel and property from the area, and the boundary on which limits for the release of radioactive effluents are based. The EAB is shown as the site boundary in Figure 1.2-3. There are no residents living in this exclusion area. Access within the EAB is controlled by TVA, and no restricted areas within the EAB are accessible to members of the public. Areas outside the EAB are unrestricted in the context of federal regulations of the NRC (10 CFR Part 20) and open to the public. The nearest resident lives just east of the EAB about 0.9 miles from the center of the reactor building (CNS and GEL Labs 2022).

Radiological Doses Due to Liquid Effluents

The release of small amounts of radioactive liquid effluents are allowed for BFN as long as releases comply with the requirements specified in federal regulations of the NRC (10 CFR Part 20) and the ODCM (TVA 2023). The liquid effluent exposure pathways given above were considered in the evaluation of radiation doses to the public resulting from radioactive liquid effluent releases. Current analyses of potential radioactive doses to members of the public due to releases of radioactivity in liquid effluents are calculated using the methodology provided in the ODCM.

The resulting calculated doses to an individual due to liquid effluents released from BFN for the years 2022, 2021 and 2020 are given in Table 3.20-1. The dose controls and limits of the ODCM, based NRC regulations (10 CFR Part 20, Appendix B, Table 2, Column 2 for concentrations of effluent releases and 10 CFR Part 50, Appendix I for any individual) are annual limits of 3 mrem or less to the total body and 10 mrem or less to any organ while the quarterly limits are 1.5 mrem or less to the total body and 5 mrem or less to any organ (TVA 2023) . The annual and quarterly limits are designed to assure that doses due to releases of radioactive material from nuclear power reactors to unrestricted areas are kept as low as practicable during normal conditions.

Table 3.20-1. Calculated Dose to Individuals From Liquid Effluents, 2020-2022

Year	Quarter	Age Group	Total Body Dose	Quarter Limit	% of Limit
2022	1	Adult	2.97E-04 mrem	1.5 mrem	< 1
2022	2	Adult	2.38E-05 mrem	1.5 mrem	< 1
2022	3	Adult	0.00E+00 mrem	1.5 mrem	< 1
2022	4	Adult	3.09E-04 mrem	1.5 mrem	< 1
2021	1	Adult	1.60E-03 mrem	5 mrem	< 1
2021	2	Adult	1.01E-03 mrem	5 mrem	< 1
2021	3	Adult	3.50E-06 mrem	5 mrem	< 1
2021	4	Adult	1.90E-05 mrem	5 mrem	< 1
2020	1	Child	1.30E-04 mrem	1.5 mrem	< 1
2020	2	Child	2.00E-04 mrem	1.5 mrem	< 1
2020	3	Adult	6.80E-04 mrem	1.5 mrem	< 1
2020	4	Adult	4.70E-04 mrem	1.5 mrem	< 1

Source: (TVA 2021b, TVA 2022b, TVA 2023)

BFN submits annual reports to the NRC detailing the release of radioactive liquid effluents for the previous year. These annual radioactive effluent release reports include summations of all radioactive liquid releases and the resulting doses for individuals and the total population, as well as the quantities of radioactive nuclides released. The overall results expected from normal operations of BFN are as follows:

- Each unit meets the dose guidelines given in 10 CFR Part 50, Appendix I.
- The dose estimates to the public are a small fraction of the Appendix I guidelines.
- The analyses of the radiological impact to humans from liquid releases in TVA's REMP for BFN continue to conform to the ALARA criterion.
- The impact to members of the public resulting from normal liquid effluent releases is minor and presents minimal risk to the health and safety of the public.

Table 3.20-2 provides the calculated quarterly total body doses to the total population in the 50-mile radius of BFN for the years 2022, 2021 and 2020 from liquid and gaseous effluents released. The natural background radiation causes an estimated dose of 332,000 person-rem/year to the population within the 50-mile radius of BFN. Therefore, BFN is contributing a dose so minor that it cannot be distinguished from the variations in the natural background radiation dose, as was expected in TVA's REMP for BFN.

Table 3.20-2. Calculated Quarterly Total Population Doses (Liquid and Gaseous) to the Total Population in a 50-Mile Radius of BFN, 2020-2022

Year	Quarter	Total Population Dose by Quarter (person-rem) Liquids	Total Population Dose by Quarter (person-rem) Gases
2022	1	2.00E-02	1.71E-01
2022	2	3.20E-04	2.05E-01
2022	3	0.00E+00	2.55E-01
2022	4	2.50E-02	1.63E-01
2021	1	4.50E-02	1.93E-01
2021	2	6.90E-02	2.26E-01
2021	3	4.60E-05	2.68E-01
2021	4	2.40E-04	1.81E-01
2020	1	8.30E-03	2.39E-01
2020	2	1.20E-02	2.59E-01
2020	3	3.90E-02	2.65E-01
2020	4	2.00E-02	2.17E-01

Source: (TVA 2021b, TVA 2022b, TVA 2023)

Radiological Impact of Gaseous Effluents

Gaseous effluents considered in the offsite dose calculation include fissions and activation gases and iodines and particulates with half-lives greater than eight days (TVA 2023). TVA uses its offsite dose calculation manual to provide methods and procedures for calculating offsite doses and to demonstrate that releases do not exceed the dose limits of 10 CFR Part 50 Appendix I.

The current analyses of potential doses to members of the public due to releases of radioactivity in gaseous effluents are performed using the methodologies described in the BFN ODCM. The methods described are based on NRC guidance for determining the doses for releases of radioactive effluents from nuclear power plants into the atmosphere provided in Regulatory Guide 1.109, *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I, Revision 1* (NRC 1977).

The release of fission and activation gases is regulated by the dose limits of 10 CFR Part 50 Appendix I and BFN ODCM. The air dose to areas at and beyond the site boundary due to noble gases released in gaseous effluents per unit shall be limited during any calendar quarter to ≤ 5 millirad (mrad) for gamma radiation and ≤ 10 mrad for beta radiation; and during any calendar year to ≤ 10 mrad for gamma radiation and ≤ 20 mrad for beta radiation.

The release of radioiodines and particulates in gaseous effluent is regulated by the dose limits of 10 CFR Part 50 Appendix I and the BFN ODCM. The dose to a member of the public from radioiodines, radioactive materials in particulate form, and radionuclides other than noble gases with half-lives greater than eight days in gaseous effluent released per unit to areas at and beyond the site boundary shall be limited to any organ during any calendar quarter to ≤7.5 mrem, and during any calendar year to ≤15 mrem. Table 3-20-3 provides a summary of gaseous effluent releases for the years 2022, 2021 and 2020.

Table 3.20-3. Gaseous Effluent Releases from BFN, 2020-2022

Year	Fission and Activation Gases (Ci)	Particulates (Ci [$T_{1/2}$ > 8 days])	Iodines (Ci)	Tritium (Ci)	Carbon14 (Ci)
2022 1st Quarter	6.92E+00	8.06E-04	1.86E-03	6.89E+01	1.19E+01
2022 2nd Quarter	2.40E+00	1.92E-04	1.48E-05	5.27E+01	1.38E+01
2022 3rd Quarter	3.10E+00	8.61E-05	5.81E-05	9.34E+01	1.38E+01
2022 4th Quarter	5.90E+00	5.87E-04	3.37E-05	3.24E+01	1.21E+01
2021 1st Quarter	< LLD	7.77E-04	2.63E-04	6.73E+01[a]	1.21E+01
2021 2nd Quarter	6.98E-01	3.79E-04	8.59E-04	9.83E+01	1.28E+01
2021 3rd Quarter	2.26E+00	3.66E-04	1.44E-03	7.82E+01	1.43E+01
2021 4th Quarter	4.28E+01	5.84E-04	2.16E-03	4.10E+01	1.42E+01
2020 1st Quarter	5.51E+01	5.22E-04	5.90E-04	1.62E+02	1.20E+01
2020 2nd Quarter	1.17E+01	6.76E-04	4.74E-04	1.23E+02	1.30E+01
2020 3rd Quarter	7.51E+00	4.14E-04	1.17E-03	1.04E+02	1.28E+01
2020 4th Quarter	2.35E+00	5.26E-04	4.21E-04	9.35E+01	1.20E+01

Source: (TVA 2021b, TVA 2022b, TVA 2023)
LLD = lower limit of detection; Ci = curies
[a] Includes activity from abnormal releases. Dilution flow was not determined for abnormal releases.

Table 3.20-4 provide the gaseous doses calculated from the gaseous releases during the quarters in 2022, 2021 and 2020, demonstrating that the air dose calculated from the emissions in Table 3.20-3 are a small fraction on the allowed dose limits.

Table 3.20-4. Doses from Gaseous Effluents, 2020-2022

Quarter	Pathway	Dose	QTR Limit	Percent of Limit
2022 1st Quarter	Gamma air	8.75E-06 mrad	5 mrad	< 1
	Beta air	3.77E-06 mrad	10 mrad	< 1
	NG Total body	4.20E-04 mrad	NA	< 1

Quarter	Pathway	Dose	QTR Limit	Percent of Limit
	NG Skin	4.94E-04 mrad	NA	< 1
	Child/thyroid	6.78E-03 mrem	7.5 mrem	< 1
	Child/total body	4.94E-03 mrem	7.5 mrem	< 1
2022 2nd Quarter	Gamma air	1.04E-05 mrad	5 mrad	< 1
	Beta air	3.67E-06 mrad	10 mrad	< 1
	NG Total body	8.00E-05 mrad	NA	NA
	NG Skin	9.54E-05 mrad	NA	NA
	Child/thyroid	9.93E-03 mrem	7.5 mrem	< 1
	Child/total body	9.93E-03 mrem	7.5 mrem	< 1
2022 3rd Quarter	Gamma air	7.13E-06 mrad	5 mrad	< 1
	Beta air	4.61E-06 mrad	10 mrad	< 1
	NG Total body	4.45E-05 mrad	NA	NA
	NG Skin	5.42E-05 mrad	NA	NA
	Child/thyroid	1.75E-02 mrem	7.5 mrem	< 1
	Child/total body	1.74E-02 mrem	7.5 mrem	< 1
2022 4th Quarter	Gamma air	1.17E-05 mrad	10 mrad	< 1
	Beta air	4.42E-06 mrad	5 mrad	< 1
	NG Total body	2.70E-04 mrad	NA	NA
	NG Skin	3.19E-04 mrad	NA	NA
	Child/thyroid	5.93E-03 mrem	7.5 mrem	< 1
	Child/total body	5.95E-03 mrem	7.5 mrem	< 1
2021 1st Quarter	Gamma air	0.00E+00 mrad	5 mrad	< 1
	Beta air	0.00E+00 mrad	10 mrad	< 1
	NG Total body	0.00E+00 mrad	NA	NA
	NG Skin	0.00E+00 mrad	NA	NA
	Child/thyroid	8.79E-03 mrem	7.5 mrem	< 1
	Child/total body	8.82E-03 mrem	7.5 mrem	< 1
2021 2nd Quarter	Gamma air	6.00E-06 mrad	5 mrad	< 1
	Beta air	6.48E-07 mrad	10 mrad	< 1
	NG Total body	6.91E-06 mrad	NA	NA
	NG Skin	7.19E-06 mrad	NA	NA
	Child/thyroid	1.25E-02 mrem	7.5 mrem	< 1
	Child/total body	4.04E-02 mrem	7.5 mrem	< 1
2021 3rd Quarter	Gamma air	1.94E-05 mrad	5 mrad	< 1
	Beta air	2.10E-06 mrad	10 mrad	< 1
	NG Total body	2.23E-05 mrad	NA	NA
	NG Skin	2.33E-05 mrad	NA	NA
	Child/thyroid	1.38E-02 mrem	7.5 mrem	< 1
	Child/total body	1.36E-02 mrem	7.5 mrem	< 1
2021 4th Quarter	Gamma air	1.74E-04 mrad	5 mrad	< 1
	Beta air	2.54E-05	10 mrad	< 1
	NG Total body	1.98E-04 mrad	NA	NA
	NG Skin	2.10E-04 mrad	NA	NA
	Child/thyroid	8.68E-03 mrem	7.5 mrem	< 1
	Child/total body	8.22E-03 mrem	7.5 mrem	< 1

Quarter	Pathway	Dose	QTR Limit	Percent of Limit
2020 1st Quarter	Gamma air	1.11E-04 mrad	5 mrad	< 1%
	Beta air	4.18E-05 mrad	10 mrad	< 1%
	NG Total body	3.81E-04 mrad	NA	NA
	NG Skin	4.59E-04 mrad	NA	NA
	Child/thyroid	2.53E-02 mrem	7.5 mrem	< 1%
	Child/total body	2.51E-02 mrem	7.5 mrem	< 1%
2020 2nd Quarter	Gamma air	4.46E-05 mrad	5 mrad	< 1%
	Beta air	1.72E-05 mrad	10 mrad	< 1%
	NG Total body	3.53E-04 mrad	NA	NA
	NG Skin	4.15E-04 mrad	NA	NA
	Child/thyroid	1.41E-02 mrem	7.5 mrem	< 1%
	Child/total body	1.41E-02 mrem	7.5 mrem	< 1%
2020 3rd Quarter	Gamma air	3.97E-05 mrad	5 mrad	< 1%
	Beta air	1.30E-05 mrad	10 mrad	< 1%
	NG Total body	2.92E-04 mrad	NA	NA
	NG Skin	3.49E-04 mrad	NA	NA
	Child/thyroid	1.48E-02 mrem	7.5 mrem	< 1%
	Child/total body	1.45E-02 mrem	7.5 mrem	< 1%
2020 4th Quarter	Gamma air	7.24E-06 mrad	5 mrad	< 1%
	Beta air	2.55E-06 mrad	10 mrad	< 1%
	NG Total body	2.14E-04 mrad	NA	NA
	NG Skin	2.53E-04 mrad	NA	NA
	Child/thyroid	1.26E-02 mrem	7.5 mrem	< 1%
	Child/total body	1.25E-02 mrem	7.5 mrem	< 1%

Source: (TVA 2021b, TVA 2022b, TVA 2023)
NA Not applicable, as air dose limits are only specified for gamma and beta radiation in areas at and beyond the Site Boundary due to noble gases released in gaseous effluents per unit.
NG Noble Gas

Individual doses due to normal liquid and gaseous effluent releases from BFN are less than 1 percent of the applicable limits. The doses are well below the federal regulatory guidelines and standards (10 CFR Part 50 Appendix I and 10 CFR Part 20).

Total Dose (Liquid and Gaseous) From All Sources

Dose limits for individual members of the public are given in the ODCM Control 1.2.3. The annual (calendar year) dose or dose commitment to any member of the public, beyond the site boundary due to releases from uranium fuel cycle (UFC) sources, shall be limited to less than or equal to 25 mrem to the total body or any organ (except the thyroid, which shall be limited to less than or equal to 75 mrem). Table 3.20-5 provides results of the calculated cumulative total dose (total body or any other organ) from all sources for the years 2020,2021, and 2022. Table 3.20-6 provides results of the calculated cumulative total dose (thyroid) from all sources for the years 2022, 2021 and 2020. These calculated doses are well within the limits specified in the ODCM. Therefore, it is concluded that normal operation of BFN presents minimal risk to the health and safety of the public.

Table 3.20-5. Cumulative Annual Total Dose (Total Body or Any Organ) From All Sources, 2020-2022

Year	Cumulative Total Dose (mrem)	Annual Dose Limit (mrem)	Percent Of Limit
2022	1.51E-01	25	< 1 %
2021	1.60E-01	25	< 1%
2020	1.46E-01	25	< 1%

Source: (TVA 2021b, TVA 2022b, TVA 2023)

Table 3.20-6. Cumulative Annual Total Dose (Thyroid) From All Sources, 2020-2022

Year	Cumulative Total Dose (mrem)	Annual Dose Limit (mrem)	% Of Limit
2022	4.21E-02	75	< 1%
2021	4.77E-02	75	< 1%
2020	7.05E-02	75	< 1%

Source: (TVA 2021b, TVA 2022b, TVA 2023)

3.20.2. Environmental Consequences – Radiological Effects of Normal Operations

Alternative A – No Action Alternative

Under the No Action Alternative, the radioactive effects at BFN would change for the decommissioning process. The shutdown of BFN would stop the generation of new radioactive effluents being released to the environment. However, decommissioning activities associated with the dismantlement of the site structures would produce temporary radioactive air emissions and air emissions from dust, concrete, vehicle exhaust, and equipment. All releases for the decommissioning phase would still be in accordance with applicable regulations, and the impact from decommissioning effluent releases would be small.

Operation of replacement generation resources would only produce radiological effects if small modular reactors (SMRs) are implemented. There would be no radioactive effects during the construction of a new SMR plant(s) unless the construction takes place at the location of another operating nuclear plant, or there are multiple units being build and one unit becomes operational before the other(s). The radiological impacts from the construction of a new nuclear plant would be of small significance to the construction workers. Workers who would be in close proximity to the operating nuclear plant(s) would be tracked and monitored (radiation badge) as necessary to meet NRC requirements. Depending on the type of nuclear technology chosen, the radioactive effects of a new operating SMR plant(s) would be expected to be less than the BFN current effects. There would be no expected observable impacts from radioactive liquid or gaseous releases from a new SMR plant(s) during normal operations. The REMP would be set up for the new SMR plant(s) to ensure there are no measurable indirect or cumulative effects to the environment offsite of the new location or to the public. Potential effects from construction and operation of an SMR plant(s) would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. Overall, impacts would be anticipated to be small. There would be no radioactive impacts from the construction and operation of other potential generation resources.

Alternative B – Proposed Action

For this alternative, TVA does not anticipate any significant changes to radioactive dose to workers or to the public. No refurbishments or plant modifications are planned during the proposed subsequent period of extended operation that would affect public exposure to radiation. Radiological dose limits for protection of the public and workers have been developed by USEPA and NRC to ensure that the cumulative impacts of acute and long-term exposure to radiation and radioactive materials are small regardless of the source or sources. Operation of BFN during the proposed subsequent period of extended operation would comply with these dose limits. Because there is no reason to expect effluents to increase during the proposed subsequent period of extended operation, annual doses to the public from continued operation are expected to continue to be a small fraction of the regulatory limits. It is expected that radiation doses to the public from continued operations would continue at current levels and would be well below regulatory limits during the proposed subsequent period of extended operation. The incremental contribution of continued operation of BFN to cumulative radiation doses and associated health impacts to workers and the public from all sources would be small.

3.21. Uranium Fuel Cycle Effects

Nuclear power plants fueled by uranium produce radioactive wastes in various forms. This section discusses the management, storage, and transportation of radioactive wastes associated with the operation of BFN, including the handling and storage of spent fuel.

3.21.1. Radioactive Waste

3.21.1.1. Affected Environment – Radioactive Waste

The radioactive waste systems at BFN Units 1, 2, and 3 are designed to collect, process, and dispose of plant-produced radioactive wastes in a controlled and safe manner. These systems are designed to limit discharges in accordance with 10 CFR Part 50, Appendix I. The actual performance and operation of installed equipment, as well as reporting of actual offsite releases and doses, are controlled by the requirements of the ODCM and NPDES permit. The ODCM is subject to NRC inspection and describes the methods and parameters used for calculating offsite doses resulting from radioactive gaseous and liquid effluents and ensuring compliance with NRC regulations. The methods employed for the controlled release of those contaminants are dependent primarily upon the state of the material: liquid, solid, or gaseous.

This section describes the current radioactive waste systems and practices at BFN along with data showing current volumes and program results. Operation of BFN radioactive waste is handled by TVA-approved procedures, and the current methods of handling the waste would be continued during the proposed subsequent period of extended operation.

Liquid Radioactive Waste Treatment Systems

The Liquid Radioactive Waste Control System collects, treats, stores, and disposes of all potentially radioactive liquid wastes. These wastes are collected in sumps and drain tanks at various locations throughout the plant and then transferred to the appropriate collection tanks in the Radioactive Waste Building for treatment, storage, discharge, or disposal.

During normal operation, the liquid effluent treatment systems process and control the release of liquid radioactive effluents to the environment such that the doses to individuals offsite are maintained within the limits of 10 CFR Part 20 and ALARA dose standards in Appendix I to 10 CFR Part 50. The Liquid Radioactive Waste Management System is designed to process the waste and then recycle it within the plant as condensate, reprocess it through the radioactive waste system for further purification, or discharge it to the environment as liquid radioactive waste effluent in accordance with state and federal regulations.

Wastes to be discharged to the environment from the liquid radioactive waste management system are processed on a batch basis, with each batch being processed by such method(s) appropriate for the quality and quantity of materials determined to be present. Processed liquid wastes may be returned to the condensate system or discharged to the environs through the circulating water discharge channel. The liquid wastes in the discharge channel are diluted with condenser effluent circulating water to achieve a permissible concentration at the site boundary.

The low conductivity (high purity) liquid wastes are processed by filtration and ion exchange through the waste filter and waste demineralizer. After processing, the waste is pumped to a waste sample tank where it is sampled and then, if satisfactory for reuse, and there is sufficient available volume in the condensate storage tanks to accept the waste, it is transferred to the condensate storage tanks as makeup water.

High-conductivity (low purity) liquid wastes are processed through a filter and are collected in a floor drain sample tank because they have low concentrations of radioactive impurities. If the concentration after dilution is less than or equal to the applicable limits, the filtered liquid may be discharged.

An alternate method of processing low and high conductivity liquid is the use of vendor-supplied skid-mounted equipment, interconnected to the permanent radioactive waste system. Depending on effluent quality and plant needs, the water can be sent to either the waste sample tank or floor drain sample tank. Processing from the waste sample tank or floor drain sample tank is identical as described above.

The processing equipment is located within concrete buildings to provide secondary enclosures for the wastes in the event of leaks or overflows. Tanks and equipment which contain wastes with high radioactive concentrations that could be determined to result in increased dose to personnel are shielded. Except where flanges are required for maintenance, most pipe connections are welded to reduce the probability of leaks. Process lines which penetrate shield walls are routed to prevent a direct radiation path from the tanks or equipment. Control of the waste system is from local panels in the Radioactive Waste Building.

Protection against accidental discharge of liquid radioactive waste is provided by valve redundancy, instrumentation for detection of alarms of abnormal conditions, procedural controls, interlocks, and radiation monitor controlled valves.

TVA procedures are used to ensure shipments of radioactive material and radioactive wastes from BFN meet TVA Nuclear requirements, waste processor requirements, burial site requirements, state regulations, and federal regulations.

Table 3-21.1 provides a summary of radioactive liquid releases for the years 2020, 2021, and 2022. The resulting total dose for each year is less than 1 percent of the allowed dose limit.

Table 3.21-1. Annual Radioactive Liquid Releases, 2020-2022

Year	**Fission and Activation** Gases (Curies)	**Tritium (Curies)**	**Dissolved and Entrained Gases (Curies)**	**Total Volume Released (Liters)**	**Total Body Dose From Liquids (mrem)**
2022	2.35E-02	9.61E+00	3.86E-04	4.01E+06	6.30E-04
2021	1.10E-01	1.51E+01	9.49E-06	3.34E+06	2.63E-03
2020	3.63E-02	4.83E+01	1.57E-04	5.41E+06	1.48E-03

Source: (TVA 2021b, TVA 2022b, TVA 2023)

Gaseous Radioactive Waste Treatment Systems
The Gaseous Radioactive Waste Management System collects and processes gaseous radioactive wastes from the main condenser air ejectors, the startup vacuum pumps, condensate drain tank vent, and the steam packing exhauster, and controls their release to the atmosphere through the plant stack so that the total radiation exposure to persons outside the controlled area is as low as reasonably achievable and does not exceed applicable regulations.

Table 3-20.2 provides a summary of quarterly gaseous total body dose for the years 2020, 2021, and 2022. The resulting quarterly total dose for each year is less than 1 percent of the allowed dose limit.

Table 3.21-2. Quarterly Gaseous Total Body Dose, 2020-2022

Year	Total Body 1st QTR (mrem) (Limit=7.5 mrem/QTR)	Total Body 2nd QTR (mrem)	Total Body 3rd QTR (mrem)	Total Body 4th QTR (mrem)
2022	4.94E-03	9.93E-03	1.74E-02	5.95E-03
2021	8.82E-03	1.25E-02	1.36E-02	8.22E-03
2020	2.51E-02	1.41E-02	1.45E-02	1.25E-02

Source: (TVA 2021b, TVA 2022b, TVA 2023)
QTR = quarter

Table 3-20.3 provides a summary of total (individual) annual dose from all sources (liquids and gases) for the years 2020, 2021, and 2022. The resulting total annual dose for each year is less than 1 percent of the allowed dose limit. Therefore, the impact from all radioactive effluent releases from BFN is small and would continue to be small during the proposed subsequent period of extended operation.

Table 3.21-3. Total Dose From All Sources, 2020-2022

Year	Total Dose (mrem)	% of Limit (limit=25 mrem)
2022	1.51E-01	<1%
2021	1.60E-01	<1%
2020	1.46E-01	<1%

Source: (TVA 2021b, TVA 2022b, TVA 2023)

Solid Radioactive Systems
Within the Solid Radioactive Waste Management System, solid radioactive wastes are collected, processed, stored, packaged, and prepared for shipment. Solid radioactive wastes include dry and dry solid wastes and wet solid wastes.

Dry Solid Wastes
Dry solid wastes include contaminated rags, paper, clothing, spent filter elements, laboratory apparatus, small parts and equipment, and tools. Items of dry solid waste are collected in suitable containers located throughout the plant. Spent elements which may have a high-radiation level are packaged in accordance with applicable burial site requirements prior to being transported for processing, burial, or approved onsite storage. Low-radiation level solid wastes may be stored onsite in approved storage areas. In such instances, a maximum curie inventory of 325 curies will not be exceeded. After a period of storage, the containers are removed from the storage area and prepared for disposal. Shielded containers are provided for offsite shipment of high-activity waste if required.

Wet Solid Wastes

Wet solid wastes consist of spent powdered ion exchange resins, filter aid sludge, and bead-type ion exchange resins. Spent powdered ion exchange resin and filter aid sludge are accumulated and stored in phase separator tanks. Successive batches of slurried materials are accumulated, and supernatant liquid decanted, until the desired settled slurry volume has been reached. High-activity-level sludge from the reactor water cleanup filter-demineralizers is stored in three cleanup phase-separator tanks. Bead-type ion exchange resins from the waste demineralizer are stored in the spent resin tank. The spent resin remains in that tank until operations personnel determine it needs to be transferred. From that tank the spent resin is transferred to the phase separator tanks where it is mixed with other sludges. After mixing it is sent to the packaging area.

Sludge from the condensate, the fuel pool filter-demineralizers, and the waste and floor drain filters are stored in six condensate phase-separator tanks. Sludge from the various sources may be either mixed in the six tanks or segregated. Each cleanup phase-separator tank and condensate phase-separator tank has decant outlets, a bottom outlet that lead to the suction of a sludge transfer pump, and an overflow outlet leading to the Radioactive Waste Building equipment drain sump. After an appropriate decay period, the sludge is reslurried and pumped to the packaging area.

The packaging system is designed to permit the use of several different types of containers, including disposable tanks (liners) in reusable shields constructed of carbon steel or high-density polyethylene plastic. Prior to a packaging run, a container is positioned at one of two dewatering systems, either in a shipping cask or in a shielded enclosure. For a condensate phase-separator, hoses are connected and the sludge pump and air-operated spargers are used to stir up the settled sludge in the phase-separator and bring it into suspension. For a cleanup phase-separator, eductors are used to mix the slurry instead of air spargers. The slurry then is pumped to the loading station and back to the phase-separator tank. A portion of the slurry is drawn off into the waste package until the package is nearly filled. Water is withdrawn through the built-in filter elements via the portable dewatering system(s) and drained into the waste package drain tank. This process is repeated until the package is nearly full of dewatered slurry. Then the portable dewatering system hoses are disconnected, package penetrations are plugged, and the package is prepared for onsite storage or offsite shipment.

3.21.1.2. Environmental Consequences – Radioactive Waste

This section updates and compares the potential for environmental effects from plant construction and operations regarding radioactive waste for actions of the viable alternatives: Alternative A No Action Alternative, and Alternative B BFN SLR.

Alternative A – No Action Alternative

If Alternative A were to be selected, TVA would allow the current BFN operating licenses to expire at the end of their terms, shutting down each unit no later than the current license expiration dates: December 20, 2033, for Unit 1, June 28, 2034, for Unit 2, and July 2, 2036, for Unit 3.

For alternative A, radioactive waste would continue to be produced in the manner and annual volumes currently generated at BFN. There would be no change in the types or rates of liquid, gaseous, or solid wastes generated during the remaining operating period. The total cumulative volumes of each type of radioactive waste would increase until permanent plant shutdown and decommissioning activities commenced. The management, handling, storage, and shipping of radioactive waste would remain consistent with current practice. All applicable federal regulations would be followed. BFN would continue to release radioactive liquids and gases to the environment in accordance with, and below the limits of, federal regulation. Solid radioactive waste would continue to be handled in accordance with TVA-approved procedures, which ensure that all federal regulations and limits pertaining to solid radioactive waste are met.

Upon shutdown, generation of routine operational radioactive waste would cease. During decommissioning, the plant would ship all stored radioactive material to be processed or to its final disposal. The life-time volume of radioactive waste shipped would be larger at the end of the 20-year period than it would be should the licenses not be renewed. The radioactive waste from activated components (piping, valves, reactor vessel, etc.) and structures (activated rebar, concrete, etc.) that would be removed during decommissioning would be approximately the same whether it were at the end of the current license or the end of the proposed subsequent period of extended operation.

Because shutdown of BFN would require construction of new replacement power either at BFN or elsewhere within the TVA system, the potential for radioactive waste generation would depend on the source and specific technology of the replacement power generation facility. If new nuclear generation were selected, the approved design would be subject to the same requirements for handling and processing radioactive waste at BFN. Similar to BFN, the environmental impacts associated with radioactive waste handling, storage, and transportation would be expected to be small. If new technology allowed for reduced radioactive waste volumes due to advancements in design, equipment, and programs in the new nuclear facility, the impacts associated with operation of a new nuclear generation facility may even be less than that at BFN.

For any non-nuclear electrical power generation facility, radioactive waste is not generated during construction or operation. Therefore, there would be no environmental impact related to radioactive waste during the construction or operation of any non-nuclear power generation facility. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. Overall, impacts would be anticipated to be small.

Alternative B – Proposed Action

Under Alternative B, radioactive waste would continue to be produced in the manner and annual volumes currently generated at BFN. There would be no change in the types or rates of liquid, gaseous, or solid wastes generated during the proposed subsequent period of extended operation. The management, handling, storage, and shipping of radioactive waste would remain consistent with current practice. All applicable federal regulations would be followed. BFN would continue to release radioactive liquids and gases to the environment in accordance with, and below the limits of, federal regulation. Impacts to the environment from releases of radioactive liquids and gases are small and would continue to be small throughout the period of extended operation. Solid radioactive waste would continue to be handled in accordance with TVA-approved procedures, which ensure that all federal regulations and limits pertaining to solid radioactive waste are met. The increased volume of radioactive waste generated during the 20-year period would result in a greater volume disposed of in a licensed landfill. The additional volume would remain a small impact on the available landfill capacity, and would not result in large cumulative impacts on licensed landfills. BFN would continue to comply with annual public dose rate and environmental emission limitations. Therefore, impacts to the public and the environment resulting from processing, storage, and transportation of solid radwaste, including cumulative effects of waste storage from BFN are small, and would continue to be small during the proposed subsequent period of extended operation.

When BFN finally shuts down at end of the current license or the end of the proposed subsequent period of extended operation, generation of routine operational radioactive waste would cease. During decommissioning, the plant would ship all stored radioactive material to be processed or to its final disposal. The life-time volume of radioactive waste shipped would be larger at the end of the 20-year period than it would be should the licenses not be renewed. The radioactive waste from activated components (piping, valves, reactor vessel, etc.) and structures (activated rebar, concrete, etc.) that would be removed during decommissioning would be approximately the same whether it was at the end of the current license or the end of the proposed subsequent period of extended operation.

3.21.2. Spent Fuel Storage

3.21.2.1. Affected Environment – Spent Fuel Storage

BFN has two ISFSI storage pads used to safely store spent fuel in licensed and approved dry cask storage containers on site. The ISFSI is licensed separately from BFN Units 1, 2, and 3 Renewed Facility Operating Licenses and would remain in place until the DOE takes possession of the spent fuel and removes it from the site for permanent disposal or processing. Expansion of the onsite spent fuel storage capacity would be required in the future if a national storage solution for the permanent storage of spent fuel does not become available during the proposed subsequent period of extended operation if the DOE does not take responsibility for the permanent storage and disposal of the onsite spent fuel. Should this be necessary, the impacts associated with this expansion would be assessed under a licensing process separate from that of BFN Units 1, 2, and 3 Renewed Facility Operating Licenses, consequently it would also be reviewed under a separate NEPA evaluation. As described in Section 1.5.1.3, expansion of the ISFSI is addressed as a reasonably foreseeable future action and considered with regard to cumulative impacts.

3.21.2.2. Environmental Consequences – Spent Fuel Storage

Alternative A – No Action Alternative

For the No Action Alternative, there would be no additional spent fuel generated after permanent plant shutdown. The BFN ISFSI would continue operation under its separate general license until the DOE takes possession of the spent fuel from the BFN ISFSI, and it can be decommissioned in a separate project. The current ISFSI storage pads are projected to be filled on or before year 2036. Under the existing licenses and assuming decommissioning at the end of the current license periods, an additional 274 dry fuel storage casks will be needed to support operations and decommissioning.

Because shutdown of BFN would require construction of new replacement power either at BFN or elsewhere within the TVA system, the potential for impacts related to nuclear spent fuel would depend on the source and specific technology of the replacement power generation facility. If new nuclear generation were selected, the approved design would be subject to the same requirements for handling and storage of spent fuel as BFN. For a new nuclear generating facility, spent fuel typically would be stored in a spent fuel pool. It is not expected that an ISFSI would be included in the initial construction. Once a new nuclear generating facility is operating, spent fuel would be produced in processes similar to BFN. The environmental impacts of a new nuclear generating facility may be reduced relative to those at BFN due to advancements in technology, design, and programs. The expected environmental impacts associated with spent fuel storage at any new nuclear generation facility would be expected to be small.

For any non-nuclear electrical power generation facility, spent nuclear fuel is not generated during construction or operation. Therefore, there would be no environmental impact related to spent nuclear fuel during construction or operation of any non-nuclear power generation facility. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

Under Alternative B, spent fuel assemblies would continue to be produced during the proposed subsequent period of extended operation at BFN in quantities and rates consistent with that seen for current plant operation. For alternative B, additional ISFSI storage capacity would be required beyond that described in Alternative A if DOE does not take possession of spent fuel. The addition of a third ISFSI storage pad to further increase storage capacity needed for the proposed subsequent period of extended operation is under consideration, but plans are in the conceptual stage and no installation schedule has been established. The BFN site has adequate space onsite to accommodate the construction of an additional ISFSI pad if necessary. Construction and operation of an additional storage pad to support the SLR is expected to have only small cumulative impacts, including small direct impacts from radiation doses from the ISFSI for onsite workers and people in the surrounding area. The resulting indirect and cumulative dose impacts would be small. The impacts associated with ISFSI expansion would be assessed under a licensing process separate from that of BFN Units 1, 2, and 3 subsequent renewed operating licenses. Dose limits would be maintained in compliance with federal regulations.

3.21.3. Transportation of Radioactive Materials

3.21.3.1. Affected Environment - Transportation of Radioactive Materials

Transportation of radioactive materials is required to operate any nuclear facility. BFN transports radioactive materials currently and would continue to do so during the proposed subsequent period of extended operation if SLR is approved by the NRC.

Table S-4 in 10 CFR 51.52 includes the NRC evaluation of the environmental effects of transportation of fuel and waste to and from light water reactors. Note "1” of Table S-4 states that data for the table come from the Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Plants in WASH-1238, December 1972, and Supplement 1 NUREG-75/038, April 1975, Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants, and the table states that the radiological risk due to effects of accidents in transportation was determined to be small.

The table addresses two categories of environmental considerations: (1) normal conditions of transport and (2) accidents in transport. (10 CFR Part 51) Subparagraphs 10 CFR 51.52(a) (1) through (5) delineate specific conditions the reactor licensee must meet to use Table S-4 as part of its environmental evaluation to determine impacts. The conditions in paragraph (a) of 10 CFR 51.52 establishing the applicability of Table S-4 relate to:

- Reactor core thermal power (not to exceed 3,800 megawatt thermal)
- Fuel form, fuel enrichment (Sintered uranium dioxide pellets with uranium-235 enrichment not exceeding 4 percent by weight)
- Fuel encapsulation (encapsulated in zircaloy rods)
- Average fuel irradiation (does not exceed 33,000 megawatt-days per metric ton)

- Time after discharge of irradiated fuel before shipment (no irradiated fuel assembly is shipped until at least 90 days after it is discharged from the reactor)
- Mode of transport for unirradiated fuel (truck)
- Mode of transport for irradiated fuel (truck, rail, or barge)
- Radioactive waste form and packaging (with the exception of spent fuel, all radioactive waste shipped from the reactor is packaged and in a solid form, by truck or rail)
- Mode of transport for radioactive waste other than irradiated fuel

Transportation of Unirradiated Fuel
10 CFR 51.52 requires that unirradiated fuel be shipped to the reactor site by truck. Table S-4 includes a separate condition requiring that the truck shipments be limited to 73,000 pounds or less. New fuel assemblies are transported to BFN by truck in accordance with DOT and NRC regulations.

Transportation of Irradiated Fuel
Packaging of irradiated fuel for offsite shipment would comply with applicable DOT and NRC regulations for transportation of radioactive material. If transportation is to a DOE repository, by law, DOE is responsible for the transportation of spent fuel from reactor sites to a repository, as shown in the Nuclear Waste Policy Act of 1982, Section 302, and DOE makes the decision on the transport mode.

BFN meets the conditions and provisions of paragraph (a) of 10 CFR 51.52. Therefore, the environmental impact and risks of transporting radioactive materials as a result of continued operation of BFN would be bound by the impacts shown in Summary Table S-4 (10 CFR 51.52).

3.21.3.2. Environmental Consequences - Transportation of Radioactive Materials

Alternative A – No Action Alternative
Alternative A would be bound by the same transportation criteria for radioactive wastes that currently applies to BFN operation. Because shutdown of BFN would require construction of new replacement power either at BFN or elsewhere within the TVA system, the potential for impacts related to transportation of radioactive materials would depend on the source and specific technology of the replacement power generation facility. If new nuclear generation were selected, the approved design would be subject to the same requirements for radioactive material transportation as BFN, and any impact would be expected to remain small. For non-nuclear power generation, the need for radioactive material transportation would not be expected. As such, environmental impacts associated with radioactive material transportation would be small for the No Action Alternative. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action
The risks of transporting radioactive materials are bound by Table S-4 (10 CFR 51.52). Since BFN would continue to meet the requirements of Table S-4 during the proposed subsequent period of extended operation, the environmental impact of any transportation of irradiated fuel would be small. Transportation impacts of all types of radioactive waste would be expected to be small.

3.22. Nuclear Plant Safety and Security

This section assesses the environmental impacts of postulated accidents involving radioactive materials at BFN and plant security, including protection against intentional and destructive acts.

It is divided into three subsections that addresses Design Basis Accidents (DBAs), severe accidents, and plant security.

- DBAs (Section 3.22.1)
- Severe Accidents (Section 3.22.2)
- Plant Security (Section 3.22.3)

3.22.1. Design-Basis Accidents

3.22.1.1. Affected Environment – Design-Basis Accidents

The potential consequences of postulated accidents are determined based on the use of a set of DBAs that are representative of the reactor designs. DBAs are those accidents that both the licensee and the NRC staff evaluate to ensure that the plant can withstand normal and abnormal transients, and a broad spectrum of postulated accidents without undue hazard to the health and safety of the public. A number of these postulated accidents are not expected to occur during the life of the plant but are evaluated to establish the design basis for the preventive and mitigative safety systems of the facility. The acceptance criteria for DBAs are described in Title 10 CFR Part 50 and 10 CFR Part 100. The DBAs considered include Loss of Coolant Accidents, Refueling, Control Rod Drop, and Steam Line Break (AEC 1972).

The environmental impacts of DBAs are evaluated during the initial licensing process, and the ability of the plant to withstand these accidents is demonstrated to be acceptable before issuance of the operating license. The results of these evaluations are found in license documentation such as the NRC staff's safety evaluation report and the licensee's updated final safety analysis report. The licensee is required to maintain the acceptable design and performance criteria throughout the life of the plant, including any extended-life operation. The consequences for these events are evaluated for the hypothetical maximally exposed individual; as such, changes in the plant environment will not affect these evaluations.

Because of the requirements that continuous acceptability of the consequences and aging management programs be in effect for SLR, the environmental impacts as calculated for DBAs should not differ significantly from initial licensing assessments over the life of the plant, including the proposed subsequent period of extended operation. Accordingly, the design of the plant relative to DBAs during the extended period is considered to remain acceptable.

TVA is not aware of any new and significant information associated with the renewal of the BFN operating licenses. Information included in the BFN License Renewal Supplemental EIS (2005) concluded that there are no impacts of DBAs during the proposed subsequent period of extended operation beyond those discussed in the GEIS, which were determined to be of small significance because all plants were designed to successfully withstand these design basis accidents.

A high degree of protection against the occurrence of postulated accidents is provided through quality design, manufacture, and construction, which ensure the high integrity of the reactor system and associated safety systems. Deviations from normal operations are handled by protective systems and design features that place and hold the plant in a safe condition. It is conservative to postulate that serious accidents may occur, even though they are extremely unlikely. Engineered safety features are installed to prevent and mitigate the consequences of postulated events that are judged credible. The probability of occurrence of accidents and the spectrum of their consequences to be considered from an environmental impact standpoint have been analyzed using best estimates of probabilities, realistic fission product releases, and realistic transportation assumptions.

Personnel with specific duties and responsibilities in the BFN radiological emergency plan program receive instruction in the performance of their duties and responsibilities during accidents and emergencies. Drills and exercises are conducted regularly to develop and maintain the key skills required for emergency response by these highly trained personnel. Drills are performed regularly for such accident conditions as fire, medical emergencies, radiological protection, and emergency communications.

3.22.1.2. Environmental Consequences – Design-Basis Accidents

Alternative A – No Action Alternative

Under the No Action Alternative, TVA would continue to properly maintain all equipment and facilities at BFN and ensure the high integrity of the reactor system and associated safety systems until all systems are shutdown and through decommissioning as appropriate. Emergency plans would continue to be maintained and implemented as needed, and personnel would continue to receive training and participate in drills and exercises until those are no longer necessary at the appropriate point in decommissioning. Because shutdown of BFN would require construction of new replacement power either at BFN or elsewhere within the TVA system, the potential for impacts related to design basis accidents would depend on the source and specific technology of the replacement power generation facility. If new nuclear generation were selected, the approved design integrates the requirements to design against and protect from a series of potential DBAs. The new nuclear plant would be designed specifically for the new technology chosen by TVA and that technology would meet all DBA criteria and be approved by the NRC. The environmental impacts of a new nuclear generating facility may be reduced relative to those at BFN due to advancements in technology, design, and programs implemented. The expected environmental impacts associated with design basis accidents at any new nuclear generation facility would be expected to be small. For any non-nuclear electrical power generation facility, there would be no applicable environmental impact related to DBAs. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

In all DBA cases considered, radiological impacts remain below the regulatory dose limits. If a DBA occurred, the impacts would be small and limited by plant design and the trained emergency actions of BFN personnel. It is concluded that the environmental risks due to postulated radiological accidents are small. Continued operation of BFN during the proposed subsequent period of extended operation does not change the analysis of accidents and the potential impacts of postulated accidents would remain small.

3.22.2. Severe Accidents

3.22.2.1. Affected Environment – Severe Accidents

The term “accident” refers to any unintentional event (i.e., outside the normal or expected plant operation envelope) that results in a release or the potential for a release of radioactive material to the environment. The NRC categorizes accidents as either design basis or severe. DBAs, described in Subsection 3.22.1, are those for which the risk is great enough that the NRC requires plant design features and procedures to prevent unacceptable accident consequences. Severe accidents are defined as accidents with substantial damage to the reactor core and degradation of containment systems. Because the probability of a severe accident is very low, the NRC considers them too unlikely to warrant normal design controls to prevent or mitigate the consequences. Severe accident analyses consider both the frequency of a severe accident and the offsite consequences to determine the public risk.

The risk of nuclear power plant severe accidents is normally determined by a plant-specific probabilistic safety assessment that provides a systematic and comprehensive methodology for determining the risks associated with severe accidents due to the operation of the nuclear power plant.

3.22.2.2. Environmental Consequences – Severe Accidents

Alternative A – No Action Alternative

If the BFN operating license was not extended for the additional 20-year period, BFN would shut down and the potential impacts from postulated severe accidents would no longer be applicable.

Because shutdown of BFN would require construction of new replacement power either at BFN or elsewhere within the TVA system, the potential for impacts related to severe accidents would depend on the source and specific technology of the replacement power generation facility.

If new nuclear generation were selected, the approved design would be analyzed for the risk of a severe accident occurring, and the consequences to the onsite and offsite environment evaluated. The impacts would be required to be small and of no significance for the plant to gain approval for construction and operation. The new plant would be specifically analyzed based on the selected technology, and that technology would necessarily require approval by the NRC prior to construction and operation. The environmental impacts of a new nuclear generating facility may be reduced relative to those at BFN due to advancements in technology, design, and programs implemented. The expected environmental impacts associated with severed accidents at any new nuclear generation facility would be expected to be small and of no significance.

For any non-nuclear electrical power generation facility, there would be no applicable environmental impact related to severe radiological accidents. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

The environmental impacts related to potential severe accidents are within the requirements specified for BFN. Severe accident analyses considered both the risk of a severe accident occurring and the onsite and offsite consequences if the accident did occur to determine the significance. The risk results for continued operation of BFN for the proposed subsequent period of extended operation are not significant, and environmental impacts associated with postulated severe accidents would be expected to be small.

3.22.3. Plant Security

3.22.3.1. Affected Environment – Plant Security

TVA has in place detailed sophisticated security measures to prevent physical intrusion into all its nuclear plant sites, including BFN, by hostile forces seeking to gain access to plant nuclear reactors or other sensitive facilities or materials. TVA security personnel are trained and retrained to react to and repel hostile forces threatening TVA nuclear facilities. TVA’s security measures and personnel are inspected and tested by the NRC. It is highly unlikely that a hostile force could successfully overcome these security measures and gain entry into sensitive facilities, and even less likely that they could do this quickly enough to prevent operators from putting plant reactors into safe shutdown mode. However, the security threat that is more frequently identified by members of the public or in the media are not hostile forces invading nuclear plant sites, but attacks using hijacked jet airliners, the method used on September 11, 2001, against the World Trade Center and the Pentagon. The likelihood of this now occurring is equally remote in light of today's heightened security at airports, but this threat has been carefully studied.

The Nuclear Energy Institute (NEI) commissioned the Electric Power Research Institute (EPRI) to conduct an impact analysis of a large jet airliner being purposefully crashed into sensitive nuclear facilities or containers including nuclear reactor containment buildings, spent fuel storage pools, spent fuel dry storage facilities, and spent fuel transportation containers. Using conservative analyses, EPRI concluded that there would be no release of radionuclides from any of these facilities or containers because they are already designed to withstand potentially destructive events. Nuclear reactor containment buildings, for example, have thick concrete walls with heavy reinforcing steel and are designed to withstand credible earthquakes, overpressures, and hurricane force winds. The EPRI analysis used computer models in which a Boeing 767-400 was crashed into containment structures representative of all United States nuclear power containment types. The containment structures suffered some crushing and chipping at the maximum impact point, but were not breached. The results of this analysis are summarized in an NEI paper titled "Deterring Terrorism: Aircraft Crash Impact Analyses Demonstrate Nuclear Power Plant's Structural Strength" (NEI 2002).

The EPRI analysis is fully consistent with research conducted by the NRC. When the NRC considered such threats, Commissioner McGaffigan observed (NRC 2007):

> Today the NRC has in place measures to prevent public health and safety impacts of a terrorist attack using aircraft that go beyond any other area of our critical infrastructure. In addition to all the measures the Department of Homeland Security and other agencies have put in place to make such attacks extremely improbable (air marshals, hardened cockpit doors, passenger searches, etc.), NRC has entered into a Memorandum of Understanding with NORAD/NORTHCOM to provide real-time information to potentially impacted sites by any aircraft diversion.
>
> As NRC has said repeatedly, our research showed that in most (the vast majority of) cases an aircraft attack would not result in anything more than a very expensive industrial accident in which no radiation release would occur. In those few cases where a radiation release might occur, there would be no challenge to the emergency planning basis currently in effect to deal with all beyond-design-basis events, whether generated by mother nature, or equipment failure, or terrorists. (NRC 2007)

Notwithstanding the very remote risk of a terrorist attack affecting operations, TVA increased the level of security readiness, improved physical security measures, and increased its security arrangements with local and federal law enforcement agencies at all of its nuclear generating facilities after the events of September 11, 2001. These additional security measures were taken in response to advisories issued by NRC. TVA continues to enhance security at its plants in response to NRC regulations and guidance. The security measures TVA has taken at its sites are complemented by the measures taken throughout the United States to improve security and reduce the risk of successful terrorist attacks. This includes measures designed to respond to and reduce the threats posed by hijacking large jet airliners.

In the very remote likelihood that a terrorist attack would successfully breach the physical and other safeguards at BFN resulting in the release of radionuclides, the consequences of such a release are reasonably captured by the consideration of the impacts of severe accidents discussed above in this section.

Nuclear plant security is applicable to BFN until it is decommissioned and all spent fuel is removed from the site, regardless of the date of the decommissioning.

3.22.3.2. Environmental Consequences – Plant Security

Alternative A – No Action Alternative

As noted above, nuclear plant security requirements would continue to apply at BFN until decommissioning has been completed and all spent fuel has been removed from the site. Environmental impacts associated with a plant security event occurring during plant operation or during decommissioning activities can be reasonably expected to be bound by the severe accident scenarios considered above and would be expected to be small.

Because shutdown of BFN would require construction of new replacement power either at BFN or elsewhere within the TVA system, the potential for impacts related to plant security would depend on the source and specific technology of the replacement power generation facility. If new nuclear generation were selected, any new nuclear plant would be designed and constructed to meet all security design considerations and regulations. Any environmental impact, as noted above, would be bound by the severe accident scenarios and would be expected to remain small. For any non-nuclear electrical power generation facility, nuclear plant security regulations are not applicable. Potential effects from construction and operation of any replacement generation resource would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified.

Alternative B – Proposed Action

As discussed for Alternative A, environmental impacts related to any plant security event associated with facility operation or during decommissioning activities are reasonably expected to be small and bound by the severe accident scenarios considered in Section 3.22.2. As such, any plant security event-related environmental impact resulting from the proposed subsequent period of extended operation would be expected to be small.

3.23. Non-radiological Public Health and Safety

Located in Limestone County on the northern shore of Wheeler Reservoir across from Lawrence and Morgan Counties, BFN impacts public health and safety in all three counties. As discussed in Section 3.16, an array of police, fire, and medical services are available in the region. Law enforcement agencies in all three counties promote public safety by preventing and stopping crimes, providing criminal investigations, and responding to emergencies (ASA 2022). Dedicated and volunteer fire departments in Alabama provide fire protection and other emergency services including emergency response to motor vehicle accidents, hazardous material incidents, and rescue operations. Hospitals provide emergency medical care along with diagnostic services, treatment, and recovery services.

If a situation evolves where outside emergency support becomes necessary at BFN, the plant communicates this need to local and state emergency service agencies. Advance plans and arrangements have been made in conjunction with state and local authorities, where applicable, for warning the local populace of an emergency and possible need for evacuation. Safety measures may include preventing public entry to affected areas, providing medical care of injured or exposed personnel, surveying affected areas for radioactivity, and restricting use of water and food supplies (TVA 2021a, TVA 2022d).

Non-radiological public health and safety concerns at BFN include electric shock hazards and microbiological hazards in the form of thermophilic (increased temperature adapted) microorganisms.

3.23.1. Affected Environment – Non-Radiological Public Health and Safety

Electric Shock Hazards

Flowing charges create a magnetic field, and a magnetic field induces a current of electric charge in conductive objects. Transmission lines, and all electric wiring, create magnetic fields that induce a current of electric charge. The strength of the induced current and charge is dependent on the magnitude of the current through the transmission line, the design of the transmission line, the distance to the charged object, the conductive nature of the charged object, and whether the conducting object is grounded. Induced currents and charges can cause shocks under certain conditions (TVA 2019d).

Transmission lines and right of ways are designed to minimize the potential for such shocks. Stationary conductive objects, including metal fences and guardrails, with proximity to the transmission lines allowing a possible charge to develop have been grounded; thus, preventing a probable source for shocks. In addition, by precluding direct public access to transmission line towers, transmission lines are designed to preclude direct contact shock hazards to the public (TVA 2019d).

The in-scope BFN transmission lines are located on the BFN site. TVA is the owner and operator of the transmission lines connecting BFN to the transmission grid. All TVA transmission lines are designed to meet or exceed the medium loading requirements of the National Electrical Safety Code (NESC) and are designed to surpass the short-circuit NESC safety requirement. And, thus, the public is precluded from accessing the site and from direct contact with these transmission lines. Further, any induced current from these lines would be 5 milliamperes or less.

Microbiological Hazards

Discharge of thermal effluents into Wheeler Reservoir has the potential to promote the growth of thermophilic microorganisms, some of which can cause adverse effects on human health. Microorganisms of particular concern for their potential to impact the health of the plant workers and the public include bacteria such as *Legionella* spp. as well as free-living amoebae of the genera *Naegleria*. These microorganisms can grow in warm waters that can occur at nuclear power plants in cooling towers and cooling water discharges (Tyndall 1981, Tyndall 1983, Tyndall et al. 1985).

Bacteria pathogenic to humans usually thrive at temperatures above 30ºC (86ºF) and are ubiquitous in the environment. During the summer months, temperatures in Wheeler Reservoir are at their highest, which is when there is the most concern for human pathogens. In terms of hydrothermal impacts on Wheeler Reservoir, operation of the circulating water system is regulated by the State of Alabama under NPDES permit number AL0022080 (ADEM 2018). BFN operates within the parameters of the permit using the helper cooling towers as needed for additional cooling and by reducing the power/heat generated to remain in compliance.

Legionella bacteria are responsible for Legionnaires' disease, with the onset of pneumonia in the first two weeks following exposure through inhalation. Risk groups for serious effects from *Legionella* include the elderly, cigarette smokers, persons with chronic lung disease or an immunocompromising disease, and persons receiving immunosuppressive drugs (CDC 2021a, CDC 2021b). A temperature range of 77°F to 113°F is favorable for *Legionella* growth (CDC 2021a, CDC 2021b). Exposure to *Legionella* from plant operations is a potential problem for workers who dislodge biofilms during the cleaning of condenser tubes or cooling (CDC 2021a). TVA has performed rigorous sampling of cooling tower basins, cooling tower water, and surrounding areas with the potential for growth of *Legionella.* Sampling results identified levels of *Legionella* that were lower than the standard threshold that could potentially impact workers' or the public's health.

Naegleria fowleri (*N. fowleri*) is a free-living pathogenic amoeba that occurs naturally in surface waters and is the main cause of primary amoebic meningoencephalitis (PAM). *N. fowleri* is thermophilic and can grow in heated plant effluent and become a hazard to recreational water users. Amoebic meningoencephalitis is an extremely rare disease that results from the nasal intake of water containing the amoeba. Primary affected groups are individuals of all ages, but groups with the greatest risk of severe disease include infants, the elderly, and those with compromised immune systems. *N. fowleri* is commonly present in freshwaters in the United States; however, infections are rare. From 1962 through 2021 there were only 154 reported cases of *N. fowleri* infection in the United States. Of those 154 cases, 36 were reported between 2011 and 2021 (CDC 2021b). Alabama has not reported any cases of *N. fowleri* infection (CDC 2021a). No data currently exist to accurately estimate the true risk of PAM, and low infection rates make epidemiological studies difficult (CDC 2020). No method currently exists to accurately measure the numbers of amoebae in water, making it unclear how to set standards to protect human health (CDC 2017).

3.23.2. Environmental Consequences – Non-Radiological Public Health and Safety

This section addresses impacts to non-radiological public health and safety from the No Action and the BFN SLR Alternatives. Initiation of decommissioning activities for each BFN unit is required prior to the expiration of each unit's operating license.

Alternative A – No Action Alternative

With the closure of BFN, the in-scope transmission lines would no longer be necessary. The 500-kV transmission lines connected into TVA's 500-kV transmission system would no longer conduct electric charge from the closed BFN. With the closure of BFN, the possibility of electric shock hazard from in-scope BFN transmission lines is nullified.

In addition, with the closure of BFN, the cooling systems would no longer discharge plant effluent into Wheeler Reservoir; no longer heating the waters for thermophilic microorganism growth. In addition, with the closing of BFN, additional cooling from the helper cooling towers would no longer be required, and a possible source for *Legionella* would be eliminated. Impacts to public health would be small and beneficial.

However, under the No Action Alternative, the shutdown of BFN would require construction of replacement power either at BFN or elsewhere within the TVA system. Potential effects from construction and operation would be evaluated in separate analyses once the new generation construction project locations and technologies are specifically identified. These separate analyses would investigate potential impacts to non-radiological public health and safety issues including electric shock hazards and microbiological hazards. The type and level of impact would vary depending upon proximity, mitigation measures, and general construction and operation practices. Impacts could range from small to moderate.

Alternative B – Proposed Action

Under Alternative B, no changes are anticipated to the current plant operations and maintenance procedures and the proper safety protocols protecting the health of the employees and the public would remain in place.

All TVA transmission lines are designed to meet or exceed NESC medium loading requirements and short-circuit safety requirements. Also, the public is precluded from accessing the site and from direct contact with in-scope transmission lines. As a result, any induced current from these lines would be 5 milliamperes or less and the possible shock hazard to the public is small.

Further, operation of BFN Units 1, 2, and 3 and their cooling systems are not expected to change substantially during the proposed subsequent period of extended operation, and there is no reason to believe that discharge temperatures would increase or that disinfection would be discontinued Compliance with the current NPDES permit would continue to protect against high temperatures in the BFN discharge mixing zone that might result in human health impacts from microbiological organisms. From 2015 to 2020, average water temperatures from the cooling water discharge during the warmest months of the year did not exceed 90°F. Maximum temperatures recorded during those months and years did not exceed 91°F. These temperatures are below the range at which *N. fowleri* is typically found, and the low levels of *Legionella* found in onsite sampling of waters favorable for its growth indicate that conditions in the reservoir are unlikely to support its growth there. No new impacts to public health would be anticipated through this action.

3.24. Decommissioning

Regulatory guidance for the consideration of environmental impacts associated with decommissioning is provided in of NUREG-1437 (NRC 2013). The regulatory options and environmental impacts associated with decommissioning BFN are discussed below.

Regulatory Options for Decommissioning

Under all of the alternatives, TVA is required to begin decommissioning each BFN unit no later than the expiration of its operating license. Decommissioning decisions and actions would have to be made sooner under the No Action Alternative than under the BFN SLR Alternative.

The same decommissioning options apply to each alternative. When TVA proposes a decommissioning option, appropriate environmental reviews would be conducted as decommissioning is a separate licensing action. A description of decommissioning options is provided below. TVA currently has no preference among decommissioning options and is not proposing one now. However, the base assumption is that relicensing would not unreasonably increase the amount of radioactive or nonradioactive equipment to be disposed of at decommissioning.

To decommission a nuclear power plant, radioactive material on the site must be reduced to levels that would permit termination of the NRC license. This involves removing the spent fuel from the reactor and spent fuel pools, dismantling any systems or components containing activated materials (such as the reactor vessel and primary loop piping), and cleaning up or dismantling contaminated materials. Activated materials cannot be decontaminated and would have to be removed from the facility and shipped to a waste processing, storage, or disposal facility. Contaminated materials may either be cleaned of contamination on site or removed and shipped to a waste processing, storage, or disposal facility. TVA would decide how to decontaminate material based on the amount of contamination present, the ease with which it can be removed, and the costs and risks to remove the contamination versus the cost and risks to ship the contaminated material to a waste processing, storage, or disposal facility.

The NRC has evaluated the environmental impacts of three methods for decommissioning nuclear power facilities: DECON, SAFSTOR, and ENTOMB (see definitions below) (NRC 2013). NRC regulations state that decommissioning and license termination must be completed within 60 years of permanent cessation of operations. However, existing nuclear power plant decommissioning projects are demonstrating that decommissioning can be completed decades before the 60-year requirement needs to be considered. The choice of decommissioning options and the decommissioning timeline is strongly influenced by uncertainties in LLRW disposal costs and other economic factors.

DECON calls for the timely removal of radioactive material and radioactive contamination to permit unrestricted release of the reactor site. Equipment and structures are decontaminated to levels that meet NRC-approved release criteria or removed and disposed as LLRW.

The advantages of DECON include the following (NRC 2000):

- The operating license is terminated and the facility and site become available for other purposes more quickly than with the other options.
- Availability of the operating work force that is knowledgeable of the facility.
- Elimination of the need for long-term security, maintenance, and surveillance of the facility, which would be required for the other decommissioning options.
- Greater certainty about the availability of low-level waste disposal facilities to accept the LLRW.
- Lower estimated costs compared to the SAFSTOR alternative, largely as a result of future price escalation. Most activities that occur during DECON would also occur during the SAFSTOR period, only at a later date. However, it is anticipated that the later the date for completion of decommissioning the greater the cost. Some of these increases may be offset by technological advances during the SAFSTOR period.

The disadvantages of DECON may include the following (NRC 2000):

- Higher worker and potentially public doses. There is less benefit from radioactive decay that would occur in the SAFSTOR option.
- A larger near-term commitment of disposal site space than the SAFSTOR option.

SAFSTOR is a deferred decontamination strategy that takes advantage of the natural decay of a significant portion of the radiation. After all fuel assemblies, nuclear source material, radioactive liquid wastes, and stored solid wastes are removed from the plant, the remaining structure would then be placed in a safe and secure state. Monitoring systems would be used throughout the SAFSTOR period and a full-time security force would be maintained. The facility would later enter a DECON phase so the license could be terminated within the required 60-year timeframe. This option makes the site unavailable for alternate uses for an extended period, but there could be a reduced need for radioactive waste disposal.

The advantages of SAFSTOR include the following (NRC 2000):

- A substantial reduction in radioactivity as a result of the radioactive decay during the storage period.
- A reduction in worker dose when compared to DECON.
- A potential reduction in public exposure from fewer shipments of radioactive waste as compared to DECON.

- A potential reduction in the amount of radioactive waste disposal space required as compared to DECON.
- Lower cost during the years immediately following permanent cessation of operations.
- More time to benefit from growth through investment of the decommissioning trust fund prescribed by NRC regulations (10 CFR Part 50).

The disadvantages of SAFSTOR include (NRC 2000):

- Shortage of personnel familiar with the facility at the time of deferred dismantlement and decontamination.
- Site unavailable for alternate uses during the extended storage period.
- Uncertainties regarding the availability of LLRW disposal sites and disposal costs in the future.
- Continuing need for maintenance, security, and surveillance.
- Higher total cost for the subsequent decontamination and dismantlement period (assuming typical price escalation during the time the facility is stored); however, this could be partially offset by reduced radioactive waste disposal volumes resulting from radioactive decay and growth of the decommissioning trust fund.

For the ENTOMB option, radioactive structures, systems, and components are encased in a structurally long-lived substance, such as concrete. The entombed structure is appropriately maintained, and continued surveillance is carried out until the radioactivity decays to a level that permits termination of the license.

The advantages of the ENTOMB option are (NRC 2000):

- Encasing materials generally provide radiation shielding resulting in reduced worker dose while decontaminating and dismantling other parts of the facility.
- A potential reduction in public exposure from fewer shipments of radioactive waste.
- The ENTOMB option may have a relatively low cost compared to the DECON and SAFSTOR options.

The disadvantages of ENTOMB include (NRC 2000):

- Because most power reactors will have radionuclides in concentrations exceeding the limits for site release even after 100 years, this option may not be feasible under current regulations. This option may be acceptable for reactor facilities that can demonstrate that radionuclide levels will decay to levels that will allow release of the site.
- Although several small reactors have been entombed or partially entombed, no NRC licensees have proposed the ENTOMB option for a power reactor undergoing decommissioning. Therefore, there is virtually no industry experience to provide a source of lessons learned regarding this option for decommissioning commercial nuclear power plants.

Environmental Impacts Associated with Decommissioning

Discontinuing operation of BFN and the initiation of decommissioning may allow some other commercial or industrial use of part of the site in the future. This would mitigate to some extent the negative socioeconomic impacts of loss of employment. This may include use of the site for electric power generation. Any such future use would require its own environmental review. New, improved decommissioning technologies and efficiencies may be available by the time TVA considers making a decommissioning decision.

Environmental issues associated with decommissioning that result from continued plant operation during the license renewal period are discussed in the GEIS (NRC 2013). These issues are assigned either a Category 1 or a Category 2 designation. For all Category 1 issues, no additional plant-specific analysis is required by the NRC, unless new and significant information is identified. Category 2 issues are those that do not meet one or more of the criteria of Category 1; therefore, additional plant-specific review for these issues is required. There are no Category 2 issues related to decommissioning at BFN.

In summary, neither of the alternatives would result in eliminating any decommissioning option or result in any environmentally unacceptable conditions. Delaying decommissioning of the BFN reactors as a result of the proposed subsequent period of extended operation would have small beneficial and negative impacts when compared to the alternative. However, the net impact of either alternative would be similarly small.

3.25. Unavoidable Adverse Environmental Impacts

This section describes principal unavoidable adverse environmental impacts for which mitigation measures are either considered impractical, do not exist, or cannot entirely avoid the adverse impact. Specifically, this section considers unavoidable adverse impacts that would occur for either the No Action Alternative (Alternative A) or SLR of BFN Units 1, 2, and 3 (Alternative B). The unavoidable construction and operational effects are identified in Tables 3.25-1 and 3.25-2.

Table 3.25-1. Construction-Related Unavoidable Adverse Environmental Impacts

Resource, Alternative	Unavoidable Adverse Impacts
Land Use Alternative A	Construction of new generating assets to replace the 3,900 MWe generating capacity of BFN would require clearing and disturbing of land. The amount of land that would be disturbed is not known at present due to the different combination of generating assets that could be utilized to replace BFN. If greenfield sites are uses, all the land may be changed from the “as found” land use designation while a brownfield site may not change the land-use designation but would require clearing and disturbing activities of the same nature. There would potentially be a long-term commitment of land for the potential new transmission corridors if they are needed and not already present. Some land used as landfills could be dedicated to long-term disposal of construction debris and not available for other uses.
Land Use Alternative B	No major refurbishments or plant modifications are planned during the proposed subsequent period of extended operation. The potential future expansion of the ISFSI is on land already designated for BFN and does not represent any change in land use. Additionally, should a new ISFSI become necessary, impacts would be evaluated in subsequent NEPA and licensing documents.

Resource, Alternative	Unavoidable Adverse Impacts
Hydrologic and Water Use Alternative A	A small amount of water is consumed during construction activities. The impact would vary based on the source of water (groundwater vs surface water) and the combination of generating assets that would be constructed to replace the generating capacity of BFN.
Aquatic Ecology Alternative A	Any construction for the new generating assets that would take place at the waterbody's edge or dredging activities may cause direct, short-term, and small loss of some organisms and temporary degradation of habitat. New transmission lines that cross streams may cause a small disruption of some organisms and degradation of habitat.
Terrestrial Ecology Alternative A	Any construction for the new generating assets would cause small to large alterations to habitat and the species that inhabit them. Construction, clearing, and grading of a new site could directly harm or displace animals. These impacts would be intermittent and continue throughout the construction phases.
Socioeconomics and Environmental Justice Alternative A	Construction workers and local residents would experience elevated levels of traffic through the course of the construction phases needed to build the new generating assets to replace BFN. The locations of the new sites would determine the level of impact on the surrounding community. Rural areas would potentially experience a greater impact than urban locations. The influx of a construction work force would cause short-term, small to large effects on local housing, infrastructure, land use, and community services such as fire or police protection. In the short term, there may be school crowding. Increased tax revenue would mitigate some of this impact. Construction workers and local residents would be exposed to elevated levels of dust, exhaust emissions, and noise from construction and equipment. These constitute small unavoidable impacts. No unavoidable adverse construction impacts to environmental justice populations are anticipated.
Hazardous and Solid, Waste Alternative A	The potential impacts of waste depend on the combination of generating assets that would be constructed to replace BFN. The quantities and types of solid waste generated would be determined primarily by the number of acres, the initial condition of the selected site, and the location and type of technology chosen. Waste would be generated through operation activities. However, impacts would be small as waste would be disposed of in accordance with procedures and applicable regulations.

Table 3.25-2. Operations-Related Unavoidable Adverse Environmental Impacts

Resource, Alternative	Unavoidable Adverse Impacts
Land Use Alternative A	Various amounts of land would be needed in order to construct new generating assets to replace BFN. Land use at offsite locations for these new generating assets would be a long-term commitment. There would be a long-term commitment of land for the required transmission corridors and supporting structures and facilities of the new generating assets. Potential for unanticipated disturbances to historic, cultural, or paleontological resources would be mostly or entirely mitigated. Additional land Could be used for long-term disposal of general trash and hazardous waste normally associated with large industrial facilities. The viewscape of the new generating assets and supporting facilities would be adversely affected over the operational period.
Land Use Alternative B	The BFN site is approximately 880 acres. The majority of the land use is classified as hay/pasture and developed. Land use would continue to be primarily hay/pasture and developed until the plant is shut down and decommissioned. After decommissioning, the site may be used for a different purpose. The ISFSI would remain until the DOE takes possession of the spent fuel, and the ISFSI land would be used for a different purpose. If necessary, the BFN site has adequate space onsite to accommodate the construction of a third ISFSI pad. Impacts associated with this expansion would be assessed under a licensing process separate from that of BFN Units 1, 2, and 3 Subsequent Renewed Facility Operating Licenses. The viewscape of the BFN site and transmission facilities would continue to be impacted over the operational period, but no more than at the present.
Hydrologic and Water Use Alternative A	Water use would vary depending on the generating assets that would be constructed and operated to replace the generating capacity of BFN. All facilities would be operated in compliance with NPDES permits, applicable water quality standards, storm water pollution and SPCC plans would ensure that the impacts would be small.
Hydrologic and Water Use Alternative B	Normal plant operations result in discharge of small amounts of chemicals and radioactive effluents to Wheeler Reservoir throughout the life of BFN. Compliance with the NPDES permit; applicable water quality standards; storm water pollution prevention and SPCC plans; and discharge of radioactive effluents in compliance with applicable regulatory standards would ensure adverse impacts would be small. Discharge of cooling water results in a thermal plume in Wheeler Reservoir throughout the operational life of a BFN unit. The differences between plume temperature and ambient water temperature are maintained within limits set in the NPDES permit. When in service, helper cooling towers release much of the heat to the atmosphere that would otherwise be discharged to the reservoir. Water lost to evaporation represents consumption of water that would not be available for other uses. The consumptive use of surface water, which would continue throughout the operational life of the plant, is less than 0.2 percent of the available surface water. Water use would remain similar to that of current operations during the proposed subsequent period of extended operation

Resource, Alternative	Unavoidable Adverse Impacts
Aquatic Ecology Alternative B	Entrainment or impingement results in a loss of fish and other aquatic organisms. BFN operates in an open mode and uses helper cooling towers when needed to remain in compliance with the NPDES permit, typically a few months during the hottest part of the summer (usually July and August). The impacts of entrainment or impingement on aquatic species would continue to be small.
Socioeconomics and Environmental Justice Alternative A	The loss of operational jobs and potential relocation of employees would have a negligible effect on the permanent population of Lauderdale, Limestone, and Colbert Counties, but the loss of operational jobs could have a dampening effect on the housing market, specifically in Limestone County. The loss of operational jobs could result in a loss of population in Limestone County where a large percentage of BFN operational workers live. The sizeable operational work force needed for the new generating assets would likely come from local and regional sources, creating new jobs for several years. The impact of an influx of workers on a smaller community or city located near the selected site could result in substantial strain on public services and housing. The impacts on the minority or low-income populations would be proportional to their proximity to the new generation facilities. Acquiring adequate housing would be necessary for workers that would relocate to the area for any of the generating asset projects. Upgrading existing or building new infrastructure, water, and wastewater facilities could be required, particularly with the creation of new housing subdivisions. Small unavoidable adverse impacts are expected over the life of the operation of the new generating assets that would be needed to replace BFN.
Radiological Alternative A and B	Small radiological doses to workers and members of the public from radioactive liquid and gaseous effluent releases to air and surface water would occur over the operational life of this project. Releases are well below regulatory limits. While employees are potentially exposed over the long term, adherence to applicable regulatory standards, radiological safety procedures, work plans and safety measures reduce this to a small impact. The potential impacts of radioactive waste and spent fuel are reduced through specific plant design features in conjunction with a waste minimization program. Potential impacts are further reduced through employee safety training programs and work procedures, and by strict adherence to applicable regulations for storage, treatment, transportation, and ultimate disposal of this waste in a geological repository, or reprocessing. These mitigation measures reduce the risk of radioactive impacts, but there remains some small residual risk. Waste disposal constitutes a long-term commitment of land.

Resource, Alternative	Unavoidable Adverse Impacts
Hazardous, Solid, and Low-Level Radioactive Waste Alternative A	The potential impacts of waste depend on the combination of generating assets that would be constructed to replace BFN. The quantities and types of solid waste generated would be determined primarily by the number of acres, the initial condition of the selected site, and the location and type of technology chosen. Waste would be generated through operation activities. However, impacts would be small as waste would be disposed of in accordance with procedures and applicable regulations. Should SMRs be used as for replacement generation, LLRW would be stored, treated, and disposed. Disposal of these materials represents a long-term commitment of land. The impacts of low-level radioactive and nonradioactive hazardous waste are reduced through waste minimization programs, employee training programs, and strict adherence to work procedures and applicable regulations.
Hazardous, Solid, and Low-Level Radioactive Waste Alternative B	LLRW would be stored, treated, and disposed. Disposal of these materials represents a long-term commitment of land. The impacts of low-level radioactive and nonradioactive hazardous waste are reduced through waste minimization programs, employee training programs, and strict adherence to work procedures and applicable regulations.
Atmospheric and Meteorological Alternative A	Atmospheric and meteorological impacts would vary and depend on the combination of generating assets that would be constructed to replace BFN. There would be impacts from the operation of some of these options. All facilities would be required to meet all air quality standards and the impacts would be small to moderate. Should SMRs be used as a replacement generation source, any emissions would be maintained within limits established in permits. Air emissions from diesel generators, equipment, and vehicles would have a small impact on workers and local residents over the operational life of this project. A small amount of radioactive emissions would occur from the SMR plant(s) during normal operations. Compliance with permit limits and regulations for installing and operating air emission sources and monitoring of those air emissions would result in little or no adverse impacts. Should cooling towers be used they could emit a plume of water vapor resulting in a limited obstructed view of the sky. The plumes present little environmental effect on humans or biota.
Atmospheric and Meteorological Alternative B	Although emissions would be maintained within limits established in permits, air emissions from diesel generators, equipment, and vehicles would have a small impact on workers and local residents over the operational life of this project. A small amount of radioactive emissions would occur from nuclear plants during normal operations. Compliance with permit limits and regulations for installing and operating air emission sources and monitoring of those air emissions would result in little or no adverse impacts. Helper cooling towers would emit a plume of water vapor resulting in a limited obstructed view of the sky. The plumes present little environmental effect on humans or biota.

3.26. Relationship Between Short-Term Versus Long-Term Productivity of the Human Environment

This section focuses on and compares the significant short-term benefit (e.g., principally generation of electricity) and uses of environmental resources which have long-term consequences on environmental productivity. Table 3.26-1 summarizes the proposed action's short-term uses and benefits versus the long-term consequences on environmental productivity. For the purposes of this section, the term “short-term” is the period of time during which continued power generation activities would take place for BFN (years of 2033 – 2056), including prompt decommissioning for Alternative B. This discussion applies to the general ramifications of implementing any of the proposed alternatives.

Table 3.26-1. Summary of BFN – Alternative B Principal Short-Term Benefits Versus the Long-Term Impacts on Production

Alternative B – BFN Subsequent License Renewal	Short-Term Uses and Benefits	Relationships to Maintenance and Enhancement of Long-Term Environmental Productivity
Land Use	Continued commitment of land for industrial use until the plant is shut down and decommissioned.	No permanent loss as the land could be released for other uses or returned to its natural state after decommissioning.
Aquatic Ecology	Entrainment and impingement of aquatic biota will continue, but the impacts will continue to be small.	No large permanent detrimental disturbance to biota or their habitats.
Socioeconomic Growth	For continued operation of BFN, the impacts to local socioeconomic conditions would be expected to remain unchanged and of small impact. When BFN is required to shut down and go into decommissioning, the short-term impacts to the local economy would be expected to be small.	Payments in lieu of taxes, plant expenditures, and employee spending leads to some long-term direct and secondary growth in the local economy, infrastructure, and services that may continue after BFN is decommissioned.
Irradiated Spent Fuel	Provides a short-term supply of clean carbon-free energy.	Managed as radioactive waste and either reprocessed or isolated from the biosphere for thousands or tens of thousands of years. Long-term commitment of the local ISFSI storage area and the underground geological repository.
Other Radioactive Waste	The radioactively contaminated reactor vessel and equipment are required for the short-term production of nuclear energy.	Contaminated waste would be moved offsite and must be managed and isolated from the biosphere for hundreds or thousands of years depending on the level of radiotoxicity and half-life.

Alternative B – BFN Subsequent License Renewal	Short-Term Uses and Benefits	Relationships to Maintenance and Enhancement of Long-Term Environmental Productivity
Potential for Accident	Potential consequences of a reactor accident could range from small to large. However, the probability or likelihood of a severe accident is calculated to be very remote. Because the probability of such an event is so small, the overall risk of a nuclear accident is, likewise, considered to be so small as not to constitute a potentially significant impact upon the human environment.	In the advent of an accident, the impacts could be long-term and large. Affected areas would be remediated, and would eventually be returned to industrial or other purposeful life.
Depletion of Natural Resources	As a reactor fuel, the uranium provides a short-term supply of clean carbon-free energy.	Continued operation of BFN would contribute to the long-term cumulative depletion of the global supply of uranium.
Offset Usage of Finite Fossil Fuel Supplies	During operation, BFN would avoid the consumption of fossil fuels, with some increase in the use of uranium. Consumption of fossil fuels in the uranium fuel cycle is substantively less than would occur for equivalently sized fossil-fuel based generation.	Reduces the cumulative long-term depletion of global fossil fuel supplies.
Materials, Energy, and Water	BFN generates far more electrical power than is used to operate the plant. A small amount of materials are used during plant operation. A relatively small quantity of cooling water is lost through evaporation and drift from cooling systems.	Operation of BFN contributes to the cumulative long-term irretrievable use of materials, energy, and water. However, BFN provides far more energy than is consumed.
Air Pollution	Operation of BFN avoids air pollutants that would likely be produced by fossil-fueled plants if the reactor operation was not extended into the period of extended operation.	Operation of BFN results in a long-term cumulative avoidance of greenhouse emissions that would likely be produced by fossil-fueled plants.
Social Changes	Operation of BFN through the proposed subsequent period of extended operation would produce little change from the current social characteristics of the local area.	Payments made in lieu of taxes by TVA, and wages spent by the operational staff, would inject large revenues into the local economy that have long-lasting economic growth and development effects, which would continue after BFN is decommissioned.

The principal short-term benefit from the continued operation of BFN through the proposed subsequent period of extended operation would be the production of a clean and reliable form of electrical energy. Alternative A would also supply clean and reliable electrical energy, although the natural gas-fired combined cycle (CC) and combustion turbine (CT) generation would be the least clean (air quality) of all the replacement generation options. The short-term beneficial impacts of usage outweigh the adverse impacts on long-term environmental productivity.

With respect to long-term benefits, nuclear energy (Alternative B and the SMR option within Alternative A) avoids CO_2 emissions that may have a large long-term detrimental effect on global climate. Nuclear energy also reduces the depletion of fossil fuels. Sections 3.21 describes effects associated with uranium fuel use. Impacts associated with Alternative A SMR(s) and Alternative B include radioactive waste, spent fuel storage, and transportation of radioactive materials. Section 3.25.1 and Section 3.25.2 describe the effects of mining, conversion, enrichment of uranium, fabrication of nuclear fuel, use of fuel, and disposal of the spent fuel as applicable to Alternatives A (SMRs) and B. Effects of natural gas-fired production (i.e., CC and CT facilities as part of Alternative A).

There are two key long-term adverse impacts on productivity of importance to the nuclear alternatives. Both of these environmental impacts are governed by the half-lives of the respective radioisotopes. The first involves long-term radioactive contamination of the reactor vessel, equipment, and other material exposed to radioactive isotopes. The second involves irradiated spent fuel that must be safeguarded and isolated from the biosphere for thousands of years or reprocessed for use as fuel.

3.26.1. Short-Term Uses and Benefits

There are a number of short-term benefits derived from the continued operation of BFN during the proposed subsequent period of extended operation. The proposed subsequent period of extended operation of BFN stands out as the best choice of the two alternatives. Table 3.27-1 presents a summary of BFN's principal short-term benefits versus the long-term impacts on productivity. These short-term uses and benefits, as summarized below include the following:

- Electricity generation.
- Fuel diversity.
- Avoidance of air pollution and greenhouse gas emissions.
- Land use.
- Aquatic Biota.
- Socioeconomic changes and growth.

The principal short-term benefit of the proposed subsequent period of extended operation of BFN would be the continued base load generation to meet the demand for electricity in TVA's power service area. Energy diversity is also fundamental to the objective of achieving a reliable and affordable electrical power supply system. Over-reliance on any one fuel source leaves consumers vulnerable to price spikes and supply disruptions. Continued operation of BFN supports the goal of a diversified mix of electrical generating sources. TVA's goal is to reduce the carbon emissions of the TVA generating system, and Alternative A or B supports that goal. However, Alternative A would not be as effective as there is potential for the construction of natural gas facilities.

BFN would not require changes to the transmission system to maintain the short-term and long-term capacity and reliability of the power supply in TVA's service area. Alternative A would potentially require extensive new infrastructure for transmission lines and pipelines depending on the location and type of new generation resources.

There would be no major construction or refurbishments during the proposed subsequent period of extended operation. Therefore, no additional impacts to terrestrial resources would occur. Land use would not change at the site until decommissioning has occurred. The land may be released for other uses or returned to its natural state after BFN has been decommissioned. Alternative A would potentially require extensive land-use changes for the construction of the new plants and infrastructure, resulting in large impacts to the terrestrial resources.

BFN would not experience any major construction or refurbishments during the proposed subsequent period of extended operation, and impacts to flora and fauna have already occurred and would be expected to remain stable at the site. Alternative A would potentially cause small to large impacts to flora and fauna due to the construction of new generating assets. Aquatic biota impacts have been determined to be of small impact due to impingement and entrainment during operation of BFN. Alternative A would have an even smaller impact due reduced amounts of nuclear generating assets.

The eventual decommissioning of BFN would result in small to moderate short-term impacts to local communities due to the loss of jobs, decreased tax revenue, people moving out of the area, school enrollment decreasing, and impacts on fire, police, and public services. Secondary impacts to local businesses and communities would be expected to be short-term and small. Decommissioning impacts would occur either at the end of the proposed subsequent period of extended operation or at the time the current licenses would expire.

3.26.2. Maintenance and Enhancement of Long-Term Environmental Productivity

Potential long-term effects on the productivity of the human environment are described in this section and summarized in Table 3.26-1. The assessment of long-term productivity impacts does not include the short-term effects related to the continued operation of BFN or the construction and operation of new generating assets needed to replace BFN.

Some of the adverse environmental impacts would remain after practical measures to avoid or mitigate them have been taken.

Land Use

The BFN site land use would continue to be designated as industrial through the proposed subsequent period of extended operation. A new solar, battery storage, and nuclear or natural gas-fired plant site land use would have to be designated for construction and operation of the new facilities.

After any of the generating plants considered under Alternatives A and B are shut down and decommissioned, the land-use designation could be changed as appropriate for the new use of the land. After BFN, or SMR (Alternative A), is shut down and decommissioned to NRC standards, the land would be available for other industrial or non-industrial uses. Decommissioned natural gas-fired plants or solar facilities are not subject to NRC standards, but the land would be available for a multitude of potential land uses.

Therefore, land-use impacts are not expected to preclude long-term productivity. Similarly, after decommissioning, there would be no long-term effects related to air emissions, water effluents, and other resources described in Chapter 3.

Exposure to Hazardous and Radioactive Materials and Waste

Under Alternatives A (SMR facilities) and B, workers may be exposed to low doses of radiation and trace amounts of hazardous materials and waste. Workplace exposures are carefully monitored to ensure that radioactive exposure is within regulatory limits. Local non-workers also receive a very small incremental dose of radiation. Radiological monitoring and impacts related to the operation of BFN or an SMR are described in Chapter 2. The persistence of radionuclides depends on the half-life of the radionuclides. The doses are in compliance with applicable regulatory standards and permits and do not substantially affect humans, biota, or air and water resources.

Potential for Nuclear Accident

Under Alternative A (SMR facilities) and Alternative B, the risk of a potential accident at BFN or from SMRs would be the product of the potential consequences, and the probability or likelihood that an event would occur. The potential consequences of an accident could range from small to large. However, the probability or likelihood of a large accident is very remote. Therefore, the overall risk of a nuclear accident is likewise so small as not to constitute a potentially significant impact upon the human environment. The results of analysis in Section 3.22 indicate that the environmental risks due to postulated accidents are small.

Uranium Fuel Cycle and Depletion of Uranium or Natural Gas

The principal use of uranium is as a fuel for nuclear power plants. With approximately 440 nuclear reactors operating worldwide, these plants currently produce approximately 16 percent of the world's electrical power generation. Global uranium fuel consumption is increasing as nuclear power generation continues to expand worldwide. Continuing to operate BFN through the proposed subsequent period of extended operation would contribute to a small incremental increase in the depletion of uranium.

The operation of a new natural gas-fired plant would contribute to the depletion of the limited global supply of natural gas, although currently natural gas supplies in the United States appear to be increasing as a result of the development of natural gas shale formations.

Offset Usage of Finite Fossil Fuel Supplies

Fossil fuels represent a finite geological deposit, the use of which constitutes a cumulative irreversible commitment of a natural energy resource. The continued operation of BFN or the construction and operation of solar facilities or SMRs helps offset the cumulative depletion of this limited resource.

Use of Materials, Energy, and Water

Construction and operation of BFN have already resulted in the long-term, irreversible use of materials and energy for the completion of BFN. Construction and operation of SMRs, solar facilities, battery storage, or natural gas-fired plants would result in the long-term, irreversible use of materials and energy for the construction and operation of the new generation facilities. However, over the term of operation, BFN, solar facilities, SMRs, or natural gas-fired plants would provide far more energy than is consumed in their construction. A small amount of water is consumed in the construction of any new electrical generation plant. During operation of nuclear power plants, a relatively modest quantity of cooling water is also consumed as loss to the atmosphere through evaporation and drift.

3.27. Irreversible and Irretrievable Commitments of Resources

This section describes anticipated irreversible and irretrievable commitments of environmental resources that would occur in either the continued operation of BFN or the construction and operation of generating assets needed to replace the generating capacity of BFN. The irreversible and irretrievable commitments are summarized in Table 3.27-1 below.

For the purposes of this analysis, the term “irreversible” applies to the commitment of environmental resources (e.g., permanent use of land) that cannot by practical means be reversed to restore the environmental resources to their former state. In contrast, the term “irretrievable” applies to the commitment of material resources (e.g., irradiated steel, petroleum) that, once used, cannot by practical means be recycled or restored for other uses.

Table 3.27-1. Summary of Irreversible and Irretrievable Commitments of Environmental Resources

Environmental and Material Resources Issues	Irreversible	Irretrievable
Socioeconomic Changes Alternatives A and B	Alternative A decommissioning and construction of new generating assets would result in both short-term and long-term small changes in the population, nature, and character of the local community, and local socioeconomic structure. Alternative B would also undergo decommissioning which would result in both short-term and long-term small changes in the population, nature, and character of the local community, and local socioeconomic structure	None.
Disposal of Hazardous and Radioactively Contaminated Waste Alternatives A and B	Alternatives A (i.e., SMRs as part of the replacement facilities for BFN) and B result in the generation of radioactive, hazardous, and nonhazardous waste that would be disposed of in licensed landfills or disposal repositories. Alternative A (i.e., construction and operation of the various generating assets) also results in hazardous and nonhazardous waste that would be disposed of in licensed landfills. Land committed to the disposal of radioactive, hazardous, and nonhazardous wastes is an irreversible impact because it is committed to that use, and is largely unavailable for other purposes.	None.
Commitment of Underground Geological Resources for Disposal of Radioactive Spent Fuel Alternatives A and B	Spent nuclear fuel is isolated from the biosphere for thousands or tens of thousands of years in a deep underground geological repository. This long-term commitment makes the surrounding geological resources unusable for thousands of years.	None.
Destruction of Geological Resources during Uranium Mining and Fuel Cycle and Natural Gas Production Alternatives A and B	None.	Uranium mining can result in contamination and destruction of geological resources, and pollution of lakes, streams, underground aquifers, and the soil. Natural gas production can result in contamination and destruction of geological resources and pollution of lakes, streams, underground aquifers, and the soil.

Environmental and Material Resources Issues	Irreversible	Irretrievable
Contaminated and Irradiated Materials Alternatives A and B	None.	Some of the materials used as components and structures in the operation of BFN or new SMR facility are radioactively contaminated or irradiated over the life of the plant. This material cannot be reused or recycled and must be isolated from the biosphere for hundreds or thousands of years.
Land Use Alternatives A and B	None.	The range of available land uses for the BFN site or alternative new generation facilities and associated transmission line ROWs would be restricted for the life of the plant and transmission lines, resulting in irretrievable lost production or use of renewable resources such as timber, agricultural land, or wildlife habitat during the period the land is used.
Water Consumption Alternatives A and B	None.	Relatively small amounts of potable water are used during operation of BFN. A small fraction of the cooling water taken from Wheeler Reservoir is lost through evaporation. The combination of generating assets that could be constructed could use small amounts of potable water during operation. The impact to surface water is small relative to available resources, but the volume used is a natural resource that is no longer readily available for use.
Consumption of Energy Alternative A and B	None.	Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity is consumed in construction and to a lesser extent, operation of BFN or in the construction and operation of new power generation facilities. Alternative A would consume large amounts of natural gas to fuel CC and CT facilities if these were chosen to help replace the generating capacity of BFN.

Environmental and Material Resources Issues	Irreversible	Irretrievable
Consumption of Uranium Fuel and Natural Gas Alternatives A and B	None.	BFN or a new SMR would contribute a relatively small increase in the depletion of uranium used to fuel the reactors. A new natural gas-fired plant would contribute to the depletion of natural gas used to fuel the plant.

3.27.1. Irreversible Environmental Commitments

Irreversible environmental commitments resulting from the continued operation of BFN or operation of a new nuclear in the form of SMRs would relate primarily to those of the UFC: (1) land disposal of equipment and materials contaminated by hazardous and LLRW, (2) UFC effects that include commitment of underground geological resources for disposal of radioactive waste and spent fuel, and (3) destruction of geological resources during uranium mining.

Implementation of Alternatives A and B (at decommissioning) would result in both short-term and long-term small changes in the population, the nature and character of the local community, and the local socioeconomic infrastructure.

Uranium Fuel Cycle

The UFC is defined as the total of those options and processes associated with the provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

Environmental effects are contributed from uranium mining and milling, the production of uranium hexafluoride, isotopic enrichment, fuel fabrication, use of the fuel, possible future reprocessing of irradiated fuel, transportation of radioactive materials, disposal of used (spent) fuel and management of wastes.

BFN or SMR plants would generate radioactive, hazardous, and nonhazardous wastes that require disposal. This waste is disposed of in permitted hazardous, mixed, or radioactive landfills or disposal facilities. Land committed to the disposal of radioactive and hazardous wastes represents an irreversible impact because it is committed to that use and can be used for few other purposes.

Emissions for fuel production or storage of spent fuel would be considered irreversible. The analysis of these environmental effects results in the finding that all resource impacts were small. The UFC effects from either Alternative A or B impacts would be only small effects.

In June 2008, the DOE submitted to the NRC a license application to build a deep geologic repository for used nuclear fuel and other high-level radioactive waste at Yucca Mountain, Nevada, a remote desert location. A year later, President Obama announced plans to discontinue the Yucca Mountain project and empanel a blue ribbon commission to provide recommendations for long-term management of high-level radioactive waste. The DOE announced formation of the commission on January 29, 2010. TVA believes that a geologic repository will ultimately be the permanent storage solution.

3.27.2. Irretrievable Environmental Commitments

Irretrievable environmental commitments resulting from the continued operation of BFN or the construction and operation of new power generation plants include the following:

- Construction and irradiated materials.
- Water consumption.
- Consumption of energy.
- Consumption of uranium fuel or natural gas.
- Land use.
- Destruction of geological resources during uranium mining and fuel cycle or natural gas production.

Construction and Irradiated Materials

Common irretrievable commitments of materials comprising the components and structures used either for operation of BFN or construction and operation of SMRs include such items as concrete, rebar, structural steel, power cable, small bore piping, and large bore piping. A portion of these materials becomes contaminated or irradiated over the life of nuclear operation. This material cannot be reused or recycled and must be isolated from the biosphere for hundreds or thousands of years. However, because some of this material may be reused (if uncontaminated) or decontaminated for future use, the recycled portion does not constitute an irretrievable commitment of resources.

While the amount of construction materials is large, use of such quantities in large-scale construction projects such as nuclear reactors, hydroelectric and coal-fired plants, and many large industrial facilities (e.g., refineries and manufacturing plants) represents a relatively small incremental increase in the overall use of such materials. Even if this material is eventually disposed of, use of construction materials in such quantities has a small impact with respect to the national or global consumption of these materials. An additional irretrievable commitment of resources includes materials used during normal plant operations, some of which are recovered or recycled.

Construction of a natural gas-fired plant, solar farm, or battery storage facility would require fewer materials and would not be subject to irradiation or contamination, resulting in almost no irretrievable commitment of resources. Construction of transmission lines and infrastructure for Alternative A would require the irretrievable commitment of fossil fuels (diesel and gasoline), oils, lubricants, and other consumables used by construction equipment and workers commuting to the site. Other materials used for construction of the proposed facilities would be committed for the life of the facilities. Some of these materials, such as ceramic insulators and concrete foundations, may be irretrievably committed, while the metals used in conductors, supporting structures, and other equipment could be and would likely be recycled. The useful life of the transmission structures is expected to be at least 60 years. Natural gas pipelines require maintenance that involves irretrievable commitment of fossil fuels as well and have a finite lifetime.

Water Consumption

Relatively small amounts of potable water are used during the operation of BFN and small amounts would be needed for the construction and operation of new generating assets.

Some of the cooling water taken from Wheeler Reservoir for BFN would be lost through the helper cooling towers by way of drift and evaporation. The impact to surface water resources is relatively small, but represents a natural resource that may no longer be available for use.

Energy Used in Construction or Operation of New Power Generation Plants
Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity are consumed in the construction and, to a much smaller extent, operation of all power generation plants. Beyond ancillary (e.g., vehicles, equipment) usage, nuclear reactors do not consume fossil fuels such as petroleum or coal, but a natural gas-fired plant would consume large quantities of natural gas resources.

The total amount of energy consumed during construction or operation of a modern electrical generation plant is very minor in comparison to the total amount consumed within the United States. On net balance, the nuclear reactor produces far more energy (as measured in BTUs) than is consumed in its construction and operation. For this reason, one of the key considerations related to irreversible and irretrievable requirements is that operation of BFN or construction of an SMR or Solar Facility helps conserve or avoid the consumption of finite fossil fuel supplies.

Land Use
The land that would be used for ROWs for pipelines and transmission lines for Alternative A (i.e., CC or CT, solar, storage, and/or SMRs and associated infrastructure) would constitute an irretrievable commitment of onsite resources, such as wildlife habitat and forest resources, for the length of time the pipeline and transmission lines are in place. However, the approximate previous land use and land cover could be returned upon retirement of these facilities.

Uranium Fuel Cycle and the Depletion of Uranium and Natural Gas
Global uranium fuel consumption is increasing as nuclear power generation continues to expand worldwide. Sources of uranium include primary mine production as well as secondary sources. Continued operation of BFN would contribute a relatively small increase in the depletion of uranium. Under Alternative A, BFN would close and the decrease in the depletion of uranium would be offset by SMRs that would be constructed to aid in replacing BFN.

Operation of the CC or CT plants would result in the irretrievable loss of natural gas, which would be used to fuel the CCs or CTs. 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.

3.27.3. Energy Resources and Conservation Potential
The total amount of energy consumed during continued operation of BFN or the construction or operation of the various generating facilities under Alternatives A is very small in comparison to the total amount consumed within the United States. Considering the resulting net balance of energy, a reactor or CC or CT gas turbine would produce far more energy (as measured in BTUs) than would be consumed in its construction or operation. Operation of a nuclear plant helps conserve or avoid the consumption of finite fossil fuel supplies. A CC gas turbine is more efficient than a simple cycle gas turbine and also consumes less fossil fuel than a coal plant.

Nonrenewable energy in the form of fuels (gas, oil, and diesel) and electricity would be consumed in construction of any plant, and to a much smaller extent, in the operation of either BFN or other generating assets that would be constructed to replace the generating capacity of BFN.

Processing of nuclear fuel is, however, an energy-intensive activity. Existing uranium enrichment facilities are large and each facility services several nuclear generating plants. For comparative purposes, the energy required to process or enrich uranium sufficient to fuel a single 1,000 MW pressurized boiling water reactor nuclear plant would approximate that of the output from a 50 MW fossil-fuel (coal-fired) facility operating at 75 percent capacity factor. Newer technologies (e.g., centrifuge or atomic vapor laser isotope separation) currently, or becoming, commercially available for enrichment utilize significantly less power than older technologies. As it is anticipated that these new, less energy intensive technologies will eventually become the norm for production of nuclear fuel, the processing portion of the UFC would likely use even less energy and become even more “carbon-friendly” in the future.

DOE formally announced in a June 29, 2009, Federal Register notice (74 FR 31017) that the department had decided to no longer pursue the prior administration's domestic Global Nuclear Energy Partnership program and that the department would focus on long-term research and development of technologies with the potential to produce beneficial changes to the manner in which nuclear waste is managed. This announcement effectively ended DOE efforts to pursue design and construction of spent nuclear fuel recycling facilities, either at a commercial or engineering scale.

CHAPTER 4 – SUBMITTED ALTERNATIVES, INFORMATION AND ANALYSIS

The Supplemental Environmental Impact Statement (SEIS) includes a summary that identifies all alternatives, information, and analyses submitted by State, Tribal, and local governments, in Section 1.5, and other public commenters during the scoping process for consideration in developing the SEIS (40 Code of Federal Regulations 1502.17). During the scoping period, comments pertained to safety, aging infrastructure, alternatives, general environmental concerns, air quality, water quality and stormwater, wetlands and streams, waste disposal, climate, and environmental justice. The comments related to Tennessee Valley Authority's (TVA's) proposed action are included in Appendix D of the Scoping Report (Appendix A of this SEIS).

Based on the scoping process, reviews, and assessments of the proposed action, TVA determined that the scope of the SEIS should include the following topics:

- Land Use
- Geology and Soils
- Surface Water Resources, Hydrology, and Water Quality
- Groundwater Resources
- Floodplains and Flood Risk
- Wetlands
- Aquatic and Terrestrial Ecology
- Endangered and Threatened Species
- Managed and Natural Areas
- Recreation
- Air Quality, including Meteorology
- Global Climate Change and Greenhouse Gases
- Transportation
- Visual Resources
- Noise and Vibration
- Socioeconomics, including Environmental Justice
- Archaeological Resources and Historic Structures
- Hazardous, Solid, and Low-Level Nuclear Waste
- Radiological Effects of Normal Operations
- Uranium Fuel Cycle Effects
- Nuclear Plant Safety and Security
- Decommissioning

CHAPTER 5 – LIST OF PREPARERS

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Appendix A
Scoping Report

Document Type: SEIS–Administrative Record
Index Field: SEIS Scoping Report
Project Name: BFN Subsequent License Renewal
Project Number: 534475 (2021-11)

FINAL

BROWNS FERRY NUCLEAR (BFN) PLANT

SUBSEQUENT LICENSE RENEWAL ENVIRONMENTAL IMPACT STATEMENT

PUBLIC SCOPING REPORT

Prepared by:

Tennessee Valley Authority
Intersection of Nuclear Plant & Shaw Rd.
Athens, Alabama 35611

October 2021

J. Taylor Cates
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Symbols, Acronyms, and Abbreviations

ADEM	Alabama Department of Environmental Management
BFN	Browns Ferry Nuclear
CWA	Clean Water Act
EA	Environmental Assessment
EIS	Environmental Impact Statement
EJ	Environmental Justice
EO	Executive Order
EPU	Extended Power Uprate
GEIS	Generic Environmental Impact Statement
MWe	Megawatts electric
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NRC	Nuclear Regulatory Commission
PNNL	Pacific Northwest National Laboratory
SEIS	Supplemental Environmental Impact Statement
SLR	Subsequent License Renewal
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

Browns Ferry Nuclear (BFN) Plant Supplemental Environmental Impact Statement (SEIS)

Public Scoping Report

July 2021

The Tennessee Valley Authority (TVA) proposes to submit a Subsequent License Renewal (SLR) Application to the Nuclear Regulatory Commission (NRC) requesting renewal of the Browns Ferry Nuclear (BFN) Plant operating licenses. Renewal of the NRC operating licenses will authorize the plant to continue to operate for an additional 20 years beyond the current 20 -year renewed operating licenses expiration dates of 2033, 2034, and 2036 for Units 1, 2, and 3, respectively. Subsequent NRC license renewal for the operating BFN facilities does not involve new major construction or modifications beyond normal maintenance and refurbishment. However, there are other proposed projects such as spent fuel storage expansion that is not directly related to NRC license renewal that are connected to, or could affect, license renewal. Therefore, TVA is initiating the preparation of a Supplemental Environmental Impact Statement (SEIS) pursuant to the National Environmental Policy Act (NEPA) to assess the environmental impacts of the proposed action.

Background

TVA operates BFN Units 1, 2, and 3 consistent with its mission as charged under the TVA Act of 1933. BFN consists of three General Electric boiling water reactors and associated turbine generators that collectively supply approximately 3,900 Megawatts electric (MWe) to the TVA transmission and distribution system.

In March 2002, TVA issued a Final SEIS followed by a Record of Decision in June 2002 for the operating license renewal of BFN. TVA submitted a License Renewal Application to the NRC in December 2003 for a 20-year extension of the operating licenses for each BFN unit. NRC prepared its own SEIS in consideration of TVA's license application. NRC's Final SEIS concluded that the impacts of license renewal would not be adverse and issued Supplement 21 regarding Browns Ferry Nuclear Plant Units 1, 2, and 3, to the Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants (NUREG-1437) in June 2005. The NRC issued renewed operating licenses for Units 1, 2, and 3 in May 2006, allowing operation of the three BFN units until 2033, 2034, and 2036, respectively.

TVA submitted a license amendment request for extended power uprate (EPU) of approximately 15 percent for all three units in September 2015. The NRC issued a Draft Environmental Assessment (EA) in the Federal Register in December 2016 for public comment. In May 2017, the NRC issued the Final EA and Finding of No Significant Action related to the EPU license amendment. NRC issued the license amendment in August 2017. BFN Unit 3 reached EPU in Summer 2018, Unit 1 reached EPU in December 2018, and Unit 2 reached EPU in Spring 2019.

TVA's Objectives

The purpose of the proposed action is to help provide continued generation of baseload power from the BFN site between 2033 and 2056 by obtaining NRC license renewals to operate all three BFN units. BFN's current generation supports future forecasted baseload power needs, as outlined in TVA's 2019 Integrated Resource Plan, by helping to maintain grid stability and generating capacity for TVA's generation portfolio mix. As an integral part of TVA's current generation portfolio, in 2020, BFN produced approximately 20 percent of TVA's average generation. Renewal of the current NRC operating licenses would allow BFN to continue supplying approximately 3,900 MWe of safe, clean, reliable, and cost-effective baseload power for an additional 20 years. BFN license renewal is a key component of meeting TVA's goal of a net-zero carbon emissions generating system by 2050.

TVA must decide whether to submit a SLR Application to the NRC to extend the operating licenses of the three units for an additional 20 years beyond their current license terms. TVA is preparing an SEIS to inform TVA decision-makers and the public about the environmental consequences of the proposed action.

Proposed Alternatives

Several alternatives will be analyzed in addition to the continuing operation of BFN by license renewal for the generating capacity and energy needed to provide approximately 3,900 MWe of base load power between 2033 and 2053. Potential options for meeting TVA's purpose and need include the range of supply-side and demand-side actions identified in TVA's Integrated Resource Plan. While development of alternatives is a continuing process, preliminary internal scoping by TVA has identified the following four possible alternatives,

- **Alternative A: No Action** – TVA would not submit an application to NRC for SLR. The existing licenses would expire in 2033, 2034, and 2036 and TVA would begin the process of evaluating and planning for the necessary decommissioning of all three BFN units. The 3,900 MWe baseload generation would no longer produced by BFN.
- **Alternative B: BFN NRC Subsequent License Renewal** – TVA would submit a SLR Application to NRC for renewal of BFN Units 1, 2, and 3 licenses until 2053, 2054, and 2056 respectively.
- **Alternative C: Use of Existing Generating Assets** – TVA would cease operations at BFN, and BFN's generating baseload electricity would be replaced using existing generating assets, including natural gas, coal, hydro, nuclear, and storage.
- **Alternative D: Use of Existing and Construction of New Generating Assets** – TVA would cease operations at BFN, and BFN's generating baseload electricity would be replaced using a mix of existing and newly constructed generating assets, including solar, natural gas, nuclear, battery and hydro storage, etc.

Environmental Review Process

NEPA requires the identification and analysis of potential environmental effects of proposed federal actions and alternatives before those actions take place. The NEPA review process is intended to help federal agencies make decisions that are based on an understanding of the action's environmental impacts and, if necessary, to take actions that protect, restore, and enhance the environment. NEPA also requires that federal agencies provide opportunities for public involvement in the decision-making process.

TVA is initiating the preparation of this SEIS to assess the environmental impacts of the proposed action and a reasonable range of alternatives. An EIS is the most intense level of NEPA review. A supplement is prepared to update a previous EIS; in this case the 2002 SEIS for BFN License Renewal. During the completion of this SEIS, the public and environmental and permitting agencies will have opportunities to provide input on the development of the environmental review. After considering input from the scoping period, TVA will develop and publish a Draft SEIS that will be provided to the public and intergovernmental agencies for additional comment. During the Draft SEIS public comment period, TVA plans to conduct a public meeting. TVA will consider all the comments received during the public review of the Draft SEIS, make revisions as appropriate, and publish a Final SEIS stating a preferred alternative. Subsequently, TVA will publish a Record of Decision documenting its final decision regarding the proposed action.

TVA estimates that the Draft SEIS will be published in Fall 2022, the Final SEIS would be published in Early 2023, and a final decision would be made in Spring 2023.

Public Outreach During Scoping Period

The purpose of the scoping period is to present TVA's project objectives and initial alternatives for input from the public and interested stakeholders.

On June 1, 2021, TVA published a Notice of Intent (NOI) in the Federal Register announcing plans to prepare a SEIS to address the potential environmental effects associated with extending the operation of BFN Units 1, 2, and 3 for an additional 20 years (see Appendix A). The NOI initiated a 30-day public scoping period, which concluded on July 1, 2021. In addition to the NOI in the Federal Register, TVA published notices regarding this effort in two local newspapers: The Decatur Daily which serves the Decatur and the Tennessee Valley in northern Alabama and the News Courier which serves Limestone County. TVA also issued a news release to media and posted the news release on the TVA Web site (See Appendix B).

To accommodate social distancing guidelines and public health recommendations related to the COVID-19 pandemic, TVA created a virtual meeting room that was available for the duration of the scoping period. The URL link to the virtual meeting room was included in the NOI and can be accessed through TVA's website (https://www.tva.com/environment/environmental-stewardship/environmental-reviews/nepa-detail/browns-ferry-nuclear-plant-subsequent-license-renewal) through the completion of the EIS process. The virtual scoping meeting room contains information on the NEPA process and the proposed action, as well as links to TVA and NRC websites related to the project. The virtual scoping meeting room also allows the public to submit a comment or feedback on the project during open comment periods (scoping and draft SEIS review). Posterboards and screenshots from the virtual scoping meeting room are included in Appendix C.

Summary of Public Scoping Feedback

TVA received a total of 23 comments regarding the SLR of BFN Units 1, 2, and 3 from five commenters. Of the five comment submissions, two were from federal entities (U.S. Environmental Protection Agency [USEPA] and U.S. Geological Survey [USGS]) and three were from members of the public. Nine of the 23 comments received were in regard to safety and aging infrastructure. The remaining comments received pertained to alternatives, general environmental concerns, air quality, water quality and stormwater, wetlands and streams, waste disposal, climate, and environmental justice. The comments related to TVA's proposed action are provided below. Original comment submissions are included in Appendix D.

Public Scoping Comments

Safety and Aging Infrastructure

Comment 1: There is no evidence these installations will remain safe for an additional 20 years. I ask that all systems be thoroughly inspected and investigated before these extensions are considered and the results made public. (Commenter: Steve Sondheim)

Comment 2: Commenters noted the collapse of the Surfside, Florida condo building as an example that older structures are vulnerable to a variety of aging factors. Aging, stressed components are more likely to fail the longer they are in service. A link to an article was included. (Commenters: Steven Sondheim and Don Safer)

Comment 3: The Supplemental Environmental Impact Statement should reevaluate fundamental assumptions of safety that have been used to justify previous SLRs of other nuclear power reactors in the US. (Commenter: Don Safer)

Comment 4: The SEIS should include the effects of a catastrophic accident and massive radiation release at one or more of these aging reactors that were designed to operate for 40 years. Extending operation to 80 years demands an exhaustive study of the aging management. The longer these reactors run, the greater the risk of a devastating accident. (Commenter: Don Safer)

Comment 5: The Browns Ferry reactors are Fukushima style GE Mark 1 reactors, a design that has a long, controversial history, with many questioning the lack of robustness in the containment system and foreshadowing the three reactor melt-downs, hydrogen explosions, resulting containment breeches, and release of massive amounts of radiation at Fukushima. Links to four articles were included to support this comment. (Commenter: Don Safer)

Comment 6: The Browns Ferry reactors have a history of mechanical problems and other issues resulting in six separate shut-downs of longer than a year including the longest shutdown of any US reactor (Unit 1 from 1985 to 2007) and the second and third longest shutdowns (Unit 3 from 1985 to 1995 and Unit 2 from 1984 to 1991). In 2011 they received one of only 4 “Red finding” safety warnings from the NRC for extended safety performance deficiencies. Safety concerns have plagued these reactors throughout their lives. Links to three articles were included to support this comment. (Commenter: Don Safer)

Comment 7: The BFN spent fuel pools locations are over 40 feet off the ground and with only sheet metal roofing overhead and these pools contain an enormous amount of deadly radiation. The SEIS should consider deficiencies in the BFN spent fuel pools and the environmental effects of a failure of one or more of these pools and the resulting release of radiation. Links to three articles were included to support this comment. (Commenter: Don Safer)

Comment 8: The commenter states that “reasonable assurance” of reactor safety during the proposed SLR period is far from certain. The safety of this license extension is wholly unproven. The NRC and the nuclear reactor operators have taken a “don’t look, don’t want to know” approach to verification of continued integrity of inner reactor critical components that are subject to the intense conditions in a nuclear reactor (heat, neutron bombardment, pressure, extreme temperature swings in SCRAM events, etc.). The commenter also provided a quote from former NRC Commissioner Victor Gilinsky and the link to the story from which the comment was taken, noting the absence of validity of the NRC’s SLR process. (Commenter: Don Safer)

Comment 9: The commenter stated that SEIS should consider the wide range of critical knowledge gaps in the age-related material degradation process in General Electric Mark 1 boiler water reactors and the management of that degradation over 60 or 80 years. The SEIS should also provide an evidence basis on materials safety and systems reliability to make informed, scientifically qualified decisions in regulatory review of longer license extensions of nuclear power plants. Harvesting and material testing of nuclear plant components and compiling an evidence basis to assess age-related degradation management are necessary for “reasonable assurance,” which is an explicit NRC requirement for license extension. The commenter provided a link to a Department of Energy Pacific Northwest National Laboratory (PNNL) Technical Letter Report published in December 2017 in which PNNL was instructed to identify knowledge gaps and recommended harvestings and analysis of materials in decommissioning. He noted that a revised report (PNLL-27120, Rev. 1) was republished in April 2019 having removed scores of references to critical knowledge gaps and recommendations to require decommissioning harvesting and analysis for reasonable assurance in NRC safety and environmental review and approval process of license extension applications. Without scientifically founded “reasonable assurance,” the NRC lacks a legal basis for granting Subsequent License Renewal. (Commenter: Don Safer)

Alternatives
Comment 10: Nuclear power is not needed if renewable energy is adequately deployed by 2035-40. (Commenter: Steven Sondheim)

Comment 11: The No Action Alternative (A) should be chosen, and a new process started that focuses on alternative (E): Replacement of BFN Generating Capacity with Renewable Energy Sources. TVA should bring on board renewables, energy efficiency and additional storage with urgency. Renewable energy is the fastest growing energy resource in the world and the United States. The commenter provide links to two articles. (Commenter Don Safer)

General Environmental Concerns
Comment 12: The SEIS should comprehensively cover all conceivable environmental impacts of continued operation of the BFN reactors. It should consider the fundamental environmental, health and environmental justice problems inherent in nuclear power at every step in the nuclear fuel chain: uranium mining, milling, fuel fabrication, operations, radioactive waste, and decommissioning. (Commenter: Don Safer)

Air Quality
Comment 13: Limestone County is in attainment with the Clean Air Act National Ambient Air Quality Standard. (Commenter: USEPA)

Water Quality and Stormwater
Comment 14: Based on NEPA, the proposed project may be located within a mile of an impaired stream Round Island Creek/Round Island Creek (Wheeler Lake). TVA should consider implementing best management practices during maintenance for areas greater than one acre per the Clean Water Act’s (CWA) National Pollutant Discharge Elimination System Permit for stormwater, where applicable, to ensure that water quality impairments are not exacerbated. (Commenter: USEPA)

Wetlands and Streams
Comment 15: The EPA recommends that TVA collaborate with Alabama Department of Environmental Management (ADEM) and US Army Corps of Engineers (USACE) to determine any potential impacts from the hydraulic and hydrological design associated with thermal discharges to the Tennessee River that may impact terrestrial and/or aquatic species, including both flora and fauna. TVA in collaboration with USACE may wish to include CWA Section 404(b)(1) documents in the SEIS to support any wetland and stream mitigation decisions and to help ADEM evaluate potential stream impact requirements for the CWA Section 401 Water Quality permit. Providing adequate wetland and stream information within the NEPA process can help to streamline the final environmental review and permitting processes for these

resources. According to NEPAssist, there are five approved mitigation or conservations banks in the facility vicinity - Flint River Mitigation Bank Phase I (1042), Wheeler Pointe Mitigation Bank (1044). ADOT Town Creek (1198) and ADOT Crow Creek (1199) and Robinson Spring Mitigation Bank (930) should mitigation be required. (Commenter: USEPA)

Waste Disposal

Comment 16: The SEIS should indicate if there will be any changes in the generation of waste including low-level radioactive waste, mixed low-level radioactive waste, transuranic waste, and hazardous and Toxic Substance Control Act wastes over the life of the program. The SEIS should indicate where TVA will send the spent nuclear fuel and spent fuel debris for storage pending long-term disposal options. (Commenter: USEPA)

Climate

Comment 17: Climate change may impact the proposed project, posing threats to aging infrastructure, worker health and safety and the environment. We recommend that the SEIS include an evaluation of climate-related impacts including discussions of frequency and severity of major storm events, wildfires, or drought that could lead to power disruptions or increased cooling demands in summer months. Efforts that TVA is taking at BFNP to address and adapt to potential climate impacts should be discussed in the SEIS. (Commenter: USEPA)

Comment 18: [The SEIS] should consider the growing threats to nuclear power reactor operation and safety posed by the ever-growing effects of climate change. (Commenter: Don Safer)

Environmental Justice

Comment 19: The SEIS should include an analysis that is consistent with the Environmental Justice (EJ) Executive Order (EO) 12898. The analysis should indicate whether minority, low income or other overburdened populations reside within the vicinity of the proposed project area. If so, the EPA recommends that the communities with EJ concerns should be meaningfully involved throughout the decision-making process to help identify potential benefits and burdens associated with relicensing and permitting decisions. Adaptive and innovative approaches to both public outreach and community involvement regarding project issues should take place during the project planning. It would also be helpful to include a current map depicting the population demographics near the BFNP facility. EPA's EJSCREEN can be used a preliminary screen to help identify potential issues. (Commenter: USEPA)

General Comments

Comment 20: The USGS has no comment at this time. Thank you. (Commenter: USGS)

Comment 21: Renew the licenses. Keep the plant running. We need it. (Commenter: Jack Keeling)

Comment 22: I highly object to the extension of licenses to the Browns Ferry Nuclear Power reactors from 60-80 years which is 40 years beyond the original license. (Commenter: Steven Sondheim)

Comment 23: The subsequent license renewal (SLR) of the three Browns Ferry (BFN) Reactors should be rejected. (Commenter: Don Safer)

Appendix A: Federal Register Notice of Intent

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• 20 CFR 404.1740(b)(8) and 416.1540(b)(8)—This regulatory section requires representatives to disclose to SSA whether the representative is or has been disqualified from participating in or appearing before any Federal program or agency, including instances in which a Federal program or agency took administrative action to disqualify the representative in lieu of disciplinary proceedings. If the disqualification occurs after the appointment of the representative, the representative will immediately disclose the disqualification to SSA; and;

• 20 CFR 404.1740(b)(9) and 416.1540(b)(9)—This regulatory section requires representatives to disclose to SSA whether the representative has been removed from practice or suspended by a professional licensing authority for reasons that reflect on the representative's character, integrity, judgment, reliability, or fitness to serve as a fiduciary. If the removal or suspension occurs after the appointment of the representative, the representative will immediately disclose the removal or suspension to SSA.

A representative's obligation to report these events is ongoing, and SSA requires representatives to report any time one or more of these events occurs. We consider this information essential to ensure the integrity of our administrative process and to safeguard the rights of all claimants. SSA requires representatives to notify SSA in writing, but there is no prescribed format for these reports. The respondents are individuals appointed to represent claimants before SSA.

Type of Request: Extension of an OMB-approved information collection.

Regulation section	Number of respondents	Frequency of response	Average burden per response (minutes)	Estimated annual burden (hours)	Average theoretical hourly cost amount (dollars) *	Total annual opportunity cost (dollars) **
404.1740(b)(5)/416.1540(b)(5)	43,600	1	5	3,633	* $26.45	** $96,093
404.1740(b)(6)/416.1540(b)(6)	2	1	5	0	* 69.86	** 0
404.1740(b)(7)/416.1540(b)(7)	50	1	5	4	* 69.86	** 279
404.1740(b)(8)/416.1540(b)(8)	10	1	5	1	* 69.86	** 70
404.170(b)(9)/416.1540(b)(9)	10	1	5	1	* 69.86	** 70
Totals	43,672			3,639		96,512

* We based this figure on average hourly wages for paralegals/legal assistants and lawyers as posted by the U.S. Bureau of Labor Statistics (*https://www.bls.gov/oes/current/oes_nat.htm*).

** These figures do not represent actual costs that SSA is imposing on representatives to complete the required disclosures; rather, these are theoretical opportunity costs for the additional time representatives or their employees and associates will spend to complete the required disclosures. *There is no actual charge to representatives to complete the required disclosures.*

Dated: May 25, 2021.

Naomi Sipple,

Reports Clearance Officer, Social Security Administration.

[FR Doc. 2021–11421 Filed 5–28–21; 8:45 am]

BILLING CODE 4191–02–P

TENNESSEE VALLEY AUTHORITY

Supplemental Environmental Impact Statement—Browns Ferry Nuclear Site Subsequent License Renewal

AGENCY: Tennessee Valley Authority.

ACTION: Notice of intent.

SUMMARY: The Tennessee Valley Authority (TVA) intends to prepare a Supplemental Environmental Impact Statement (SEIS) to address the potential environmental effects associated with obtaining subsequent license renewals (SLR) for the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 located in Limestone County, Alabama. Renewal of the operating licenses would allow the plant to continue to operate for an additional 20 years beyond the current operating licenses expiration dates of 2033, 2034, and 2036 for Units 1, 2, and 3, respectively. TVA plans to evaluate a variety of alternatives including a no-action alternative. Public comments are invited to identify other potential alternatives, relevant information, and analysis related to the proposed action.

DATES: The public scoping period begins with the publication of this Notice in the **Federal Register** and comments on the scope of the SEIS must be received or postmarked by July 1, 2021. To accommodate social distancing guidelines and public health recommendations related to the COVID–19 pandemic, TVA will have a virtual meeting room available for the duration of the scoping period. Visit *https://www.tva.com/nepa* to obtain more information.

ADDRESSES: Comments may be submitted in writing to J. Taylor Cates, NEPA Specialist, 1101 Market Street, BR 2C–C, Chattanooga, TN 37402. Comments may also be submitted online at: *https://www.tva.com/nepa* or by email to *nepa@tva.gov.* Due to COVID–19 teleworking restrictions, electronic submission of comments is encouraged to ensure timely review and consideration.

FOR FURTHER INFORMATION CONTACT: Other related questions should be sent to Tennessee Valley Authority, J. Taylor Cates, NEPA Specialist, 1101 Market Street, BR 2C–C, Chattanooga, TN 37402, or 423–751–2732/*jtcates@tva.gov.*

SUPPLEMENTARY INFORMATION: This Notice is provided in accordance with the Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) at 40 CFR parts 1500–1508 and Section 106 of the National Historic Preservation Act (NHPA), and its implementing regulations (36 CFR part 800). The SEIS will be prepared consistent with the 2020 CEQ regulations for implementing NEPA at 40 CFR parts 1500–1508 (85 FR 43304–43376, Jul. 16, 2020). The regulations of the Nuclear Regulatory Commission (NRC) in 10 CFR part 54 set forth the applicable license extension requirements.

TVA Power System

TVA is a corporate agency and instrumentality of the United States, created by and existing pursuant to the TVA Act of 1933 (16 U.S.C. part 831), and created to, among other things, foster the social and economic welfare of the people of the Tennessee Valley region and promote the proper use and conservation of the Valley's natural resources. TVA generates and distributes electricity for business customers and local power distributors, serving more than 10 million people in parts of seven southeastern states. TVA is fully self-financed without Federal appropriations, and funds virtually all operations through electricity sales and power system bond financing. In addition to operating and investing its revenues in its electric system, TVA provides flood control, navigation and management for the Tennessee River system, and assists local power companies and state and local governments with economic development efforts.

Dependable electrical capacity on the TVA power system is about 33,000 Mega Watts Electric (MWe). TVA's current generating assets include one pumped-storage facility, one diesel generator site, three nuclear plants, five coal plants, nine combustion turbine plants, eight combined cycle plants, 14 solar energy sites, 29 hydroelectric dams, and several small renewable generating facilities. A portion of delivered power is obtained through long-term power purchase agreements. About 13 percent of TVA's annual generation is from hydro; 14 percent is from coal; 27 percent is from natural gas; 41 percent is from nuclear; and the remainder is from wind and solar. TVA also gains available capacity through its energy efficiency programs. TVA transmits electricity from these facilities over almost 16,000 miles of transmission lines. Like other utility systems, TVA has power interchange agreements with utilities surrounding the Tennessee Valley region, and routinely buys and sells power.

Background

TVA operates BFN Units 1, 2, and 3 in Limestone County, Alabama. BFN is located on an 840-acre tract on the north shore of Wheeler Reservoir at Tennessee River Mile (TRM) 294, approximately 10 miles northwest of Decatur, Alabama, and 10 miles southwest of Athens, Alabama. BFN consists of three General Electric boiling water reactors (BWRs) and associated turbine generators that collectively supply approximately 3,900 MWe of electric power to the TVA transmission and distribution system.

In March 2002 and June 2002, TVA issued a Final SEIS (FSEIS) and a Record of Decision (ROD) for the operating license renewal of BFN. TVA submitted a License Renewal Application (LRA) to the NRC in December 2003 for a 20-year renewal of the operating licenses for each BFN unit. The environmental conclusions of the NRC FSEIS did not differ from the TVA FSEIS conclusions, and the NRC issued Supplement 21 regarding Browns Ferry Nuclear Plant Units 1, 2, and 3, to the Generic EIS (GEIS) for License Renewal of Nuclear Plants (NUREG–1437) in June 2005. The NRC issued operating license renewals for Units 1, 2, and 3 in May 2006, allowing continued operation of the three BFN units until 2033, 2034, and 2036, respectively.

In September 2015, TVA submitted a license amendment request (LAR) for extended power uprate (EPU) of all three units. The NRC issued a draft Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) in the **Federal Register** on December 1, 2016 for public comment. On May 22, 2017 the NRC issued the Final EA and FONSI related to the EPU license amendment.

Project Purpose and Need

The purpose of the proposed action is to help provide continued generation of baseload power between 2033 and 2053 by obtaining license renewals to operate BFN Units 1, 2, and 3. BFN is considered baseload power because the plant generally runs at close to maximum output. BFN's current baseload generation supports future forecasted baseload power needs, as outlined in TVA's 2019 Integrated Resource Plan (IRP), by helping to maintain grid stability and generating capacity for TVA's generation portfolio mix. As an integral part of TVA's current generation portfolio, in 2020, BFN produced approximately 20 percent of TVA's average generation capacity. Renewal of the current operating licenses would allow BFN to continue supplying approximately 3,900 MWe capacity of baseload power.

TVA needs to generate sufficient electricity to supply the Tennessee Valley with increasingly clean, reliable, and affordable electricity for the foreseeable future for the region's homes and businesses, working with local power companies to keep service steady and reliable. By renewing the licenses, TVA would maximize use of existing assets to support TVA's goals of generating electricity at the lowest feasible cost for the people of the Tennessee Valley. BFN's carbon-free generating capacity supports TVA's goal of a net-zero carbon emissions generating system by 2050.

Preliminary Proposed Action and Alternatives

TVA proposes to submit a Subsequent LRA (SLRA) to the NRC requesting renewal of BFN operating licenses. Renewal of the current operating licenses would permit operation for an additional 20 years past the current operating license terms, which expire in 2033, 2034, and 2036 for Units 1, 2, and 3, respectively. This SEIS is being prepared to provide the public and TVA decision-makers an assessment of the environmental impacts of renewing BFN Unit 1, 2, and 3 operations, as well as provide the public an opportunity to participate in the SEIS process. License renewal does not require any new construction or modifications beyond normal maintenance and minor refurbishment. However, there are other proposed projects not directly related to SLR that are connected to, or could affect, license renewal.

The SEIS proposes to address a range of alternatives (A–D) including: (A) The No-Action Alternative; (B) BFN Subsequent License Renewal; (C) Use of Existing Generating Assets; and (D) Use of Existing and Construction of New Generating Assets. Two additional alternatives, (E) Replacement of BFN Generating Capacity Entirely with Renewable Energy Sources and (F) Replacement of BFN Generating Capacity Entirely with Purchase Power, were considered but eliminated.

Anticipated Environmental Impacts

The SEIS will include a detailed evaluation of the environmental, social, and economic impacts associated with implementation of the proposed action. Resource areas to be addressed in the SEIS include, but are not limited to: Air quality; aquatics; botany; climate change; cultural resources; emergency planning; floodplains; geology and groundwater; hydrothermal; land use; navigation; noise and vibration; radiological safety; soil erosion and surface water; socioeconomics and environmental justice; threatened and endangered species; transportation; visual; waste; water use; wetlands; and wildlife. Measures to avoid, minimize, and mitigate adverse effects will be identified and evaluated in the SEIS.

In preparing this SEIS, TVA will consider the analysis within the NRC's Generic Environmental Impact Statement (GEIS) for License Renewal of Nuclear Plants (NUREG–1437, Revision 1), where the NRC generically considered the environmental effects of renewing nuclear power plant operating licenses for a 20-year period (results are codified in 10 CFR part 51). The GEIS identified 78 environmental issues and reached generic conclusions on environmental impacts for 59 of those issues that apply to all plants or to plants with specific design or site characteristics. The GEIS' generic assessment is relevant to the assessment of impacts of the proposed action at BFN. Generic information from the NRC GEIS that is related to the current assessment would be incorporated by reference, generally following the tiering process described in 40 CFR 1501.11, with the SEIS providing a more narrow analysis relevant to the specific aspects of this proposed project. Additional plant-specific review would be conducted for impacts not covered by the GEIS and which are encompassed by the range of resource issue areas identified above.

Anticipated Permits and Other Authorizations

TVA anticipates consulting with the required authorities including, but not limited to: The Endangered Species Act; Bald and Golden Eagle Protection Act; Rare Species Protection and Conservation Act; National Historic Preservation Act; Clean Air Act; and Federal Clean Water Act.

TVA anticipates seeking required permits or authorizations as appropriate, from the following governmental entities: The Nuclear Regulatory Commission; US Army Corps of Engineers; US Coast Guard; US Environmental Protection Agency; Alabama Department of Environment and Conservation; US Fish and Wildlife Service; Alabama State Historic Preservation Officer; and Tribal Historic Preservation Officers. This is not an exhaustive list, other permits or authorizations may be sought as required or appropriate.

Public Participation and Scoping Process

TVA seeks comment and participation from all interested parties for the proposed action, including, but not limited to, assisting TVA in determining the scope of issues for analysis in the SEIS. Information about this project is available at *https://www.tva.com/nepa,* which includes a link to an online public comment page. TVA invites the public to identify other alternatives, and analysis relevant to the proposed action. Comments must be received or postmarked no later than July 1, 2021. Federal, state, local agencies, and Native American Tribes are also invited to provide comments.

Please note that any comments received, including names and addresses, will become part of the project administrative record and will be available for public inspection.

To accommodate social distancing guidelines and public health recommendations related to the COVID–19 pandemic, TVA will have a virtual meeting room available for the duration of the scoping period that includes a range of information on the proposed action. Visit *https://www.tva.com/nepa* to obtain more information about the virtual open house.

SEIS Preparation and Schedule

TVA will consider comments received during the scoping period and develop a scoping report which will be published at *https://www.tva.com/nepa.* The scoping report will summarize public and agency comments that were received and identify the projected schedule for completing the SEIS process. Following completion of the environmental analysis for SLR, TVA will post a Draft SEIS for public review and comment on the project web page. TVA anticipates holding a public open house, which may be virtual, after releasing the Draft SEIS. Open house details will be posted on TVA's website in conjunction with the Draft SEIS. TVA expects to release the Draft SEIS in mid-2022.

TVA will consider comments received on the Draft SEIS, as well as cost, engineering, risk and other applicable evaluations before selecting one or more alternatives as preferred in the Final SEIS. TVA projects completing a Final SEIS in early 2023. A final determination on proceeding with the preferred alternative will be documented in a ROD.

Authority: 40 CFR 1501.9.

Rebecca Tolene,

Vice President, Environment.

[FR Doc. 2021–11557 Filed 5–28–21; 8:45 am]

BILLING CODE 8120–08–P

DEPARTMENT OF TRANSPORTATION

Federal Aviation Administration

Notice of Intent To Release Certain Properties From All Terms, Conditions, Reservations and Restrictions of a Quitclaim Deed Agreement Between City of Tallahassee and the Federal Aviation Administration for the Tallahassee International Airport, Tallahassee, FL

AGENCY: Federal Aviation Administration (FAA), DOT.

ACTION: Request for public comment.

SUMMARY: The FAA hereby provides notice of intent to release certain airport properties 44.66 acres at the Tallahassee International Airport, Tallahassee, FL from the conditions, reservations, and restrictions as contained in a Quitclaim Deed agreement between the FAA and the City of Tallahassee, dated March 14, 1990. The release of property will allow the City of Tallahassee to dispose of the property for non-aeronautical purposes. The City of Tallahassee requests the release of a 44.66 acre tract located along Capital Circle SW in Tallahassee, Florida to facilitate the widening of State Road 263 for municipal development. This capital improvement project is funded by the Florida Department of Transportation. The parcel is currently designated as aeronautical property. The property will be released of its federal obligations given the land is no longer required by The City of Tallahassee. The Fair Market Value (FMV) of this parcel has been determined to be $2,020,050.00.

Documents reflecting the Sponsor's request are available, by appointment only, for inspection at the Tallahassee International Airport and the FAA Airports District Office.

SUPPLEMENTARY INFORMATION:

Section 125 of The Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR–21) requires the FAA to provide an opportunity for public notice and comment prior to the ''waiver'' or ''modification'' of a sponsor's Federal obligation to use certain airport land for non-aeronautical purposes.

DATES: Comments are due on or before July 1, 2021.

ADDRESSES: Documents are available for review at the Tallahassee International Airport, 3300 Capital Circle SW, Suite One, Tallahassee, FL 32310–8732 and the FAA Airports District Office, 8427 SouthPark Circle, Suite 524, Orlando, FL 32819–9058. Written comments on the Sponsor's request must be delivered or mailed to: Stephen Wilson, Program Manager, Orlando Airports District Office, 8427 South Park Circle, Suite 524, Orlando, FL 32819–9058.

In addition, a copy of any comments submitted to the FAA must be mailed or delivered to Mr. Eric Houge, Airport Engineer, Tallahassee International Airport, 3300 Capital Circle SW, Suite One, Tallahassee, FL 32310–8732.

FOR FURTHER INFORMATION CONTACT: Stephen Wilson, Program Manager, (407) 487–7229, Orlando Airports District Office, 8427 SouthPark Circle, Suite 524, Orlando, FL 32819–9058.

Issued in Orlando, FL on May 26, 2021.

Bartholomew Vernace,

Manager, Orlando Airports District Office, Southern Region.

Revision Date 11/22/00.

[FR Doc. 2021–11435 Filed 5–28–21; 8:45 am]

BILLING CODE 4910–13–P

Appendix B: Newspaper Advertisements and Media Release

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Free beer, other new incentives for Biden's 'vaccine sprint'

By Zeke Miller
The Associated Press


Biden

WASHINGTON Dangling everything from sports tickets to a free beer, President Joe Biden is looking for that extra something anything that will get people to roll up their sleeves for COVID 19 shots when the promise of a life saving vaccine by itself hasn't been enough.

Biden on Wednesday announced a "month of action" to urge more Americans to get vaccinated before the July 4 holiday, including an early summer sprint of incentives and a slew of new steps to ease barriers and make getting shots more appealing to those who haven't received them. He is closing in on his goal of getting 70% of adults at least partially vaccinated by Independence Day essential to his aim of returning the nation to something approaching a pre pandemic sense of normality this summer.

"The more people we get vaccinated, the more success we're going to have in the fight against this virus," Biden said from the White House. He predicted that with more vaccinations, America will soon experience "a summer of freedom, a summer of joy, a summer of get togethers and celebrations. An All American summer."

The Biden administration views June as "a critical month in our path to normal," Courtney Rowe, the director of strategic communications and engagement for the White House COVID 19 response team, told the AP.

Biden's plan will continue to use public and private sector partnerships, mirroring the "whole of government" effort he deployed to make vaccines more widely available after he took office. The president said he was "pulling out all the stops" to drive up the vaccination rate.

Among those efforts is a promotional giveaway announced Wednesday by Anheuser Busch, saying it will "buy Americans 21+ a round of beer" once Biden's 70% goal is met.

"Get a shot and have a beer," Biden said, advertising the promotion even though he himself refrains from drinking alcohol.

Additionally, the White House is partnering with early childhood centers such as KinderCare, Learning Care Group, Bright Horizons and more than 500 YMCAs to provide free childcare coverage for Americans looking for shots or needing assistance while recovering from side effects.

The administration is also launching a new partnership to bring vaccine education and even doses to more than a thousand Black owned barbershops and beauty salons, building on a successful pilot program in Maryland.

They're the latest vaccine sweeteners, building on other incentives like cash giveaways, sports tickets and paid leave, to keep up the pace of vaccinations.

"The fact remains that despite all the progress, those who are unvaccinated still remain at risk of getting seriously ill or dying or spreading the disease to others," said Rowe.

Aiming to make injections even more convenient, Biden is announcing that many pharmacies are extending their hours this month and thousands will remain open overnight on Fridays. The White House is also stepping up its efforts to help employers run on site vaccination clinics.

Biden will also announce that he is assigning Vice President Kamala Harris to lead a "We Can Do This" vaccination tour to encourage shots. It will include first lady Jill Biden, second gentleman Doug Emhoff and Cabinet officials. Harris' travel will be focused on the South, where vaccination rates are among the lowest in the country, while other officials will travel to areas of the Midwest with below average rates.

To date 62.9% of the adult U.S. population have received at least one dose of a COVID 19 vaccine and 133.9 million are fully vaccinated. The rate of new vaccinations has slowed to an average below 555,000 per day, down from more than 800,000 when incentives like lotteries were announced, and down from a peak of nearly 2 million per day in early April when demand for shots was much higher.

The lengths to which the U.S. is resorting to convince Americans to take a shot stands in contrast to much of the world, where vaccines are far less plentiful. Facing a mounting U.S. surplus, the Biden administration is planning to begin sharing 80 million doses with the world this month.

"All over the world people are desperate to get a shot that every American can get at their neighborhood drugstore," Biden said.

Thanks to the vaccinations, the rate of cases and deaths in the U.S. are at their lowest since the beginning of the pandemic last March, averaging under 16,000 new cases and under 400 deaths per day.

As part of the effort to drive Americans to get shots, the White House is borrowing some tools from political campaigns, including phone banks, door knocking and texting. The administration says more than 1,000 such events will be held this weekend alone. Additionally, it is organizing competitions between cities and colleges to drive up vaccination rates.

Other new incentives include a $2 million commitment from DoorDash to provide gift cards to community health centers to be used to drive people to get vaccinated. CVS launched a sweepstakes with prizes including free cruises and Super Bowl tickets. Major League Baseball will host on site vaccine clinics and ticket giveaways at games. And Kroger will give $1 million to a vaccinated person each week this month and dozens of people free groceries for the year.

The fine print on the Anheuser Busch promotion reveals the benefits to the sponsoring company, which will collect consumer data and photos through its website to register for the $5 giveaway. The company says it will hand out credits to how ever many people qualify.

COVID-19

From Page A1


Cole Smith receives a Moderna variant vaccine shot from clinical research nurse Tigisty Girmay on March 31 at Emory University's Hope Clinic in Decatur, Ga. [AP PHOTO/BEN GRAY, FILE]

appear effective against worrisome virus mutants, at least for now.

Scientists do not yet know what's called the correlate of protection, the level below which antibodies cannot fend off the coronavirus with out additional help.

Dr. Anthony Fauci, the U.S. government's leading infectious disease expert, told a Senate subcommittee last week that vaccine protection would not be infinite.

"I would imagine we will need, at some time, a booster," Fauci said. "What we're figuring out right now is what that interval is going to be."

To date, 62.8% of the adult U.S. population has received at least one dose of a COVID 19 vaccine and 133.6 million, or more than 40 percent, are full vaccinated. The rate of new vaccinations has slowed to an average below 600,000 per day, according to the Centers for Disease Control and Prevention. That's closing in on President Joe Biden's goal of 70% with at least one inoculation by July 4.

Infections and deaths continue to fall. The nation's seven day average for daily new cases fell to less than 17,300 on Tuesday, down from more than 31,000 two weeks ago. Daily deaths declined to 588, down from 605, according to data from Johns Hopkins University. In all, the virus has killed more than 595,000 people in the U.S.

So called long lived plasma cells are one of the body's backups. Immunologist Ali Ellebedy at Washington University in St. Louis found that nearly a year after people recovered from mild COVID 19, those plasma cells had migrated to the bone marrow where they were continuing to secrete antibodies. That's why although antibodies do diminish with time, they have not disappeared.

Now Ellebedy is hunting for the same cells in vaccine recipients, and while the research isn't finished, he's finding hints that they're forming.

An even more important backup system comes in the form of memory B cells. If existing antibodies are not enough to stop the coronavirus, memory B cells are poised to churn out large numbers of new antibodies, Ellebedy explained. Numerous studies have found those memory cells after COVID 19 vaccination.

And if the virus makes it past those defenses, yet another immune branch the memory T cells jumps in to eliminate infected cells and prevent severe illness.

With different coronaviruses that cause common colds, people tend to get re infected every two to five years, Wherry noted.

Based on natural immunity against those related viruses, "we are sort of expecting our immunity may decline," he said. "But we don't know. For these mRNA vaccines, we may be doing better than nature, better than a natural infection."

So far, health authorities agree that the most common COVID 19 vaccines in the U.S. and Europe protect against the virus mutations that are currently circulating, though not as strongly as they guard against the original virus.

Why? The vaccines mimic the protein that covers the outer surface of the coronavirus, and only certain spots of that protein are mutating, said FDA vaccine chief Dr. Peter Marks. The mRNA vaccines in particular make antibody levels sky rocket after the second dose. Those levels are so high that they offer some protection even when the vaccine and the variant are not a perfect match.

With so many people still unvaccinated, opportunities abound for more mutations to occur. The biggest sign that a booster might be necessary would be a jump in COVID 19 cases in fully vaccinated people, especially severe illnesses and especially if the infections are caused by a new variant.

To get ready, people vaccinated a year ago as part of the first Pfizer and Moderna vaccine trials now are being enrolled in studies of additional shots either a third dose of the original or versions that have been updated to match a variant that first emerged in South Africa. Moderna says preliminary findings are promising. More results are due this summer.

The National Institutes of Health also just began testing a system in which patients are given a different brand of booster than their original vaccination, to see if it is effective.

Most of the world's population has yet to receive a first dose. With different countries using different kinds of vaccines, decisions on booster shots may vary widely. Already, the United Arab Emirates has offered a third dose to recipients of a Chinese made shot, the first formal introduction of any kind of booster.

If boosters eventually are called for, they will not be needed all at once because antibodies fade gradually rather than disappearing suddenly.

"Even if we require boosters or get to the point where we see immunity waning a little bit, we still are going to be far better off than we were a year ago," Wherry said.

LIMESTONE LEDGER

SATURDAY

Guided nature walk
Damien Simbeck will guide a free nature walk starting 8 a.m. Saturday, June 5, at Marbut Bend Walking Trail in West Limestone. Participants can learn about the area and the wildlife who live there. Binoculars, comfortable walking shoes, sun screen and insect repellent are appreciated. The trail is handicapped-accessible.

Coffee call
The Alabama Veterans Museum & Archives' Coffee Call, sponsored by Vietnam Veterans Chapter 511 and Lyle Sadler, will take place 8 a.m. Saturday, June 5, at the museum's new facility, 114 W. Pryor St., Athens.

Family fun day
TLC Pediatrics will host a family fun day from 9 a.m. until noon Saturday, June 5, to celebrate their one-year anniversary. All invited. Games, treats, prizes and more available.

Addiction Eviction Rally
The 3rd annual Addiction Eviction Rally is set for 10:30 a.m.–7 p.m. Saturday, June 5, at Swan Creek Park, 98 U.S. 31, Athens. Free meals, school supplies, hygiene bags and food boxes available. School supply and diaper donations accepted. Three scholarships will be awarded. More information: Lori Masonia, 256-374-3202

Earth Day & Outdoor EXPO
Keep Athens-Limestone Beautiful will host its annual Earth Day & Outdoor EXPO from 11 a.m. to 2 p.m. Saturday, June 5, in Big Spring Memorial Park. Vendors will be located throughout the park with activities for kids, earth-friendly products, information and more. Steve Trash will perform at 11:30 a.m., 12:30 p.m. and 1:30 p.m. More information: KALB 256-233-8000; KALBCares@gmail.com

TUESDAY

Cooking contest
The Alabama Farmers Federation Women's Committee will accept entries for the annual Heritage Cooking Contest 10 a.m. Tuesday, June 8, at the ALFA office, 524 U.S. 72 West, Athens (across from Hobbs Jewelry). The category is candy. Copy of recipe required with registration and entry. Cash prizes available. Must be an ALFA member to enter. More information: 256-233-0938

WEDNESDAY

Childcare class
Limestone County Kids and Kin will host a free child-rearing class from 10 a.m. until noon Wednesday, June 9, at The Haven, 810 N. Malone St., Athens. The class is designed for those raising a relative's child and will focus on "Tails and Tales, Part 1." More information: Tammie Hill, 256-724-2554

UPCOMING

Community appreciation day
Women Empowering Women of Alabama and FreshWind Church will host a community appreciation day 11 a.m.–3 p.m. Saturday, June 12, at 17200 Lucas Ferry Road, Athens. Food, clothing and door prizes will be given away. All ages welcome. More information: Janice Williams, 256-233-5995

Mitchell reunion
Descendants of the Cross Key community's Mitchell family are invited to a family reunion starting 11 a.m. Saturday, June 12, at Swan Creek Park Pavilion #3, U.S. 31 in Athens. Food will be served at noon. More information: Louis, 256-232-7783

Beans and rice
Beans and rice will be given away 9–11 a.m. Saturday, June 19, by volunteers at Saint Timothy's Episcopal Church, 207 E. Washington St., Athens. No names taken; no ID required. More information: 256-232-2567; sttimothy.athens@gmail.com

Juneteenth Festival
A Juneteenth Festival will be held 10 a.m.–7 p.m. Saturday, June 19, on The Square in Athens. Food, vendors, live music, art and more available. Free admission.

Childcare class
Limestone County Kids and Kin will host a free child-rearing class from 10 a.m. until noon Wednesday, June 23, at The Haven, 810 N. Malone St., Athens. The class is designed for those raising a relative's child and will focus on "Tails and Tales, Part 2." More information: Tammie Hill, 256-724-2554

Kiddie Carnival opening
The Athens Lions Club Kiddie Carnival will start the 2021 season 6:30–9:30 p.m. Thursday, June 24, at 309 E. Forrest St., Athens. The carnival will open at those hours Thursdays, Fridays and Saturdays through July 31. Rides, concessions and games available. Free admission to carnival. Ride tickets 50 cents each. More information: "Athens Lions Club Kiddie Carnival" on Facebook

Day of Caring
Limestone County Churches Involved will host a Day of Caring from 9 a.m.–noon Saturday, June 26, at the facility on Jefferson Street in Athens. LCCI will offer food and general assistance to Limestone County residents, including help with rent or utilities for those who qualify. More information: the Rev. Thom Porter, 256-262-0671

ONGOING

Summer feeding program
Women Empowering Women of Alabama, in partnership with FreshWind Church, is offering free meals for children 1-18 years old. Meals available 10 a.m.–1 p.m. Mondays through Fridays from Monday, June 7, until Friday, July 23.

Bill assistance
Community Action Partnership of Huntsville-Madison and Limestone County Inc.'s LIHEAP Cooling Season will begin June 1. Elderly and/or disabled residents and parents of children 18 or younger who meet the income qualifications can apply for assistance with their cooling bills. Call 256-907-1550 to schedule an appointment. More information: www.caa-htsval.org/services/utilities.html

Walk-in vaccine clinic
The Athens-Limestone Hospital COVID-19 vaccine clinic will accept walk-ins for the Pfizer COVID-19 vaccine on a first-come, first-serve basis for ages 12 and older. Clinic hours are 8 a.m.–3 p.m. Mondays through Fridays at Emmanuel Baptist Church, 1917 U.S. 72 West, Athens. More information: ALH COVID-19 hotline, 256-262-6188

New library hours
The Houston Memorial Library and Museum has extended its hours. Patrons can now visit 10 a.m.–4 p.m. Mondays, Wednesdays, Thursdays and Fridays; 10 a.m.–7 p.m. Tuesdays; and 10 a.m.–4 p.m. on the first Saturday of each month. Book sale room also now open. Additional changes may be announced later. Masks and social distancing requested. More information: 256-233-8770

Vaccine rides
The Limestone County NAACP is offering free rides at 12:30 and 3:30 p.m. Mondays through Fridays for those wishing to receive their COVID-19 vaccine at the Athens-Limestone Hospital clinic. More information: 256-227-8489; 256-216-5668

Food giveaway
Ebenezer Missionary Baptist Church's food pantry will be open 11 a.m.–1 p.m. on the third Saturday of each month at 1911 Hine St., Athens. Patrons must provide proof of at least one of the following: eligibility to receive supplemental food assistance (SNAP/food stamps); eligibility for Temporary Assistance to Needy Families; eligibility to receive Supplemental Security Income; income at or below 130% of the federal poverty level; or special circumstances (fire, flood, illness, injury, etc.). Eligibility forms provided at distribution site. Must have valid ID card or driver's license. Only one distribution per household while supplies last. Monetary and food donations accepted. More information: 256-424-5403

Used book sale
Friends of the Athens-Limestone Public Library host a used book sale from 10:15 a.m.–2:15 p.m. each Tuesday and first Saturday of each month at the library, 603 S. Jefferson St., Athens. More information: 256-232-1233

Virtual exercise class
Limestone County Council on Aging presents virtual exercise class 2–3 p.m. Mondays and Fridays via Zoom. The classes are called S.A.I.L., which stands for Stay Active and Independent for Life. More information: 256-233-6412

Corruption hotline
The Alabama Attorney General's Office and the Federal Bureau of Investigation are asking residents with knowledge of public corruption in Limestone County to email details to reportcorruption@ago.state.al.us or call the tip line at 844-404-TIPS

CHURCH EVENTS

Sermon series
Alabama Fork CPCA will host a two-part virtual sermon series titled "Thirsting for More" 9 a.m. Sunday, June 6, and Sunday, June 13. More information: 256-431-7926; sundaymorningseminary.org

Gospel singing
Berea Baptist Church will host a Southern gospel singing with the Hogan family starting 6 p.m. Sunday, June 13, at 16779 Lucas Ferry Road, Athens. Love offering will be received. More information: Gary Wilson, 256-497-9763

CEMETERY CLEANUP

Reunion Cemetery
Reunion Cemetery will host decoration day with a chicken and goat stew fundraiser Saturday, June 5. Attendees are asked to bring their own container. Donations made payable to the Reunion Cemetery Fund should be sent to Nicole Collins, 25172 Alabama 127, Elkmont, AL 35620.

New Garden Cemetery
New Garden Cemetery will host a cleanup day Saturday, June 5, with the annual decoration day held Sunday, June 6. Donations are needed for upkeep and can be made both days at the cemetery. Those who cannot attend in person can mail donations to Harold Atkinson, 20321 Sandlin Road, Elkmont, AL 35620; or to Harold Robinson, 14016 Robinson Lane, Elkmont, AL 35620

City cemeteries
The City of Athens reminds residents and families of the following regarding its cemeteries: No flowers or decorations allowed on the ground between April 1 and Oct. 31, unless following a funeral; flower placement acceptable year-round on monuments, at their base or at foot markers; fresh flowers will be removed one week after a funeral; silk flowers will be removed 21 days after a funeral; approval by cemetery superintendent required before planting flowers, shrubs, trees or sod; city personnel will remove all trees or shrubs deemed detrimental to adjacent lots or grave openings; and worn, tattered or damaged U.S. flags will be removed and disposed of properly.

MEETINGS

• **Legion.** American Legion Post 49 will meet 7 p.m. Thursday, June 3, at the Disabled American Veterans building, 25396 Airport Road, Athens. More information: Rod Huffman, 256-233-3023

Limestone Ledger is a community calendar in which nonprofit organizations can notify the public of events. Publication of donation requests or services offered should not be considered an endorsement by this newspaper. The News Courier encourages residents to research organizations before donating or accepting services. All items will run as space allows until the day of the event and should be submitted at least one week prior to the event for best results. Ongoing items run for up to one month but can be resubmitted regularly. Email submissions to newscouriersoundoff@gmail.com, fax to 256-233-7753 or bring to The News Courier, 410 W. Green St., Athens.

TVA

TVA MEDIA ADVISORY

TVA Requests Input on Browns Ferry Nuclear Subsequent License Renewal

ATHENS, Ala. – The Tennessee Valley Authority is asking for public comment on its Notice of Intent to prepare a Supplemental Environmental Impact Statement on proposed actions associated with obtaining U.S. Nuclear Regulatory Commission license renewals for the Browns Ferry Nuclear Plant Units 1, 2 and 3 in Limestone County, Alabama.

The NRC license renewals would authorize the Browns Ferry Nuclear Plant Units 1, 2, and 3 to continue operation for an additional 20 years beyond the current NRC operating licenses expiration dates of 2033, 2034, and 2036, respectively. TVA plans to evaluate a variety of alternatives including a no-action alternative.

TVA has a virtual meeting room available from June 1 through July 1, 2021. Access the virtual meeting and other details at https://www.tva.com/nepa under the section titled Open for Public Comment.

Comments must be received or postmarked by July 1, 2021, and may be submitted in writing to J. Taylor Cates, NEPA Specialist, 1101 Market Street, BR 2C-C, Chattanooga, TN 37402; online at https://www.tva.com/nepa; or by email to nepa@tva.gov. Due to COVID-19 teleworking restrictions, electronic submission of comments is encouraged to ensure timely review and consideration.

All comments received, including names and addresses, will become part of the administrative record and available for public inspection.

For more information about TVA and its 88-year mission of service to the Tennessee Valley, click here.

\# # #

Media Contact: Malinda Hunter, Chattanooga, 423-718-9245
TVA Public Relations, Knoxville, 865-632-6000
http://www.tva.com/newsroom
Follow TVA news on Facebook, Twitter and Instagram

(Distributed: June 2, 2021)

TENNESSEE VALLEY AUTHORITY

TVA Requests Input on Browns Ferry Nuclear Subsequent License Renewal

Jun 2, 2021

ATHENS, Ala. – The Tennessee Valley Authority is asking for public comment on its Notice of Intent to prepare a Supplemental Environmental Impact Statement on proposed actions associated with obtaining U.S. Nuclear Regulatory Commission license renewals for the Browns Ferry Nuclear Plant Units 1, 2 and 3 in Limestone County, Alabama.

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All comments received, including names and addresses, will become part of the administrative record and available for public inspection.

Contact

Malinda Hunter
Public Relations
mhunter@tva.gov
423-718-9245

TVA Media Line

Our media staff is available 24 hours a day. If you cannot reach the contact above, please call our media line at 865-632-6000.

TVA TENNESSEE VALLEY AUTHORITY

Browns Ferry Nuclear Plant Subsequent License Renewal

Virtual Public Meeting

Enter the virtual meeting room

Notice of Intent to Prepare a Supplemental Environmental Impact Statement

On June 1, 2021, TVA published a Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) to address the potential environmental effects associated with obtaining US Nuclear Regulatory Commission (NRC) subsequent license renewals (SLR) for the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3 located in Limestone County, Alabama. Renewal of the current operating licenses would permit operations for an additional 20 years past the current operating license terms, which expire in 2033, 2034, and 2036 for Units 1, 2, and 3, respectively. The SEIS is being prepared to provide the public and TVA decision-makers with an assessment of the environmental impacts related to the aforementioned NRC license renewal, as well as provide the public an opportunity to participate in the SEIS process. The NRC license renewal would not require any new construction or modifications beyond normal maintenance and minor refurbishment. However, there are other proposed projects not directly related to the NRC SLR that are connected to, or could affect, license renewal.

BFN is considered baseload power because the plant generally runs at close to maximum output. BFN's current baseload generation supports future forecasted baseload power needs, as outlined in TVA's 2019 Integrated Resource Plan (IRP), by helping to maintain grid stability and generating capacity for TVA's generation portfolio mix. As an integral part of TVA's current generation portfolio, in 2020, BFN produced approximately 20 percent of TVA's average generation capacity. Renewal of the current operating licenses would allow BFN to continue supplying approximately 3,900 MWe capacity of baseload power.

TVA needs to generate sufficient electricity to supply the Tennessee Valley with increasingly clean, reliable, and affordable electricity for the foreseeable future for the region's homes and businesses, working with local power companies to keep service steady and reliable. By renewing the licenses, TVA would maximize use of existing assets to support TVA's goals of generating electricity at the lowest feasible cost for the people of the Tennessee Valley. BFN's carbon-free generating capacity supports TVA's goal of a net-zero carbon emissions generating system by 2050.

The SEIS proposes to address a range of alternatives (A-D) including: (A) the No-Action Alternative; (B) BFN Subsequent License Renewal; (C) Use of Existing Generating Assets; and (D) Use of Existing and Construction of New Generating Assets. Two additional alternatives, (E) Replacement of BFN Generating Capacity Entirely with Renewable Energy Sources and (F) Replacement of BFN Generating Capacity Entirely with Purchase Power, were considered but eliminated.

The NOI is provided in accordance with the Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) at 40 CFR parts 1500-1508 and Section 106 of the National Historic Preservation Act (NHPA), and its implementing regulations (36 CFR Part 800). The PEIS will be prepared consistent with the 2020 CEQ regulations for implementing NEPA at 40 CFR parts 1500-1508 (85 FR 43304-43376, Jul. 16, 2020).

Public Involvement

Public scoping was open from June 1, 2021 – July 1, 2021.

TVA is interested in an open process and wants input from the community. The public was invited to submit comments on the scope of this SEIS, alternatives being considered, and environmental issues.

Related Documents:

Notice of Intent

Contact

More information on this environmental review can be obtained from:

TVA TENNESSEE VALLEY AUTHORITY

423-751-2732
1101 Market Street, 2C-C
Chattanooga, TN 37402

Appendix C: Virtual Scoping Meeting Room Materials

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Virtual Scoping Meeting Room Posterboards

TENNESSEE VALLEY AUTHORITY

Welcome
to the

BFN SLR SEIS Virtual Scoping Open House

June 1 – July 1, 2021

The National Environmental Policy Act (NEPA) and Scoping

NEPA requires the identification and analysis of potential environmental effects of major proposed federal actions and alternatives before those actions take place. NEPA's intent is to protect, restore, or enhance the environment through well-informed federal decisions. Public involvement is integral to the federal decision-making process and is required by NEPA.

The purpose of this virtual open house is to inform the public of TVA's intent to prepare a Supplemental Environmental Impact Statement (SEIS) pursuant to NEPA to assess the environmental impacts associated with obtaining subsequent license renewals (SLR) for the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3. Additionally, TVA invites early input from the public regarding the development of the scope, alternatives being considered, and environmental issues related to the proposed action.

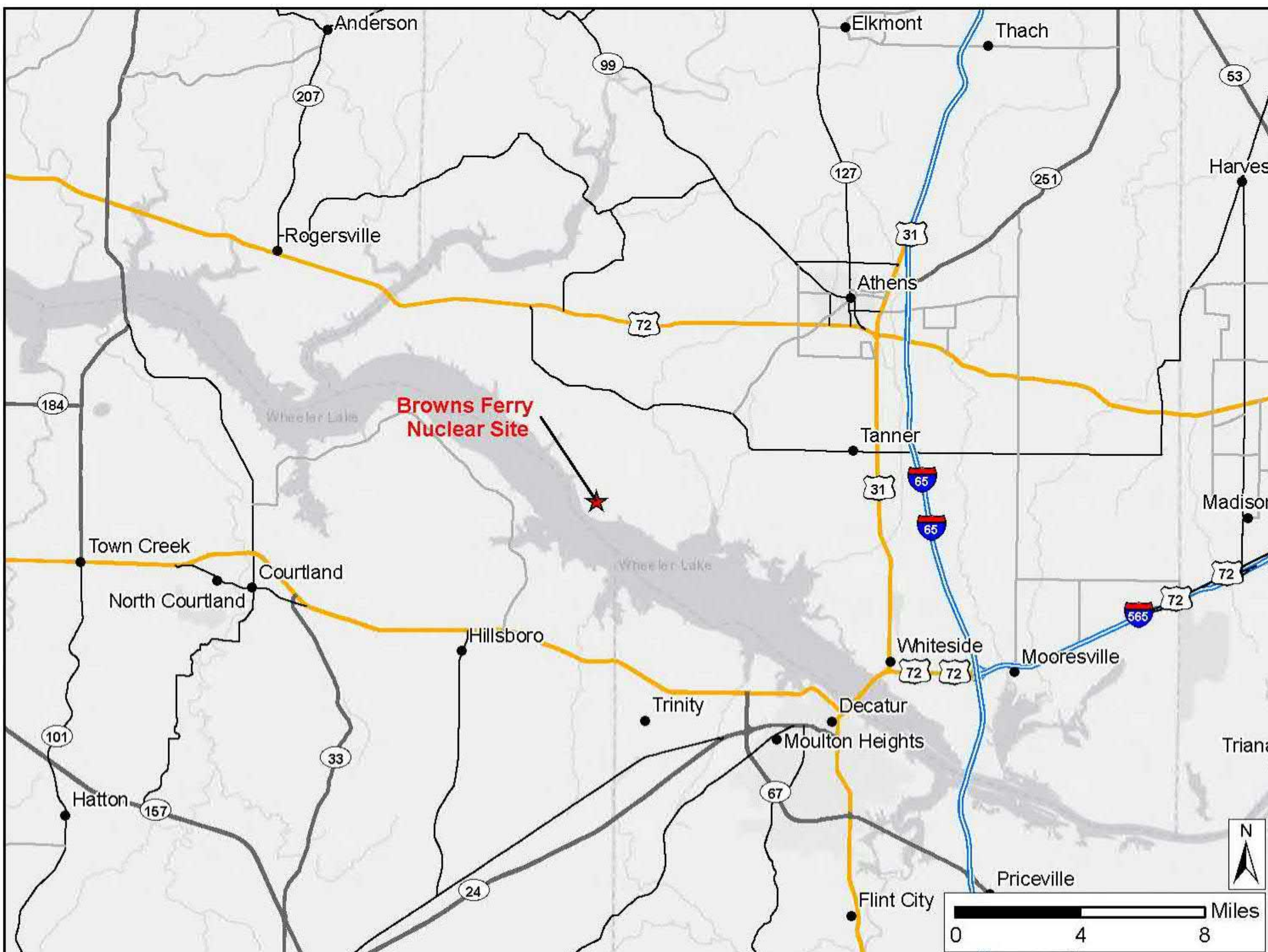
Questions to consider:

- What environmental resources should the SEIS consider?
- What potential impacts should be evaluated?
- Are there any additional alternatives that should be considered?
- Can you recommend any additional sources of information?
- What organizations should TVA be coordinating with?

TVA TENNESSEE VALLEY AUTHORITY

Project Location

The Tennessee Valley Authority's (TVA) Browns Ferry Nuclear Plant (BFN) is located on an 840-acre tract on the north shore of Wheeler Reservoir at Tennessee River Mile (TRM) 294, approximately 10 miles northwest of Decatur, Alabama, and 10 miles southwest of Athens, Alabama.



TENNESSEE VALLEY AUTHORITY

Background

TVA operates BFN Units 1, 2, and 3 consistent with its mission as charged under the TVA Act of 1933. BFN consists of three General Electric boiling water reactors (BWRs) and associated turbine generators that collectively supply approximately 3900 Megawatts electric (Mwe) of electric power to the TVA transmission and distribution system.

In March 2002, TVA issued a Final SEIS (FSEIS) followed by a Record of Decision (ROD) in June 2002 for the operating license renewal of BFN. TVA submitted a License Renewal Application (LRA) to the Nuclear Regulatory Commission (NRC) in December 2003 for a 20-year extension of the operating licenses for each BFN unit. The environmental conclusions the NRC FSEIS did not differ from the TVA FSEIS conclusions and the NRC issued Supplement 21 regarding Browns Ferry Nuclear Plant Units 1, 2, and 3, to the Generic EIS (GEIS) for License Renewal of Nuclear Plants (NUREG-1437) in June 2005. The NRC issued operating license renewals for Units 1, 2, and 3 in May 2006, allowing continued operation of the three BFN units until 2033, 2034, and 2036, respectively.

TVA submitted a license amendment request (LAR) for extended power uprate (EPU) of approximately 15% for all three units in September 2015. The NRC issued a draft Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) in the Federal Register in December 2016 for public comment. In May 2017, the NRC issued the Final EA and FONSI related to the EPU license amendment. The NRC issued the license amendment in August 2017.

Project Purpose and Need

The purpose of the proposed action is to help provide continued generation of baseload power between 2033 and 2053 by obtaining US Nuclear Regulatory Commission (NRC) license renewals to operate BFN Units 1, 2, and 3. BFN's current generation supports future forecasted baseload power needs, as outlined in TVA's 2019 Integrated Resource Plan (IRP), by helping to maintain grid stability and generating capacity for TVA's generation portfolio mix. As an integral part of TVA's current generation portfolio, in 2020, BFN produced approximately 20 percent of TVA's average generation. Renewal of the current NRC operating licenses would authorize BFN to continue supplying approximately 3,900 MWe of safe, clean, reliable, and cost-effective baseload power for the foreseeable future for the Tennessee Valley region's homes and businesses, working with local power companies to keep service steady and reliable.

By renewing the NRC licenses, TVA would maximize use of existing assets to support TVA's goals of generating electricity at the lowest feasible cost for the people of the Tennessee Valley. BFN's carbon-free generating capacity supports TVA's goal of a net-zero carbon emissions generating system by 2050.

TVA TENNESSEE VALLEY AUTHORITY

Preliminary Proposed Action

TVA proposes to submit a Subsequent License Renewal Application to the NRC requesting renewal of the BFN operating licenses.

- Renewal of the NRC operating licenses will authorize the plant to continue to operate for an additional 20 years beyond the current 20-year renewed operating licenses expiration dates of 2033, 2034, and 2036 for Units 1, 2, and 3, respectively.

- Subsequent NRC license renewal for the operating BFN facilities does not involve new major construction or modifications beyond normal maintenance and refurbishment.

- There are other proposed projects not directly related to NRC license renewal that are connected to, or could affect, license renewal.

TVA TENNESSEE VALLEY AUTHORITY

Alternatives

The SEIS proposes to address a range of alternatives including:

- Alternative A: No-Action Alternative
- Alternative B: BFN NRC Subsequent License Renewal
- Alternative C: Use of Existing Generating Assets
- Alternative D: Use of Existing and Construction of New Generating Assets

Two additional alternatives were considered but eliminated:

- Alternative E: Replacement of BFN Generating Capacity Entirely with Renewable Energy Sources
- Alternative F: Replacement of BFN Generating Capacity Entirely with Purchase Power

TENNESSEE VALLEY AUTHORITY

Anticipated Environmental Impacts

The SEIS will include a detailed evaluation of the environmental, social, and economic impacts associated with implementation of the proposed action and alternatives. Measures to avoid, minimize, and mitigate potential adverse effects will also be identified and evaluated in the SEIS.

Resource areas to be addressed in the SEIS include, but are not limited to:

- Air Quality
- Aquatics
- Botany
- Climate Change
- Cultural Resources
- Emergency Planning
- Floodplains
- Geology and Groundwater
- Hydrothermal
- Land Use
- Navigation
- Noise and Vibration
- Radiological Safety
- Soil Erosion and Surface Water
- Socioeconomics and Environmental Justice
- Threatened and Endangered Species
- Transportation
- Visual Resources
- Waste
- Water Use
- Wetlands
- Wildlife

TVA TENNESSEE VALLEY AUTHORITY

SEIS and GEIS

In preparing this SEIS, TVA will review the GEIS for License Renewal of Nuclear Plants, NUREG-1437, in which the NRC considered the environmental effects of renewing nuclear power plant operating licenses for a 20-year period (codified in 10 CFR Part 51).

The GEIS identified 78 environmental issues and reached generic conclusions on environmental impacts for 59 of those issues that apply to all plants or to plants with specific design or site characteristics.

The GEIS' generic assessment is relevant to the assessment of impacts of the proposed action at BFN. Generic information from the NRC GEIS that is related to the current assessment would be incorporated by reference, generally following the tiering process described in 40 CFR 1501.11, with the SEIS providing a more narrow analysis relevant to the specific aspects of this proposed project.

Additional plant-specific review would be conducted for impacts not covered by the GEIS and which are encompassed by the range of resource issue areas identified on the Anticipated Environmental Impacts poster.

TVA TENNESSEE VALLEY AUTHORITY

Anticipated Permits and Other Authorizations

TVA anticipates consulting with the required authorities including, but not limited to:

- Endangered Species Act
- Bald and Golden Eagle Protection Act
- Rare Species Protection and Conservation Act
- National Historic Preservation Act
- Clean Air Act
- Federal Clean Water Act

TVA anticipates seeking or renewing required permits or authorizations, from the following governmental entities:

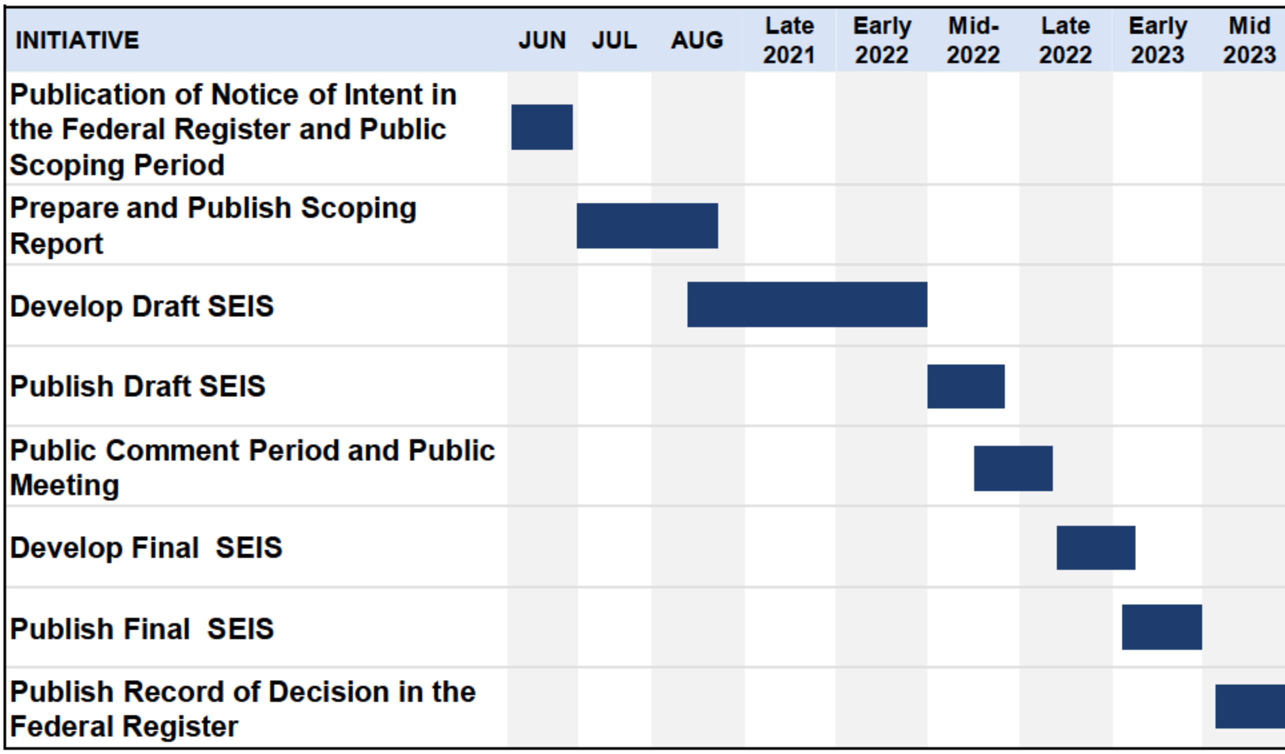
- Nuclear Regulatory Commission
- US Army Corps of Engineers
- US Coast Guard
- US Environmental Protection Agency
- Alabama Department of Environment and Conservation
- US Fish and Wildlife Service
- Alabama State Historic Preservation Officer
- Tribal Historic Preservation Officers

Other permits or authorizations may be sought as required or appropriate.

TVA TENNESSEE VALLEY AUTHORITY

SEIS Preparation and Schedule

TVA will consider comments received during the scoping period and develop a scoping report which will be published at https://www.tva.com/nepa. The scoping report will summarize public and agency comments that were received and identify the projected schedule for completing the SEIS process.



Following completion of the SLR environmental analysis, TVA will post a Draft SEIS for public review and comment on the project web page. TVA anticipates holding a public open house, which may be virtual, after releasing the Draft SEIS. Open house details will be posted on TVA's website in conjunction with the Draft SEIS. TVA expects to release the Draft SEIS in mid-2022.

TVA will consider comments received on the Draft SEIS, as well as cost, engineering, risk and other applicable evaluations before selecting one or more alternatives as preferred in the Final SEIS. TVA projects completing a Final SEIS in early 2023. A final determination on proceeding with the preferred alternative will be documented in a Record of Decision.

TVA TENNESSEE VALLEY AUTHORITY

How to Submit Comments

TVA invites the public to submit comments on the scope of this SEIS, alternatives being considered, and analysis relevant to the proposed action. Federal, state, local agencies, and Native American Tribes are also invited to provide comments.

Comments are encouraged and must be received or postmarked no later than <u>July 1, 2021</u>.

Due to COVID-19 teleworking, TVA recommends that the public submit comments electronically to ensure their timely review and consideration.

Please note that any comments received, including names and addresses, will become part of the project administrative record and will be available for public inspection.

Comments can be provided by:

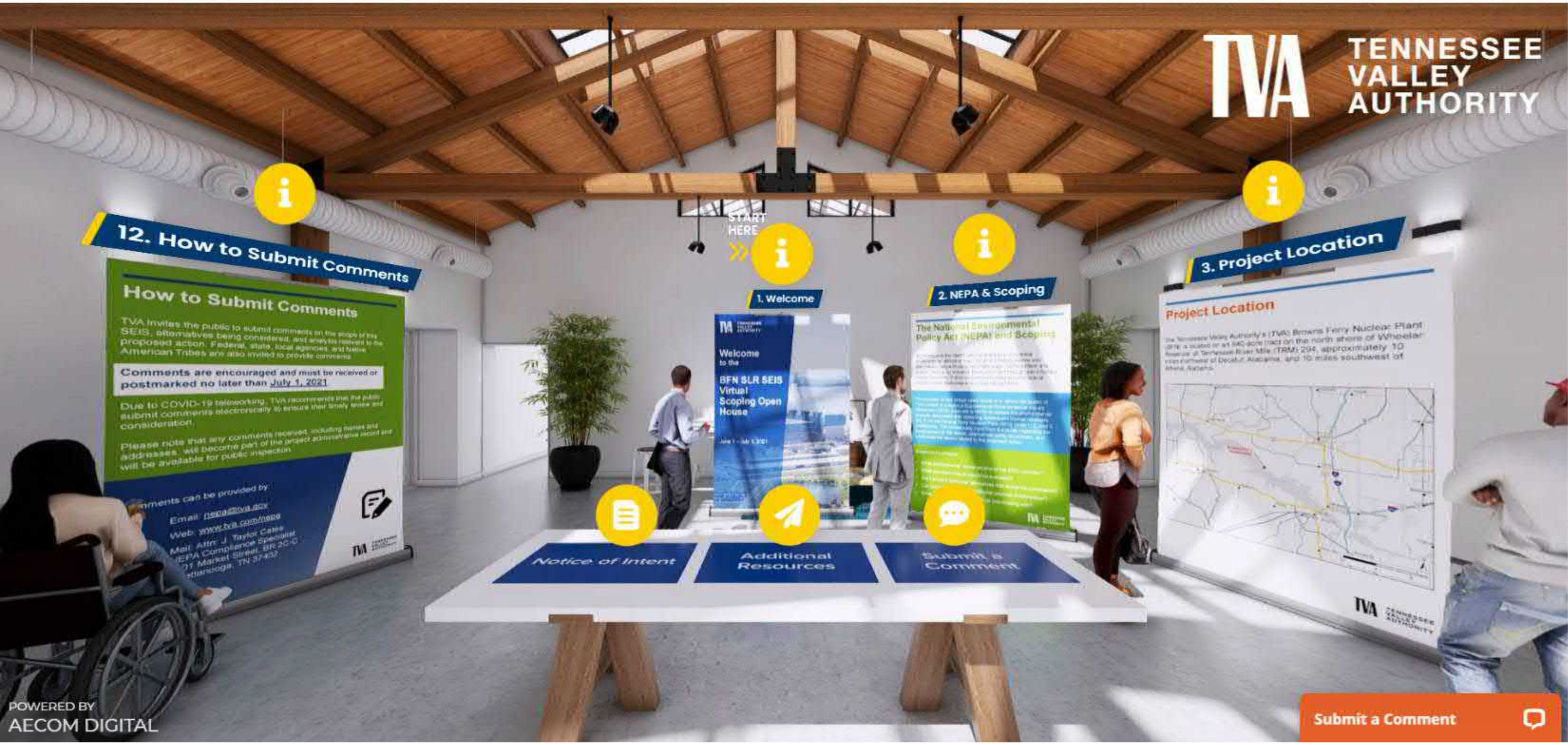
Email: nepa@tva.gov

Web: www.tva.com/nepa

Mail: Attn: J. Taylor Cates
NEPA Compliance Specialist
1101 Market Street, BR 2C-C
Chattanooga, TN 37402

TVA TENNESSEE VALLEY AUTHORITY

Virtual Scoping Meeting Room Screenshots



TVA TENNESSEE VALLEY AUTHORITY
12. How to Submit Comments
How to Submit Comments
Comments are encouraged and must be received or postmarked no later than July 1, 2021
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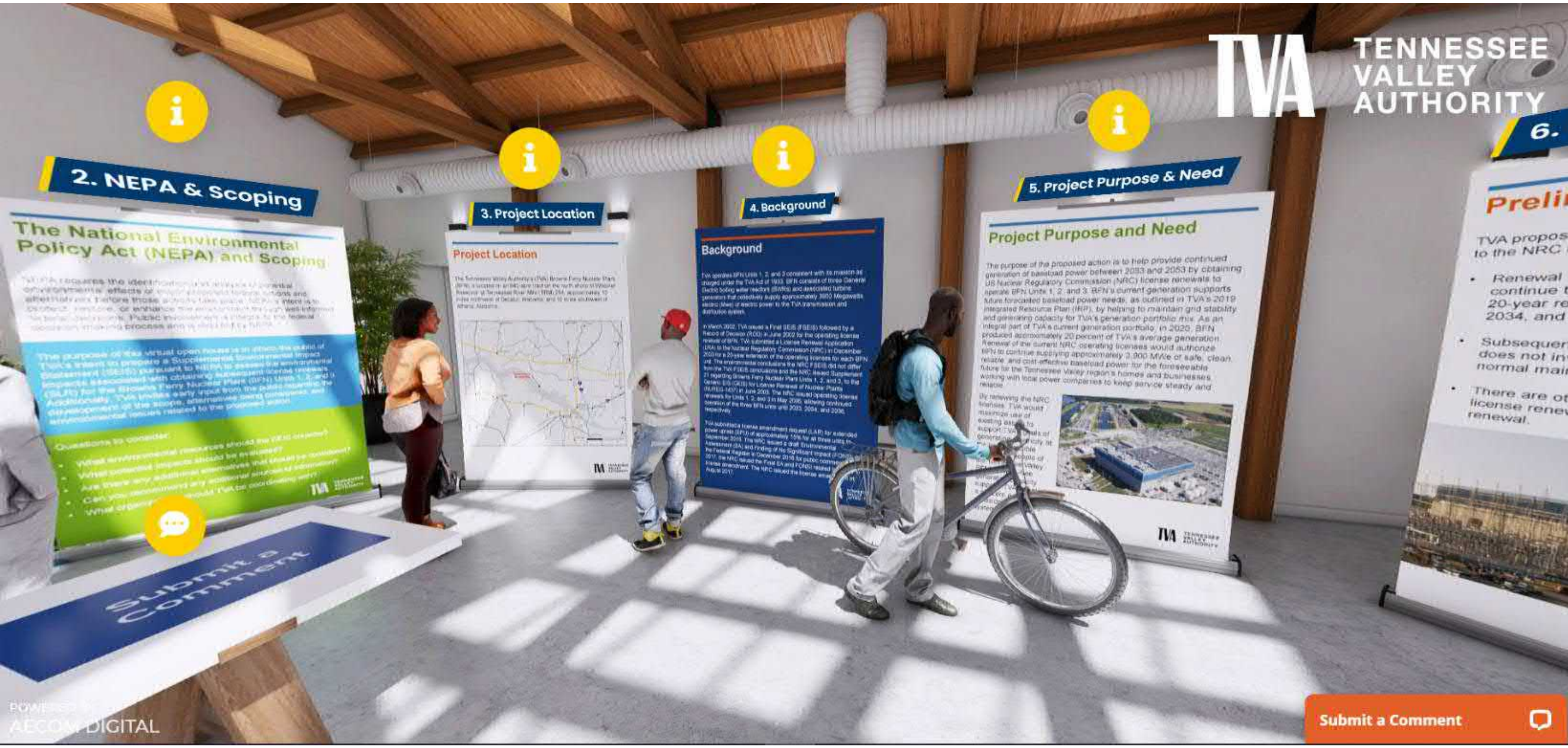
START HERE
1. Welcome
Welcome to the
BFN SLR SEIS Virtual Scoping Open House
2. NEPA & Scoping
3. Project Location
Project Location
Notice of Intent
Additional Resources
Submit a Comment
POWERED BY
AECOM DIGITAL
Submit a Comment



TVA
TENNESSEE
VALLEY
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2. NEPA & Scoping
The National Environmental Policy Act (NEPA) and Scoping
3. Project Location
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4. Background
Background
5. Project Purpose & Need
Project Purpose and Need
Submit a Comment
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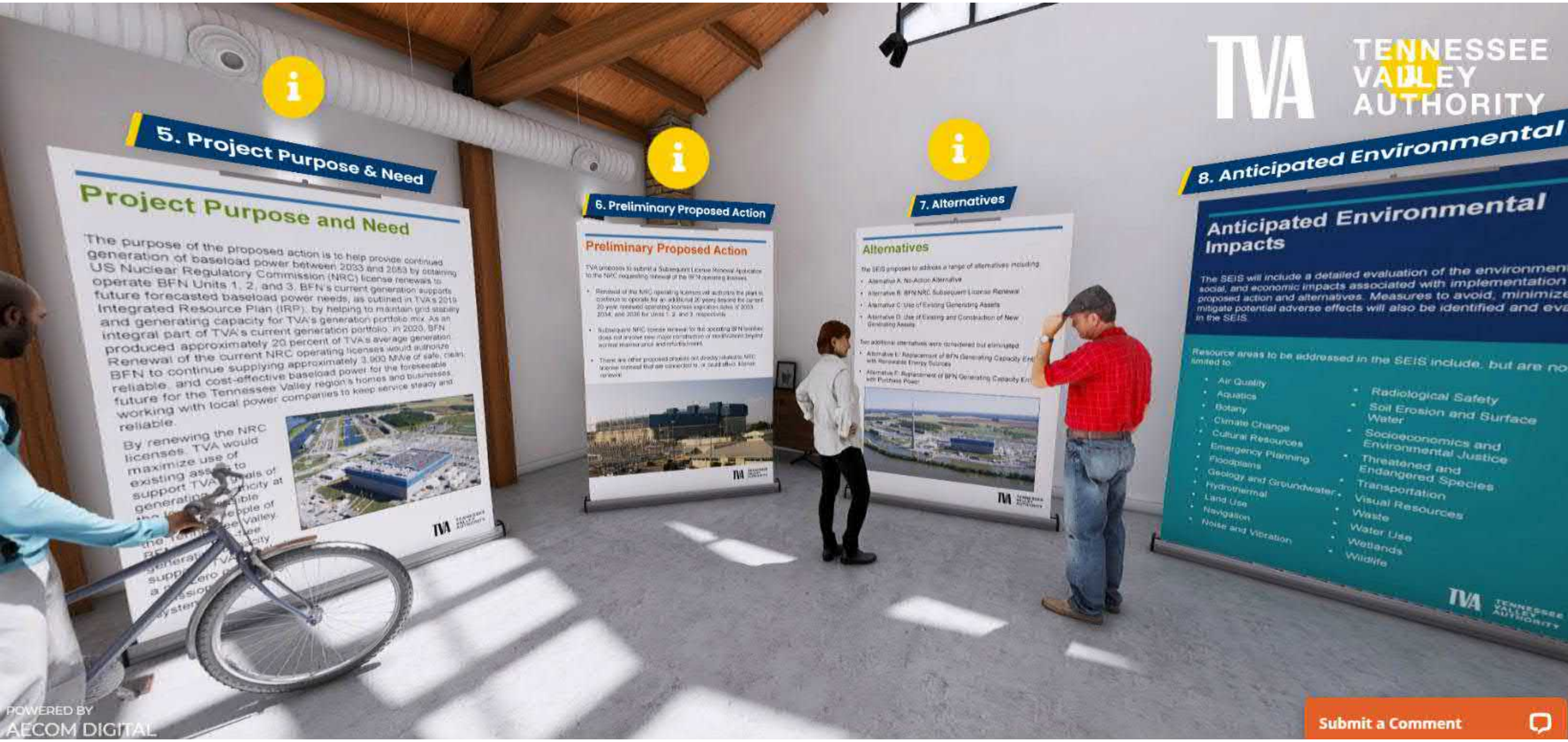
Submit a Comment



TVA TENNESSEE VALLEY AUTHORITY
5. Project Purpose & Need
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By renewing the NRC licenses, TVA would maximize use of existing assets to
6. Preliminary Proposed Action
Preliminary Proposed Action
7. Alternatives
Alternatives
8. Anticipated Environmental
Anticipated Environmental Impacts
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Botany
Climate Change
Cultural Resources
Emergency Planning
Floodplains
Geology and Groundwater
Hydrothermal
Land Use
Navigation
Noise and Vibration
Radiological Safety
Soil Erosion and Surface Water
Socioeconomics and Environmental Justice
Threatened and Endangered Species
Transportation
Visual Resources
Waste
Water Use
Wetlands
Wildlife
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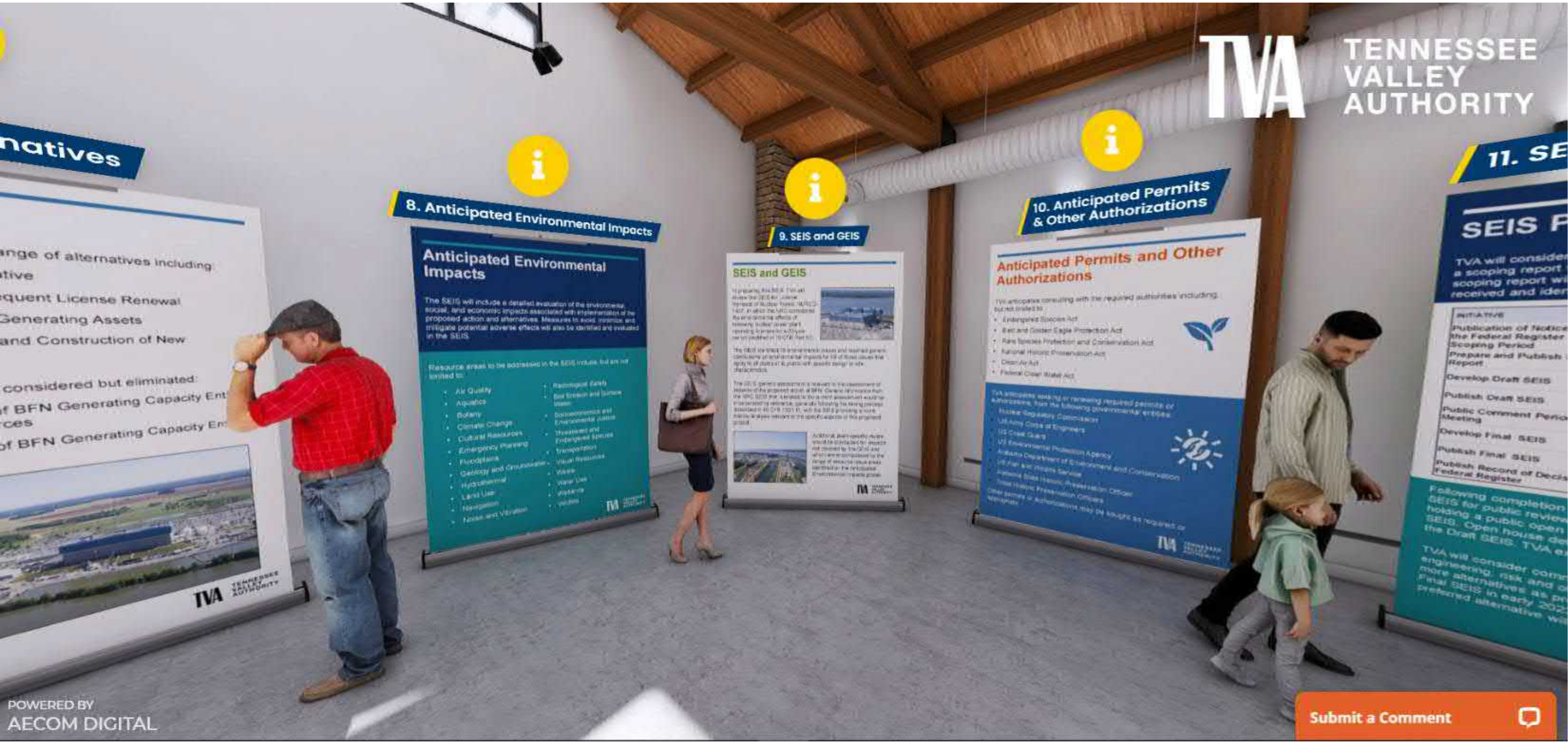
Submit a Comment



8. Anticipated Environmental Impacts
Anticipated Environmental Impacts
9. SEIS and GEIS
SEIS and GEIS
10. Anticipated Permits & Other Authorizations
Anticipated Permits and Other Authorizations
TVA
TENNESSEE VALLEY AUTHORITY
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Submit a Comment

10. Anticipated Permits & Other Authorizations
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Endangered Species Act
Bald and Golden Eagle Protection Act
Rare Species Protection and Conservation Act
National Historic Preservation Act
Clean Air Act
Federal Clean Water Act
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Nuclear Regulatory Commission
US Army Corps of Engineers
US Coast Guard
US Environmental Protection Agency
Alabama Department of Environment and Conservation
US Fish and Wildlife Service
Alabama State Historic Preservation Officer
Tribal Historic Preservation Officers
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11. SEIS Preparation & Schedule
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TVA TENNESSEE VALLEY AUTHORITY
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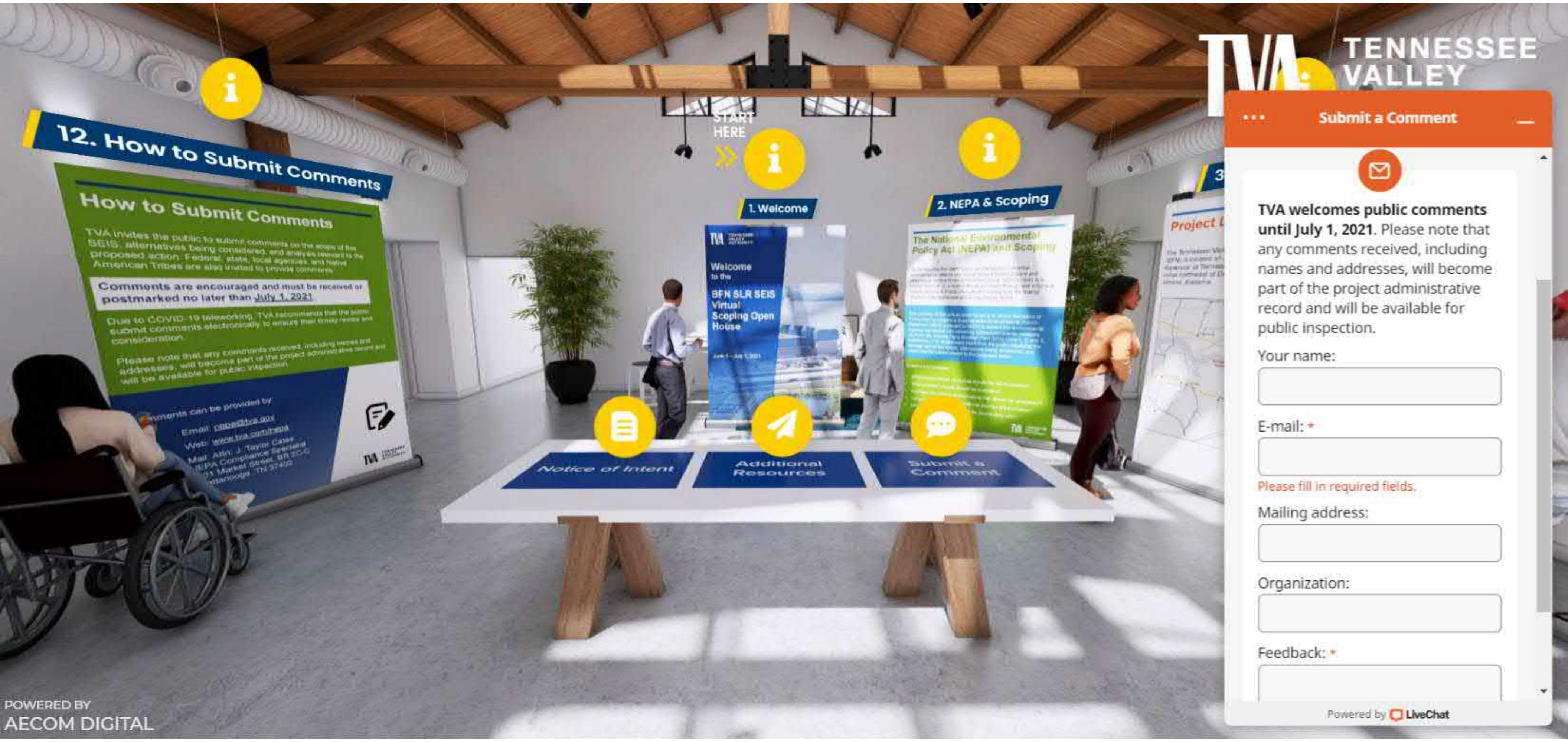
Submit a Comment



TENNESSEE VALLEY
START HERE
12. How to Submit Comments
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1. Welcome
Welcome to the BFN SLR SEIS Virtual Scoping Open House
2. NEPA & Scoping
The National Environmental Policy Act (NEPA) and Scoping
Notice of Intent
Additional Resources
Submit a Comment
Submit a Comment
TVA welcomes public comments until July 1, 2021. Please note that any comments received, including names and addresses, will become part of the project administrative record and will be available for public inspection.
Your name:
E-mail: *
Please fill in required fields.
Mailing address:
Organization:
Feedback: *
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Appendix D: Public and Agency Comments

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From:	Long, Larry
To:	Cates, J. Taylor
Cc:	Kajumba, Ntale
Subject:	Browns Ferry NOI comments
Date:	Friday, June 25, 2021 1:45:09 PM

J. Taylor Cates
Tennessee Valley Authority
NEPA Specialist
1101 Market Street, BR 2C-C
Chattanooga, TN 37402

RE: Notice of Intent to prepare a Supplemental Environmental Impact Statement for the subsequent license renewal for Browns Ferry Nuclear Plant Units 1, 2, and 3.

Dear Mr. Cates:

The U.S. Environmental Protection Agency (EPA) has reviewed Tennessee Valley Authority's (TVA) Notice of Intent (NOI) to prepare a Supplemental Environmental Impact Statement (SEIS) that addresses the environmental effects associated with obtaining relicense renewals (SLR) for the Browns Ferry Nuclear Plant (BFNP) Units 1, 2, and 3 in Limestone County, Alabama. Renewal of the operating licenses would allow the plant to continue to operate for an additional 20-years beyond the current operating licenses of 2033, 2034, and 2036 for the three units. The BFNP Units 1, 2, and 3 are located on 840-acres tract on the north shore of Wheeler Reservoir. The TVA plant consists of three General Electric boiling water reactors and associated turbine generators.

According to the NOI, TVA indicates that the SLR would not require any new construction or modifications beyond normal maintenance and minor refurbishment. However, there are other proposed projects that are connected to or could affect license renewal. We recommend that TVA evaluate the effects of the other proposed projects and describe efforts to address potential impacts in the SEIS.

Air Quality. Limestone County is in attainment with the Clean Air Act National Ambient Air Quality Standard.

Water Quality/Stormwater -Based on NEPA, the proposed project may be located within a mile of an impaired stream Round Island Creek/Round Island Creek (Wheeler Lake). TVA should consider implementing best management practices during maintenance for areas greater than one acre per the CWA's National Pollutant Discharge Elimination System Permit for stormwater, where applicable, to ensure that water quality impairments are not exacerbated

Wetlands and Streams - The EPA recommends that TVA collaborate with Alabama

Department of Environmental Management (ADEM) and US Army Corps of Engineers (USACE) to determine any potential impacts from the hydraulic and hydrological design associated with thermal discharges to the Tennessee River that may impact terrestrial and/or aquatic species, including both flora and fauna. TVA in collaboration with USACE may wish to include Clean Water Act (CWA) Section 404(b)(1) documents in the SEIS to support any wetland and stream mitigation decisions and to help ADEM evaluate potential stream impact requirements for the CWA Section 401 Water Quality permit. Providing adequate wetland and stream information within the NEPA process can help to streamline the final environmental review and permitting processes for these resources. According to NEPAssist, there are five approved mitigation or conservations banks in the facility vicinity - Flint River Mitigation Bank Phase I (1042), Wheeler Pointe Mitigation Bank (1044). ADOT Town Creek (1198) and ADOT Crow Creek (1199) and Robinson Spring Mitigation Bank (930) should mitigation be required.

Waste Disposal - The SEIS should indicate if there will be any changes in the generation of waste including low-level radioactive waste, mixed low-level radioactive waste, transuranic waste, and hazardous and Toxic Substance Control Act wastes over the life of the program. The SEIS should indicate where TVA will send the spent nuclear fuel and spent fuel debris for storage pending long-term disposal options.

Climate - Climate change may impact the proposed project, posing threats to aging infrastructure, worker health and safety and the environment. We recommend that the SEIS include an evaluation of climate-related impacts including discussions of frequency and severity of major storm events, wildfires, or drought that could lead to power disruptions or increased cooling demands in summer months. Efforts that TVA is taking at BFNP to address and adapt to potential climate impacts should be discussed in the SEIS.

Environmental Justice - The SEIS should include an analysis that is consistent with the Environmental Justice (EJ) Executive Order (EO) 12898. The analysis should indicate whether minority, low income or other overburdened populations reside within the vicinity of the proposed project area. If so, the EPA recommends that the communities with EJ concerns should be meaningfully involved throughout the decision-making process to help identify potential benefits and burdens associated with relicensing and permitting decisions. Adaptive and innovative approaches to both public outreach and community involvement regarding project issues should take place during the project planning. It would also be helpful to include a current map depicting the population demographics near the BFNP facility. EPA's EJSCREEN can be used a preliminary screen to help identify potential issues.

Thank you for the opportunity to review the proposed project. If you have any questions, feel free to contact Mr. Larry Long, of the NEPA Section, at (404) 562-9460, or by e-mail at long.larry@epa.gov.

Larry Long
Regional Mining Expert
Physical Scientist/Sr. Principle Reviewer
NEPA Section/Strategic Programs Office
Office of the Regional Administrator
61 Forsyth Street, SW

Atlanta, GA 30303
404-562-9460
404-562-9598(FAX)
long.larry@epa.gov

Intelligence does not always define wisdom, but adaptability to change does

From:	Kopec, Brett A
To:	nepa
Cc:	Janowicz, Jon A
Subject:	Fw: ENVIRONMENTAL REVIEW (ER) NEW POSTING NOTIFICATION: ER21/0210 - NOI TVA to Prepare Supplemental Environmental Impact Statement (SEIS) for the Browns Ferry Nuclear Site Subsequent License Renewal, Units 1, 2, and 3 located in Limestone County, Ala...
Date:	Monday, June 7, 2021 8:29:35 AM

Brett Kopec
USGS
Administrative Operations Assistant

From: Gordon, Alison D <agordon@usgs.gov>
Sent: Friday, June 4, 2021 5:00 PM
To: Kopec, Brett A <bkopec@usgs.gov>
Cc: Janowicz, Jon A <jjanowicz@usgs.gov>
Subject: Fw: ENVIRONMENTAL REVIEW (ER) NEW POSTING NOTIFICATION: ER21/0210 - NOI TVA to Prepare Supplemental Environmental Impact Statement (SEIS) for the Browns Ferry Nuclear Site Subsequent License Renewal, Units 1, 2, and 3 located in Limestone County, Ala...

The USGS has no comment at this time. Thank you.

From: oepchq@ios.doi.gov <oepchq@ios.doi.gov>
Sent: Tuesday, June 1, 2021 7:33 AM
To: Reddick, Virginia <Virginia_Reddick@ios.doi.gov>; Treichel, Lisa C <Lisa_Treichel@ios.doi.gov>; Alam, Shawn K <Shawn_Alam@ios.doi.gov>; Braegelmann, Carol <carol_braegelmann@ios.doi.gov>; Kelly, Cheryl L <cheryl_kelly@ios.doi.gov>; ERs, FWS HQ <FWS_HQ_ERs@fws.gov>; Runkel, Roxanne <Roxanne_Runkel@nps.gov>; Stedeford, Melissa <Melissa_Stedeford@nps.gov>; Hamlett, Stephanie R <shamlett@osmre.gov>; Janowicz, Jon A <jjanowicz@usgs.gov>; Gordon, Alison D <agordon@usgs.gov>; oepchq@ios.doi.gov <oepchq@ios.doi.gov>; Stanley, Joyce A <Joyce_Stanley@ios.doi.gov>
Subject: ENVIRONMENTAL REVIEW (ER) NEW POSTING NOTIFICATION: ER21/0210 - NOI TVA to Prepare Supplemental Environmental Impact Statement (SEIS) for the Browns Ferry Nuclear Site Subsequent License Renewal, Units 1, 2, and 3 located in Limestone County, Alabama

This e-mail alerts you to a Environmental Review (ER) request from the Office of Environmental Policy and Compliance (OEPC). This ER can be accessed here.
To access electronic ERs visit the Environmental Assignments website: https://ecl.doi.gov/ERs.cfm. For assistance, please contact the Environmental Review Team at 202-208-5464.
Comments due to Agency by: 07/01/21

From:	Wufoo
To:	nepa
Subject:	NEPA Comments - Browns Ferry Nuclear Plant [#1]
Date:	Wednesday, June 2, 2021 11:29:16 AM

Name	Jack Keeling
City	CHATTANOOGA
State	Tennessee
Organization	None
Email	[redacted]
Phone Number	[redacted]
Please provide your comments by uploading a file or by entering them below. *	Renew the licenses. Keep the plant running. We need it.

From: [redacted]
To: Cates, J. Taylor
Subject: Comments on extending licenses
Date: Thursday, July 1, 2021 7:12:59 PM

July 1 was the deadline. Today is July 1. Please submit these comments on my behalf. And please let me know if the comments will be submitted.

Steven Sondheim
[redacted]
Memphis 38117

I highly object to the extension of licenses to
The Browns Ferry Nuclear Power Reactors from 60-80 years which is 40 years beyond the original license.

Besides this power not being needed if renewable energy is adequately deployed by 2035-40, there is no evidence these installations will remain safe for an additional 20 years.

I ask that all systems be thoroughly inspected and investigated before these extensions are considered and the results made public. As the following article points out, older structures are vulnerable to a variety of aging factors.

https://readersupportednews.org/opinion2/277-75/70146-rsn-collapsed-florida-condo-sends-a-giant-nuke-warning

Sent from my iPhone

Browns Ferry Nuclear Subsequent License Renewal Scoping Comments for SEIS

The subsequent license renewal (SLR) of the three Browns Ferry (BFN) Reactors should be rejected: the collapse of the Champlain Towers South condo in Surfside, Florida reminded us of the vulnerability of aging infrastructure. Aging, stressed components are more likely to fail the longer they are in service. The No-Action Alternative (A) should be chosen, and a new process started that focuses on alternative (E): Replacement of BFN Generating Capacity with Renewable Energy Sources. TVA should bring on board renewables, energy efficiency and additional storage with urgency. Renewable energy is the fastest growing energy resource in the world: https://www.npr.org/2021/05/11/995849954/renewable-energy-capacity-jumped-45-worldwide-in-2020-iea-sees-new-normal. Renewable energy is the fastest growing in the US as well: https://www.c2es.org/content/renewable-energy/.

The Supplemental Environmental Impact Statement should reevaluate fundamental assumptions of safety that have been used to justify previous SLRs of other nuclear power reactors in the US.

The SEIS should comprehensively cover all conceivable environmental impacts of continued operation of the BFN reactors. It should consider the fundamental environmental, health and environmental justice problems inherent in nuclear power at every step in the nuclear fuel chain: uranium mining, milling, fuel fabrication, operations, radioactive waste, and decommissioning. It should consider the growing threats to nuclear power reactor operation and safety posed by the ever-growing effects of climate change.

The SEIS should include the effects of a catastrophic accident and massive radiation release at one or more of these aging reactors that were designed to operate for 40 years. Extending operation to 80 years demands an exhaustive study of the aging management. The longer these reactors run, the greater the risk of a devastating accident.

The Browns Ferry reactors are Fukushima style GE Mark 1 reactors, a design that has a long, controversial history, with many questioning the lack of robustness in the containment system and foreshadowing the three reactor melt-downs, hydrogen explosions, resulting containment breeches, and release of massive amounts of radiation at Fukushima. Please include the articles at these and all links in the SEIS scoping process: https://www.environews.tv/091117-ges-mark-1-nuclear-reactor-recalled-worldwide-like-faulty-unsafe-auto-pt-5/; https://www.nytimes.com/2011/03/16/world/asia/16contain.html;

https://abcnews.go.com/Blotter/fukushima-mark-nuclear-reactor-design-caused-ge-scientist/story?id=13141287; https://www.nirs.org/boiling-water-reactors/.

The Browns Ferry reactors have a history of mechanical problems and other issues resulting in six separate shut-downs of longer than a year including the longest shutdown of any US reactor (Unit 1 from 1985 to 2007) and the second and third longest shutdowns (Unit 3 from 1985 to 1995 and Unit 2 from 1984 to 1991). In 2011 they received one of only 4 "Red finding" safety warnings from the NRC for extended safety performance deficiencies. Safety concerns have plagued these reactors throughout their lives: https://www.nirs.org/wp-content/uploads/factsheets/brownsferryfactsheet.pdf. A whistleblower's story illuminates these concerns:
https://www.al.com/wire/2013/07/browns_ferry.html ;
https://www.al.com/wire/2013/07/browns_ferry_engineer_never_ex.html .

This 2013 study highlights more issues: https://www.bredl.org/pdf4/AL_BFN_Report_2013-final-digit.pdf including the spent fuel pools locations over 40 feet off the ground and with only sheet metal roofing overhead. Safety concerns: https://allthingsnuclear.org/dlochbaum/susquehanna-spent-fuel-pool-concerns-and-how-i-ended/ . These pools contain an enormous amount of deadly radiation. The SEIS should consider deficiencies in the BFN spent fuel pools and the environmental effects of a failure of one or more of these pools and the resulting release of radiation:
https://nautilus.org/uncategorized/risks-of-densely-packed-spent-fuel-pools/ .

The "reasonable assurance" of reactor safety during the proposed SLR period is far from certain. The safety of this license extension is wholly unproven. The NRC and the nuclear reactor operators have taken a "don't look, don't want to know" approach to verification of continued integrity of inner reactor critical components that are subject to the intense conditions in a nuclear reactor (heat, neutron bombardment, pressure, extreme temperature swings in SCRAM events, etc).

The SEIS should consider the wide range of critical knowledge gaps in the age-related material degradation process in GE Mark 1 BWRs and the management of that degradation over 60 or 80 years. It is therefore critical that the scoping process fill those gaps and provide an evidence basis on materials safety and systems reliability to make informed, scientifically qualified decisions in regulatory review of longer license extensions of civilian NPPs. Critical reactor systems, structures, and components must be strategically harvested from decommissioning similar design nuclear power plants and studied in labs by materials scientists, rather than disposing of them as is done now. This would include and not be limited to harvesting and analysis of base metals and weld materials from irreplaceable reactor pressure vessels, concrete from reactor containment structures and spent fuel pools, reactor internal components, and sections of electrical cable. These components provide a unique opportunity for real-world analysis of the effects of NPPs' harsh operational environment and the outcomes of licensees' age management programs. Essentially the only way to access, extract and study these materials is in the decommissioning process.

The DOE's Pacific Northwest National Laboratory, under contract with NRC Office of Research, published a Technical Letter Report in December 2017 entitled "Criteria and Planning Guidance for Ex-Plant Harvesting to Support Subsequent License Renewal" (PNNL-27120). The contract explicitly instructed PNNL to identify the "knowledge gaps" and make recommendations. PNNL recommended harvesting and analysis of these materials in decommissioning. The report can be found here:
http://static1.1.sqspcdn.com/static/f/356082/28026831/1542303608657/autopsy_PNNL-27120_harvesting_Dec2017.pdf?token=m0Gx1ULrrWdHLvN%2BE3yET8AfdLw%3D

The report was publicly posted for nine months on the government websites of PNNL, DOE Office of Scientific and Technical Information (OSTI) and the IAEA International Nuclear Information System (INIS), before the NRC Office of Nuclear Reactor Regulation removed it from government websites in September 2018. It was republished (only on the NRC website) as PNNL-27120 Rev.1 in April 2019. The revised version removed scores of references to critical "knowledge gaps" and recommendations to "require" decommissioning harvesting/analysis as necessary for reasonable assurance in NRC safety and environmental review and approval process of license extension applications. Without scientifically founded "reasonable assurance," the NRC lacks a legal basis for granting Subsequent License Renewal.

PNNL's recommendations from December 2017 remain well founded. Harvesting and material testing of nuclear plant components and compiling an evidence basis to assess age-related degradation management are necessary for "reasonable assurance" (which is an explicit NRC requirement for license extension). They are therefore prerequisites for approving long license extensions and are critical to fulfilling the NRC's mission of protecting public safety and the environment.

Former NRC Commissioner Victor Gilinsky has noted the absence of validity of the NRC's SLR process: "The so-called license extension safety review is a scandal. Although the whole thing is bureaucratically elaborate, and a bonanza for industry consultants and lawyers, the only question the NRC safety reviewers address is whether the plant owners have a plan for dealing with aging equipment so that the plant can meet its current "licensing basis". The NRC reviewers are specifically forbidden by regulation from questioning that licensing basis, that is, the basis on which safety depends, even though it was set many decades ago when less was known about, say, for example, seismic events, and in the light of current information may well be out of date." From a comment sent to the Bulletin of Atomic Scientists on the story at this link: https://thebulletin.org/2020/09/with-climate-change-aging-nuclear-plants-need-closer-scrutiny-turkey-point-shows-why/ . Please include that entire article in these comments.

Submitted by,

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[redacted]

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July 1, 2021

Appendix B
Public and Agency Comments and TVA's Response

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Appendix B - Public and Agency Comments Received on the Draft Environmental Impact Statement and TVA's Response to Comments

A draft of the SEIS was released for public review and comment on February 10, 2023. The availability of the Draft EIS and request for comments was announced in newspapers that serve the Limestone County area, and the Draft EIS was posted on TVA's website. TVA's agency involvement included notification of the availability of the Draft EIS to local, state, and federal agencies and federally recognized tribes. TVA also hosted an in-person public open house on March 14, 2023, from 6:00-8:00 pm central time, at Calhoun Community College-Decatur Campus, Advanced Technology Center Building #1 Lecture Hall, 6250 Hwy N, Tanner, AL 35671. Comments were accepted through March 27, 2023, via TVA's website, mail, and e-mail.

TVA received two comment letters from members of the public via TVA's website and one comment letter from the U.S. Environmental Protection Agency (EPA). TVA carefully reviewed all the comments. Comments raised during the comment period are summarized by topic below along with TVA's responses to each comment. A copy of each of the comment letters is included at the end of this appendix.

Comments Regarding Water Resources

1. **Comment**: The EPA recommends that the Final EIS provide a discussion on the applicability and analysis to include ASCE 24-14, E.O 13690 and E.O 14030 to determine the flood risk associated with this project for each of the nuclear units 1, 2, and 3. In May of 2021, E.O. 13690-Establishing a Federal Flood Risk Management, and E.O. 14030-Climate Related Financial Risk provide for a federal climate related Risk Strategy that should be applied to the analysis of this DEIS for the evaluation of floodplains (*Commenter: EPA*).

   Response: Based on information in the 2013 Fukushima Response Strategy EA, the plant grade elevation at BFN (which also includes Units 1, 2, and 3) is 565 feet above mean sea level (TVA 2013), which exceeds the 100-year flood elevation of 557.3 and 500-year flood elevation of 557.3 by 7.7 feet. Therefore, Units 1, 2, and 3 comply with EO 11988 for critical actions and the TVA Flood Storage Loss Guideline for flood-damageable development around TVA reservoirs. The plant grade also satisfies the requirements of EO 13690 for either the Freeboard Value Approach of 3 feet above the 100-year flood elevation for critical actions, or the 0.2 Percent Floodplain Approach, although TVA has not yet formally adopted EO 13690 into its floodplains analyses.

2. **Comment**: The Final EIS should also address the Cooling Water Intake Structure Rule, Clean Water Act 316(a) and (b), as well as the "nuisance" fish causation issues as it relates to thermal discharges from the facility. A more in-depth discussion is needed which addresses limits and/or engineered measures of the existing National Pollution Discharge Elimination System (NPDES) permit (*Commenter: EPA*).

   Response: TVA agrees with the comment and will address it via response to comments 4, 5, and 6.

3. **Comment**: The EPA also recommends that TVA evaluate and monitor water quality and other potential changes to the aquatic system over time, such as increases or decreases in water volume, seasonal pulse flow disruptions, and variations in water temperature. For instance, water temperature fluctuations can encourage establishment of non-native species and alternative habitat and fish populations over time. Again, TVA may want to provide a

more in-depth discussion that address the impact on indigenous fish species from thermal discharges from the cooling water system (*Commenter: EPA*).

Response: TVA has continuously to monitored water quality, hydrology, temperature, and ecology in Wheeler Reservoir for some time, as discussed in SEIS Sections 3.3 through 3.7. TVA recently installed three water quality floats in Wheeler Reservoir to collect continuous readings on temperature, pH, turbidity and other parameters. TVA also has a valley-wide program to collect water quality profiles every 2-4 weeks in most reservoirs, from 2-3 locations in each reservoir, including Guntersville and Wheeler.

There are very few flow disruptions from Guntersville and Wheeler Dams, especially in the summer when flow through Wheeler Reservoir is generally low (between 15,000 and 25,000 cubic feet per second [cfs]). TVA controls the flow through both dams, often maintaining a steady flow which helps stabilize water temperatures. Flows may be managed based on seasonal constraints and peak demand hours as well. To minimize potential for recirculation around BFN, TVA typically does not drop Wheeler Dam releases below 10,000 cfs during the summer. In times of flooding, TVA maintains a steady flow through the system, often using the spillway and the turbines 24 hours a day/7 days a week, flow rates are naturally higher during these periods.

Impacts on fish species are addressed in the response to comment 6.

4. **Comment**: TVA may also want to include a discussion of how the facility plans to continue compliance with the Cooling Water Intake Structure rule, which addresses limits and/or engineered measures to minimize the impingement and entrainment of aquatic organisms (*Commenter: EPA*).

   Response: TVA has included in Section 3.7.2 Aquatic Ecology, Entrainment and Impingement Impacts its current efforts to meet requirements of 316(b) Cooling Water Intake Structure rule. TVA agrees that adding its plans for future compliance of the Rule would be beneficial to the EIS. Sections 3.3.1.1 Surface Water Hydrology and Water Quality, 3.7.1.1 Fish, and 3.7.2 Aquatic Ecology, Entrainment and Impingement of the Final EIS have been updated with additional information.

5. **Comment**: Page 3-21, first paragraph: The TVA may want to include a more in-depth discussion by providing a description detailing existing controls in place to meet the requirements of the existing NPDES permit that pertains to both clean Water Act (CWA) 316(a) and 316(b). It should also state if the facility is, or is not, compliant with the permit (*Commenter: EPA*).

   Response: TVA agrees and updated Sections 3.3.1.1 Surface Water Hydrology and Water Quality, 3.7.1.1 Fish, and 3.7.2 Aquatic Ecology, Entrainment and Impingement of the Final EIS to describe the agency's compliance with 316(a) and (b) NPDES permit requirements and TVA's compliance standing for each. BFN is and continues to be compliant with these permit requirements.

6. **Comment**: Page 3-50, Section 3.7.1.1: TVA may want to include a discussion regarding the extent to which the facility has, or has not, caused a shift in fish species from indigenous species to "nuisance" species due to the thermal component of the cooling water discharge. Although the current text lists several species present, it needs to differentiate between

species that are more heat tolerant that may have migrated to the area of the facility over the years (*Commenter: EPA*).

Response: TVA has included its efforts to monitor health of Wheeler Reservoir with its REH program and RFAI methodology. However, TVA agrees that adding high-level results of this monitoring with regards to fish assemblage shifts from indigenous to aquatic nuisance/heat tolerant species downstream of BFN would be beneficial to the EIS. In addition to section updates described in response to comments 4 and 5, TVA also revised Section 3.7.2 Aquatic Ecology, Thermal Impacts to further address thermal impacts to fish species.

Comments Regarding Environmental Justice

7. **Comment:** TVA did not identify location-dependent, disproportionately high, and adverse impacts to minority and low-income populations resulting from continued operations of BFN. The EPA reiterates the importance of incorporating adaptive and innovative approaches for public outreach and community involvement into the proposed project. We also recommend the Final EIS include a discussion about how TVA plans to meaningfully involve and engage communities throughout the decision-making process and beyond. We further suggest that TVA include a community outreach plan in the Final EIS. For additional information on environmental justice and NEPA, please see the document, *Promising Practices for EJ Methodologies in NEPA Review*. For conducting preliminary environmental justice analysis, we continue to recommend using EJScreen, an environmental justice screening and mapping tool, for early identification of environmental and socioeconomic constraints and opportunities. The EPA's EJSCREEN can be accessed at https://www.epa.gov/ejscreen (*Commenter: EPA*).

   Response: TVA agrees that as described in Section 3.17, no location-dependent, disproportionately high, and adverse impacts to minority and low-income populations within a 20-mile radius of BFN were identified. TVA agrees with the importance of public outreach and community involvement; engaging with stakeholders and the communities we serve is a vital part of TVA's mission, and we share EPA's objective of treating members of communities with environmental justice concerns fairly, and meaningfully involving those communities in TVA's decision-making processes. For this EIS, TVA utilized targeted social media to attempt to engage the public during the public comment period on the Draft SEIS and hosted an in-person meeting at Calhoun Community College-Decatur Campus on March 14, 2023. There were no attendees. TVA has updated the NEPA website with the publication of the Final EIS and anticipates updating TVA's website and issuing a media release in association with the anticipated Record of Decision. Beyond this EIS, TVA has established several Environmental Justice cross-functional teams within the enterprise that are in the process of developing best practices for heightened ongoing TVA engagement with communities with environmental justice concerns, trainings for TVA employees on this evolving policy area, and policies to be considered by TVA decision makers. These policies, practices, and procedures that are being developed, once approved, will help improve TVA's enterprise-wide approach to improving communication and meaningful involvement with the stakeholder and communities that we serve. TVA's analysis in Section 3.17 of the SEIS is consistent with the information presented in the document Promising Practices for EJ Methodologies in NEPA Review. TVA is familiar with and agrees that EPA's tool EJSCREEN is helpful for conducting preliminary environmental justice analyses. As described in Section 3.17, TVA used U.S. Census Bureau data processed through ArcGIS® for a more in-depth identification and evaluation of individual environmental justice populations within a 20-mile radius of BFN.

Comments Regarding Climate Change and Greenhouse Gases (GHG)

8. **Comment**: While the impacts may appear to be small, we recommend that the Final EIS include a more in-depth evaluation of climate-related impacts including discussions on how TVA plans to address such impacts that may result from the increases in frequency and severity of major storm events, flooding, fires, or drought that could lead to power disruptions, major incidents or accidents, or increased cooling demands in summer months. If this information is examined in more depth in a Safety Evaluation Report, please indicate that in the Final EIS (*Commenter: EPA*).

   Response: Section 3.12 of the Final SEIS has been updated to include additional discussion and analysis regarding climate-related impacts that could affect plant operations.

   Comments Regarding Alternatives

9. **Comment**: Re. your request for public input about the 20-year extension permits for Units 1, 2, & 3, I confirm a desire for granting of the extensions. It is a clean energy that we Americans need to protect. (*Commenter: Dennis Sheaks*)

   Response: Comment noted.

10. **Comment**: Renewing the license for the Browns Ferry nuclear plant will cost thousands of American jobs. We need to be investing in more reliable sources of domestic energy such as coal and natural gas. The plant should be sunsetted as soon as possible. (*Commenter: Majeed Peffley*)

    Response: Renewal of the license for the Browns Ferry nuclear plant will preserve over 2,000 jobs for current TVA employees and contractors. Separately, TVA is investing in other generation sources which will create additional jobs. These other generation projects are evaluated under various NEPA reviews, information is available on these projects at https://www.tva.com/nepa.