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Pickwick Landing Dam
South Embankment Seismic Upgrade
Hardin County, Tennessee

FINAL ENVIRONMENTAL ASSESSMENT

TENNESSEE VALLEY AUTHORITY
Knoxville, Tennessee

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List of Acronyms

ADPH	Alabama Department of Public Health
APE	Area of Potential Effect
ARAP	Aquatic Resources Alteration Permit
BMPs	Best Management Practices
EA	Environmental Assessment
CFR	Code of Federal Regulation
DMM	Deep Mixing Methodology
EO	Executive Order
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
GIS	Geographic Information Systems
HUC	Hydrologic Unit Code
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NHD	USGS National Hydrography Dataset
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	USFWS National Wetlands Inventory
RFAI	Reservoir Fish Assemblage Index
SFHA	Special Flood Hazard Area
SHPO	State Historic Preservation Officer
TDEC	Tennessee Department of Environment and Conservation
THC	Tennessee Historical Commission
TVA	Tennessee Valley Authority
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

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CHAPTER 1 - PURPOSE AND NEED FOR ACTION

The Tennessee Valley Authority (TVA) proposes to make upgrades to the south embankment of Pickwick Landing Dam to improve performance of the dam during and following a large earthquake, should one occur. Upgrades would be made to both the upstream and downstream sides of the embankment, and would include the construction of berms and placement of fill. The project area is located in Hardin County, Tennessee.

1.1 Background

TVA is a federal corporation and instrumentality of the United States government, created in 1933 by an act of Congress to foster the social and economic well being of the residents of the Tennessee Valley region. The Pickwick Landing Dam is a multi-purpose concrete and earthen embankment dam located on the Tennessee River (Mile 206.7) in Hardin County, Tennessee, near Tennessee's border with Mississippi and Alabama (Appendix A, Figure 1). The dam was completed in the 1930s and is a significant producer of hydroelectric power and a vital navigation link on the Tennessee River. In addition to the 3,300-foot-long dam which extends to the north and two large navigation locks, there is an earthen embankment which extends to the south approximately 4,380 feet. State Highway 128 crosses the entire length of the dam. The south embankment was constructed using hydraulic fill methods and has a maximum height of about 65 feet (Exhibit 1).

Exhibit 1 Pickwick Landing Dam, South Embankment

The Pickwick Landing Dam is approximately 100 miles from southern portions of New Madrid Seismic Zone along the Mississippi River. According to the U.S. Geological Survey, the New Madrid is the most active seismic zone in the United States east of the Rocky Mountains, and there is a 7 to 10 percent chance or probability that a quake of magnitude 7 to 8 will occur in the New Madrid region within the next 50 years (USGS 2009).

A seismic stability evaluation of the dam's south embankment completed in 2014 indicates that under a "design earthquake" scenario[1], the loss of strength is likely to occur in some soil layers of the embankment, leading to slope instability. The analysis indicates that the mean annual probability of an earthquake-induced breach is between 1 in 2,500 and 1 in 1,250 for reservoir elevations between 408 (winter pool) and 414 (summer pool) feet, respectively.

Although the likelihood of a seismic event occurring at any given time is low, TVA considers the probabilities of an earthquake-induced breach to be high enough that upgrades to the south embankment are warranted. Even if a breach were not to occur, a slope stability failure (especially one in the upstream direction) caused by a large seismic event would likely require lowering the reservoir well below winter pool to ensure safety and make repairs. Making scheduled upgrades to the embankment at this time will allow TVA to avoid the significant economic impacts that would result from having to lower the reservoir below winter pool levels for an extended period following an emergency.

Soon after completing its seismic evaluation, TVA informed the public of the potential seismic issues and installed an early warning and monitoring system to address public safety. TVA has also developed a proposal to strengthen the dam's south embankment and has prepared this Environmental Assessment (EA) to consider its potential environmental impacts, in fulfillment of responsibilities as a federal entity under the National Environmental Policy Act (NEPA).

1.2 Decision to be Made

The decision to be made is whether to approve or disapprove the proposed seismic upgrades to the south embankment of the Pickwick Landing Dam. The activities associated with the proposed upgrades include the following major items.

- Proposed Upstream or East Side of the Embankment – Proposed placement of fill for the upstream berm and extended fill area within approximately 32 acres (Appendix A, Figure 2).
- Proposed Downstream or West Side of the Embankment – Proposed placement of fill for the downstream berm and extended fill area within approximately 35 acres (Appendix A, Figure 2).
- Proposed Laydown Area – Proposed materials and equipment storage on approximately 7.5 acres in a maintained area on the west side of the embankment and North Carolina Landing Road (Appendix A, Figure 2).

Additional details of the proposed activities are provided in Section 2.1.2.

1.3 Scope of the Environmental Assessment

Pursuant to NEPA and its implementing regulations promulgated by the Council on Environmental Quality (40 Code of Federal Regulations [CFR] §§ 1500–1508), federal agencies are required to evaluate the potential environmental impacts of any proposals for major federal actions. TVA prepared this EA to assess the potential consequences of TVA's

[1] TVA's design earthquake scenario specified a 3000-year time span between earthquake recurrences, a magnitude 7.8 at a 160-kilometer distance from the earthquake epicenter, and a peak ground acceleration of 0.21g (gravitational constant).

Proposed Action Alternative on the environment and human health in accordance with NEPA and TVA's procedures for implementing NEPA (TVA 1983).

This EA describes the existing environment at the project site, analyzes potential environmental impacts associated with the Proposed Action Alternative and the No Action Alternative, and characterizes cumulative impacts that could result from the proposed project in relation to other ongoing or reasonably foreseeable proposed activities within the surrounding area of the project site.

The project Study Area includes the areas along and adjacent to the dam's south embankment on both the upstream and downstream sides (Appendix A, Figure 2). On the downstream or west side of the embankment, potential actions would occur along the base of the entire embankment. Under TVA's Proposed Action Alternative, there would also be an area to the west of the embankment used for laydown of equipment and materials in support of construction activities. Project activities are also proposed upstream or east along the embankment and within the reservoir, with an extended fill area proposed along the embankment's upstream side near the dam's navigation locks.

The Study Area for the project encompasses approximately 157 acres to the east and west of the existing south embankment along Pickwick Landing Dam. Within the Study Area footprint, approximately 46 acres is proposed to be impacted directly with placement of fill material. A 100-foot buffer has been included around the area of fill and labeled as proposed impact area due to the need for an additional 50 feet to be cleared of vegetation beyond the proposed fill areas. Although most actions and environmental impacts associated with the proposed upgrades would occur within the Study Area, the area of potential impacts to certain environmental resources is broader than the Study Area's boundaries.

This EA consists of seven chapters discussing the project alternatives, environmental resources potentially affected, and analyses of impacts. The structure of the EA is outlined below:

- **Chapter 1.0:** Describes the purpose and need for the project, the decision to be made, related environmental reviews and consultation requirements, necessary permits or licenses, and the EA overview.
- **Chapter 2.0:** Describes the Action and No Action alternatives, provides a comparison of alternatives, and identifies the Preferred Alternative.
- **Chapter 3.0:** Discusses the affected environment within the Study Area.
- **Chapter 4.0:** Discusses the potential direct, indirect, and cumulative impacts on environmental resources. Mitigation measures also are proposed, as appropriate.
- **Chapters 5.0, 6.0, and 7.0:** Contain the list of preparers of this EA, the EA distribution list, and the literature cited in preparation of this EA, respectively.Based on TVA's experience with conducting environmental reviews of similar projects, the nature of the Proposed Action Alternative, and other available information, the potential effects to the following resources are considered in this environmental review:

- Floodplains
- Water supply
- Groundwater
- Surface water
- Wetlands
- Air quality
- Wildlife
- Vegetation
- Aquatic ecology
- Threatened and endangered species
- Natural areas, parks and recreation
- Transportation
- Utilities
- Socioeconomic conditions and environmental justice
- Cultural resources
- Noise
- Navigation
- Solid waste

TVA expects that most of the resources listed above would only be minimally affected by TVA's proposed upgrades; thus, the EA analyses of these resources are concise. The *primary* environmental issues related to these resources include:

- Clearing of wooded areas downstream of the dam (up to 35 acres);
- Impacts to wetlands, streams and floodplains from berm construction and new fill material; and
- Impacts from construction traffic, including importing new fill material via road or barge.

Most actions associated with the proposed upgrades would occur on or adjacent to the dam's earthen embankment, which is a previously disturbed area; therefore, impacts to most resources are anticipated to be minimal.

1.4 Necessary Permits and Consultation

TVA would secure any permits necessary to undertake the Proposed Action Alternative. All permits would be held by TVA.

1.4.1 National Pollutant Discharge Elimination System (NPDES) Stormwater Construction Permit

A NPDES Stormwater Construction Permit is required for clearing, grading or excavating of the project area to ensure proper stormwater management and treatment throughout the project. A Notice of Intent for Construction Activities and site-specific Stormwater Pollution Prevention Plan would be developed and submitted to the Tennessee Department of Environment and Conservation (TDEC) for approval.

1.4.2 Individual Aquatic Resources Alteration Permit (ARAP) Section 401 Water Quality Certification

In compliance with Section 401 of the Clean Water Act, an Individual ARAP Section 401 Water Quality Certification would be coordinated through the TDEC's Division of Water

Resources for the proposed alteration of waters of the state, including streams and wetlands.

1.4.3 Section 10 / Section 404 Clean Water Act Permit

TVA must obtain a permit under Sections 10 and 404 of the Clean Water Act to implement dredge or fill activities in jurisdictional waters of the U.S., which include wetlands. TVA would coordinate with the United States Army Corps of Engineers (USACE) to obtain this permit.

1.4.4 Consultation Requirements

1.4.4.1 Endangered Species Act

Consultation with the U.S. Fish and Wildlife Service (USFWS) on the potential impact of federal actions on federally listed threatened and endangered species, as required under Section 7 of the Endangered Species Act, began in September 2016 and will be completed prior to the commencement of any ground-disturbing activities.

1.4.4.2 National Historic Preservation Act

Consultation with the Tennessee Historical Commission (THC) on the impact of federal actions on Tennessee historic and archaeological sites is required under Section 106 of the National Historic Preservation Act (NHPA). In addition, TVA must consult with interested federally recognized Indian tribes on the impact on areas that may be of religious and cultural significance to them. Consultation with the Tennessee State Historic Preservation Office (SHPO) and interested tribes was completed by TVA in June 2016.

1.4.4.3 Executive Order 11988 - Floodplain Management

Consistent with Executive Order (EO) 11988, TVA would analyze the proposed project using the hydraulic model in the effective Flood Insurance Study to determine whether the Base Flood Elevation of the Tennessee River would increase greater than 0.00 foot as a result of the project. Based upon the outcome of the hydraulic analyses, TVA would either document that the project would cause no rise in flood elevations, or TVA would begin coordination of a Letter of Map Revision with the Hardin County, Tennessee, Floodplain Administrator.

1.5 Public Outreach

Because of the interest in the local community and the potential risk posed to the public, the Draft EA was released to the public for a 30-day comment period on August 12, 2016. The Draft EA was posted on the TVA website and notices of its availability and requests for comments were sent to more than 250 government agencies and local organizations, and businesses and homeowners. TVA also announced its availability and requested comments in a press release and in local media. Briefings were held with local officials and community leaders.

During the public review period, TVA received comments from four individuals, the Packaging Corporation of America (which has an industrial site to the west of the TVA reservation), TDEC, and USFWS. These comments and TVA’s responses are included in Appendix B. Because several commenters asked whether Pickwick Reservoir water levels would be changed during construction, TVA made minor edits to the EA to clarify that reservoir water levels would not be affected by the project.

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CHAPTER 2 - ALTERNATIVES

2.1 Description of Alternatives

To determine potential solutions to the seismic vulnerability of the Pickwick Landing Dam, TVA has augmented its own team of dam safety engineers with nationally recognized experts in dam safety. Preliminary scoping by TVA and these external experts has determined that from the standpoint of NEPA, there is one remediation alternative available to TVA that best achieves TVA's purpose and need. In this section, the remediation alternative, called the Proposed Action Alternative, and a No Action Alternative are analyzed in detail. Other alternatives evaluated by TVA but dismissed from further consideration are also briefly described. A synopsis of the potential environmental effects of adopting each alternative is provided in Table 2 provided below in Section 2.4.

2.1.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would take no action to improve the condition of the embankment. TVA would continue to operate the dam and reservoir under normal operations. The risk of a dam breach and reservoir loss during or following a large seismic event would remain.

This alternative is not considered reasonable because it does not address the risk to public health and safety or the region's economy. In the event of the dam breaching and reservoir loss, TVA estimates that flood levels below Pickwick Landing Dam would be similar to those reached in the area previously (as recently as May 2013), although flooding would occur faster. The dam's breach could result in loss of life; destruction of property (including downstream facilities); loss of delivery of critical services to communities; impacts to navigation of the Tennessee River, and impacts to basic infrastructure such as roads and bridges. Economic losses could be substantial. Downstream environmental resources in and along the river system also could be severely impacted. Pickwick Reservoir could be significantly altered, which would severely impact shoreline resources.

Taking no action to address the potential for such an occurrence is an unacceptable alternative to TVA. The alternative is analyzed in the EA to establish a baseline for assessing the environmental impacts of the Proposed Action Alternatives in accordance with NEPA regulations.

2.1.2 Alternative B – Proposed Action Alternative (Upstream and Downstream Berms with Extended Fill Areas)

Under Alternative B, TVA would make upgrades to the upstream and downstream slopes of the dam's south embankment. To address potential shallow failures of the embankment, TVA would construct berms along the toe of the upstream and downstream sides of the embankment. To address deeper failure modes, TVA would place extended fill in select locations on each side of the embankment. TVA would continue normal operations of Pickwick Dam during construction, in accordance with TVA's Reservoir Operations Study (TVA 2004).

2.1.2.1 Proposed Downstream Activities

The proposed berm along the downstream side would be located adjacent to the dam and would stabilize potential shallow downstream failures through the embankment. The

extended fill would be placed only in select locations downstream and would reach a distance downstream of the toe to stabilize potential failures through the foundation's silty sand. The area to receive the most extended fill would be to the north, close to the dam's navigational lock. The fill areas would not need to be as high as the berm. Work elements on the downstream side would include:

- Site preparation: Prior to construction, vegetation, trees and stumps in the project area would be removed and mulched, burned or disposed of off-site; topsoil and riprap would be removed to a storage area for reuse; and erosion and sedimentation controls would be installed.
- Materials and placement: The downstream berm would consist of sand and gravel imported from an off-site location, placed with bulldozers, and compacted with vibratory drum rollers. The topsoil and riprap temporarily removed during construction would be regraded into the embankment. Fill material would be clean and free of contaminants.
- Cover: The existing riprap on the downstream slope would be stripped and stockpiled so it could be used to armor the face of the new berm. The flat portion of the berm would be covered with topsoil and seeded.

Because the weight of the proposed berm could cause the existing clay tile toe drain pipes to collapse, the toe drain pipes would be replaced prior to construction, and new manholes passing through the berm would be constructed. At one location along the embankment, the existing drainage swale that collects flow would be filled as part of the fill area so it would be replaced with a buried pipe extending past the fill area.

2.1.2.2 Proposed Upstream Activities

Similar to the proposed downstream activities, a berm and fill would be built on the upstream side of the dam. Construction of the berm on the upstream side would involve placing fill consisting of crushed stone, sand and/or gravel or riprap into the reservoir adjacent to the embankment. Fill material would be clean and free of contaminants.
If sand and gravel are used for the upstream berm, vibratory densification techniques would be used to compact the berm. The berm would have a riprap face and would be constructed either with a barge-mounted crane or placed from land starting at the south abutment.

Extended fill would also be placed in an area of the embankment adjacent to the Pickwick Lock (see Exhibit 2 and Exhibit 3). Because the extended fill would extend far beyond the upstream slope, the crushed stone would be placed using barge-mounted equipment.

Reservoir operations at Pickwick Landing Dam would not change during the construction period (i.e., reservoir water levels would not be altered).

2.1.2.3 Proposed Schedule of Activities

TVA proposes to initiate some site preparation activities, including vegetation clearing, in late 2016. TVA proposes to initiate construction in 2017 and conclude in late 2021 (dates are subject to change). Work would be conducted year round during the construction period and occur primarily during daylight hours of the work week. Occasionally, activities may occur on weekend days. TVA does not anticipate the need for nighttime work activities or continuous, around-the-clock activities at any point during the project.

Exhibit 2 Proposed Action Alternative - Berms and Extended Fill Areas (Pickwick Landing Dam South Embankment)

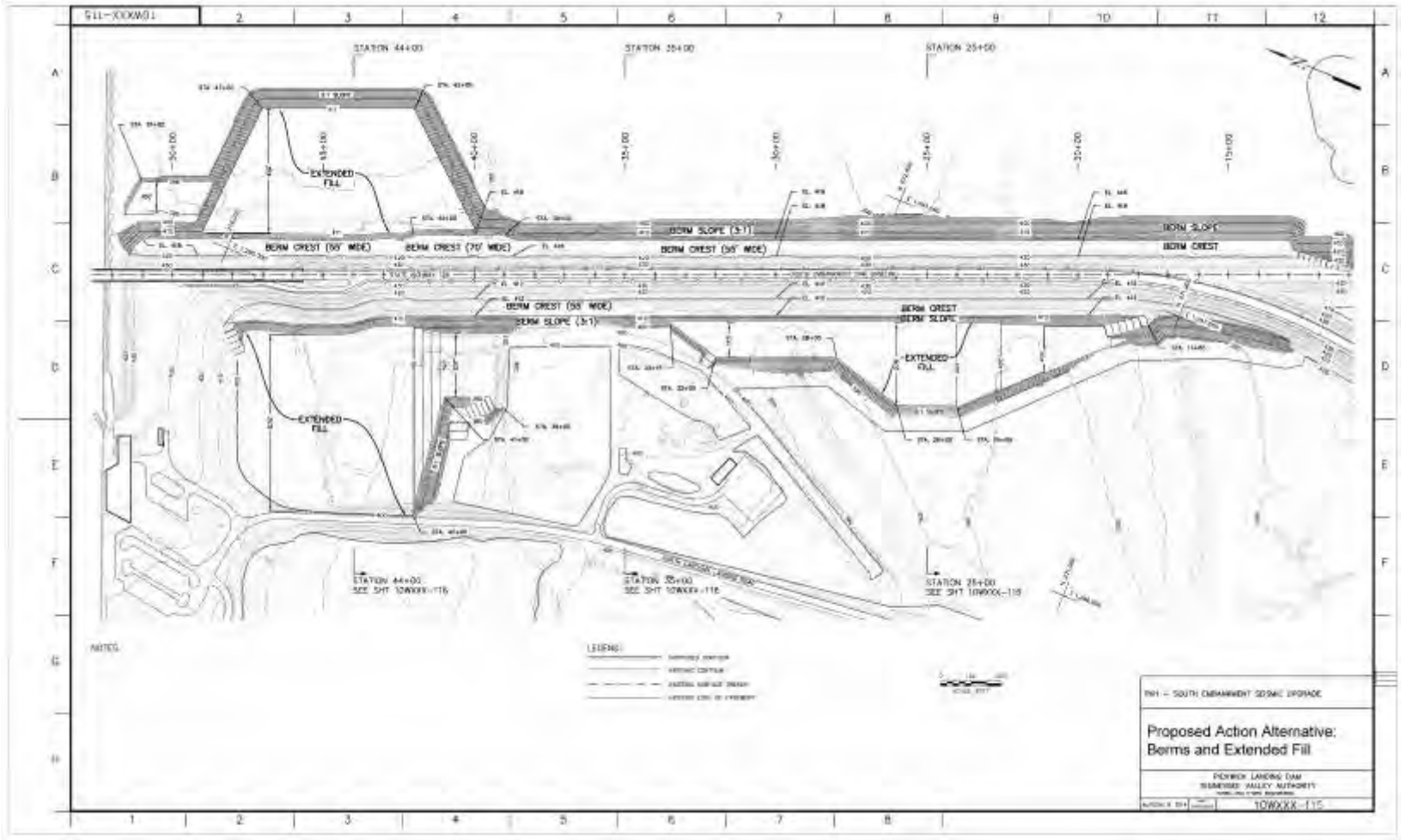

Exhibit 3 Proposed Action Alternative - Berms and Extended Fill

2.1.2.4 Proposed Access

Construction activities would not necessitate closure of or restrictions to travel on Highway 128 crossing the dam. TVA has identified several options for accessing the embankment and fill areas for construction activities. Three options exist on the upstream or east side of the embankment. The first option includes utilizing barges to bring in fill material as well as equipment for placement of the materials. The second option is to have an access road from the southern end of the embankment originating from either Playground Loop Road or State Highway 128, with one or more locations along the embankment where trucks could reenter State Highway 128, with the use of flaggers to avoid impacting traffic. The last option would be to utilize a combination of both barges on the reservoir and truck hauling operations along State Highway 128. North Carolina Landing Road would be the access route to the downstream or west side of the embankment and the laydown area. TVA would repair any damage to roads, utilities, or drainage alteration caused by construction activities.

2.1.2.5 Proposed Laydown Area

TVA has identified a location for material and equipment storage on the downstream or west side of the embankment. The site is located on the west side of North Carolina Landing Road, across from TVA's existing maintenance facility and an old target shooting range (infrequently used by TVA police personnel).

This site is approximately 7.5 acres and is an open, unmaintained field of grasses, small scrub bushes and small pine trees. Vegetation on the site would be cleared and equipment would be used to scrape the topsoil (approximately 3 to 4 inches) and to lay a nonwoven, fiber fabric on which crushed stone would be placed. The laydown area would be used for parking, equipment and material storage and staging, placement of a temporary office trailer(s), and other project management activities. Utilities currently serving the shooting range would be extended to serve the laydown area as well. After completion of the project, TVA would remove the stone and fabric, revegetate, and restore the area to its current condition.

2.2 Other Alternatives Evaluated, but Dismissed from Further Consideration

TVA's engineers and external experts evaluated a wide range of alternatives for upgrading the Pickwick Landing Dam embankment. These alternatives were considered by TVA but are not examined in greater detail in this EA because they do not fully meet TVA's objectives, purpose, or need for the project. In evaluating alternatives, consideration was given to the following:

- Whether the alternative would allow the embankment to withstand multiple earthquakes with no significant stability failures or deformations;
- Whether the alternative would allow TVA to operate the reservoir normally after the earthquake(s);
- Whether the estimated cost of construction was prohibitive;
- Whether there was too much risk for the cost of the alternative to be higher than estimated because of unexpected conditions or problems in construction;

- Whether the alternative would allow confirmation that the upgrade was performed properly and achieved the desired result;
- Whether the alternative would cause significant impacts to the use of the State Highway 128 during construction; and
- Whether the alternative would cause significant adverse environmental impacts.

These alternatives are summarized below in Table 1.

Table 1 Alternatives Evaluated but Dismissed from Further Consideration

Other Alternatives Considered	Description and Assessment
1. Downstream Only - Berm and Fill (No Work Upstream)	TVA would construct a downstream berm with an extended fill along the downstream slope. No upstream work would take place. Upstream failures might occur, but the berm and extended fill would be designed to prevent downstream failures and prevent loss of the reservoir. This alternative would have a large footprint, resulting in large environmental impacts. Performance of the alternative would be uncertain, and it would not eliminate the need to repair the dam to remediate upstream failures in the event of a failure.
2. Downstream Only - Berm and Ground Improvements (No Work Upstream)	TVA would construct a downstream berm along the downstream slope with ground improvement along the downstream toe of the dam. This alternative is similar to Alternative 1 but the ground improvement replaces the extended fill. There would be no upstream work. Upstream failures might occur, but the berm and ground improvement would be designed to prevent downstream failures and prevent loss of the reservoir. The performance of the alternative would be uncertain. Like Alternative 1, this alternative would have a large footprint, resulting in large environmental impacts to downstream areas. This alternative would not eliminate the need to repair the dam to remediate upstream failures in the event of a failure.
3. Downstream Berm and Upstream Berm and Fill	TVA would construct a variation of Alternative B (Action Alternative; refer to Section 2.1.2). Upstream activities would be the same as Alternative B (berms and extended fill); however, on the downstream side, TVA would construct a berm (as under Alternative B) but not place extended fill. Instead, on the downstream side, TVA would install ground improvements near the toe of the embankment just downstream from the newly constructed berm, which would extend along the entire embankment. Ground improvements on the downstream side would most likely involve the use of deep mixing methodology (DMM) to create sheer walls through grout injections into the ground. The option of making ground improvements on the downstream side is unfavorable because of the difficult nature of conducting quality assurance and control, and because these activities have a greater potential for impacting the environment. Compared to placing fill, the DMM is unnecessarily complicated and does not provide additional assurances.

Other Alternatives Considered	Description and Assessment
4. Downstream and Upstream Berms and Ground Improvements	This option is similar to Alternative B except that ground improvements would be conducted on both sides of the embankment, in addition to berms being constructed on each side of the embankment. TVA carefully considered ground improvements on the upstream side because it would maintain the current upstream slope, with less encroachment into the floodplain. However, conducting DMM upstream would be difficult and have the potential for environmental impacts, as DMM would be conducted in the reservoir waters. In addition, the performance of ground improvements upstream is less certain and would be difficult to verify. The unnecessary risk of environmental releases to the reservoir, the potential for costs and schedule overruns, and the difficult nature of conducting quality assurance and control makes ground improvements on the upstream side undesirable.
5. New Containment Dam (Downstream)	TVA would construct a new downstream containment dam using rock fill, zoned earth, or compacted clay, using ground improvement to treat the loose foundation soils. With a containment dam, the existing dam would remain as the primary water barrier. The containment dam would be used to prevent loss of the reservoir only if the existing dam was breached. This alternative would have a large footprint, resulting in large environmental impacts to downstream areas. This alternative would not eliminate the need to repair the original dam, in the event of a failure.
6. New Replacement Dam (Downstream)	Similar to Alternative 5, TVA would construct a new downstream replacement dam using rock fill, zoned earth, or compacted clay, using ground improvement to treat the loose foundation soils. With a replacement dam, the existing dam would be breached as part of construction, and the new dam would become the water barrier. The replacement dam would have the same crest elevation as the existing dam. This alternative would have a large footprint, resulting in large environmental impacts and would require the most time to construct; increasing its cost and lengthening the time that traffic on State Highway 128 would be disrupted.

2.3 Preferred Alternative

TVA's preferred alternative is Alternative B, the Action Alternative. Under the Action Alternative, TVA would stabilize the Pickwick Landing Dam's south embankment as described in Section 2.1.2.

2.4 Comparison of Alternatives

A comparison of impacts associated with implementing the No Action Alternative and the Proposed Action Alternative is provided in Table 2. This comparison is based on current and potential future conditions at the Pickwick Landing Dam. Although the No Action Alternative would not result in the construction impacts associated with the Proposed Action Alternative, it does not address the underlying purpose and need of the project. Under the No Action Alternative, TVA would take no action to improve the condition of the embankment and the risk of a dam breach and reservoir loss following a large seismic event would remain.

As stated in Section 1.1, TVA considers the probabilities of an earthquake-induced breach of the dam to be high enough that upgrades to the south embankment are warranted. TVA does not consider the No Action Alternative reasonable because it does not address the risk to public health and safety or the region's economy.

Table 2 Comparison of Impacts of the No Action Alternative and the Proposed Action Alternative

Resource Area	No Action Alternative	Proposed Action Alternative
Floodplains	Under the No Action Alternative, the 100-year floodplain would remain unchanged because there would be no changes to the existing floodplain. However, a seismic event could potentially result in a breach of the dam resulting in downstream flooding and a lack of flood control provided by the dam and reservoir.	The proposed berm and extended fill would occur within the 100-year floodplain and floodway of the Tennessee River. Up to 260 acre-feet of fill upstream of Pickwick Dam and up to 263 acre-feet of fill downstream of the dam would be placed in the 100-year floodplain. The final, detailed design of the project would be evaluated in a hydraulic model either to confirm no rise in 100-year flood and floodway elevations, or to develop adjustments to the floodplain at that river mile to eliminate increases in flood elevations, or to pursue a modification to the Hardin County Flood Insurance Rate Map Panels 47071C0310E, 47071C0320E, 47071C0330E, and 47071C0340E.
Water Resources (Groundwater and Surface Water)	No direct or indirect impacts regarding groundwater. No direct impacts to surface waters; however, a seismic event leading to a breach in the dam could change the surface water pool and downstream water courses. A potential breach of the dam could also impact the existing intakes/local water supply if the dam were drained.	Minimal impacts to groundwater are anticipated as BMPs would be used to avoid hazardous materials reaching groundwater. Construction would impact approximately 370 linear feet of stream on the downstream side of the dam and 18.5 acres of fill material on the upstream surface water pool. Sediment and erosion control BMPs would be installed to minimize surface water impacts. Reservoir water turbidity levels in the project area would be monitored and measures would be taken to address significant increases in turbidity.
Wetlands	No direct or indirect impacts; however, a seismic event could potentially result in a breach of the dam resulting in impacts to wetlands through loss of vegetation, soils, or	Permanent impacts on approximately 2.5 acres of wetlands would occur due to the placement of the extended fill and berm on the downstream side of the embankment. Approximately 0.6

Resource Area	No Action Alternative	Proposed Action Alternative
	hydrology.	acres of fill would be placed within a high-quality bald cypress forested wetland. TVA finds that there is no practicable alternative to avoiding these impacts and will coordinate with the USACE on mitigating these impacts.
Air Quality	No direct or indirect impacts.	Minor adverse impacts during construction resulting from construction emissions, dust and particulate matter air emissions. TVA would implement construction BMPs to address air quality during construction.
Terrestrial Ecology (Wildlife and Vegetation)	No direct or indirect impacts. However, a seismic event could potentially result in a breach of the dam resulting in impacts to terrestrial ecology. Wildlife may suffer mortality or be displaced by flooding. Vegetative communities may be changed due to flooding impacts, subsequent changes in hydrology, or opportunities for invasive species colonization.	Of the 35 acres of vegetative communities that would be impacted, approximately 22.5 acres of forest would be cleared for construction of the project. Minor impact on populations of common wildlife species due to displacement to nearby areas.
Threatened and Endangered Species	No direct or indirect impacts; however, a seismic event could potentially result in a breach of the dam resulting in downstream impacts to both terrestrial and aquatic threatened and endangered species through habitat loss or alteration.	Consultation with the USFWS under Section 7 of the Endangered Species Act is underway to address potential impacts to summer roosting habitat for federally listed bat species potentially occurring within the impact area. TVA has committed to appropriate avoidance and minimization measures including a tree clearing moratorium from April 1 to October 15 of any year and compensation for loss of suitable forest dwelling bat habitat.
Aquatic Ecology	No direct impacts; however, a seismic event resulting in a breach of the dam could alter the existing water courses and impact aquatic ecology.	Construction of the project would lead to impacts to aquatic ecology with the loss of streams and wetlands as noted earlier. Impacts to the forebay are also anticipated due to placement of fill. BMPs would be utilized to minimize impacts due to erosion, sedimentation, and turbidity.

Resource Area	No Action Alternative	Proposed Action Alternative
Natural Areas, Parks, and Recreation	No direct or indirect impacts. However, a seismic event could potentially result in a breach of the dam resulting in impacts to natural areas, parks, and recreation due to loss of the reservoir.	Minimal impacts related to noise are anticipated to occur at Pickwick Landing State Park, and no impacts are expected at adjacent natural areas. No impacts to recreation are anticipated as lake levels would operate as they currently do and waters would not be drawn down. Public access to the lake would not be impacted.
Transportation	No direct impacts. A seismic event could potentially result in a breach of the dam resulting in loss of the road or instability in the roadway base.	Roadways would be temporarily impacted with increased truck traffic hauling materials and equipment to the site for construction. Flaggers would be utilized to avoid conflicts between construction and local traffic.
Navigation	No direct or indirect impacts.	No adverse impacts are anticipated to vessels. Care would be taken to avoid impacts to vessels navigating the lock and TVA would issue navigation notices concerning any construction activities adjacent to the lock.
Waste Management	No direct or indirect impacts.	Minor direct and indirect adverse impacts. Implementation of BMPs for spill avoidance, response, and clean-up would further reduce impacts on solid waste management.
Utilities	No direct or indirect impacts; however, a seismic event leading to a breach in the dam could result in loss of the reservoir and negative impacts could occur as the reservoir provides services such as hydroelectric power and water supply.	No direct impacts are anticipated to existing known utilities. No impacts would occur to hydroelectric power generation and reservoir operations would not be affected. TVA would coordinate with utility owners to ensure no impacts occur to known water supplies or other utilities that may be identified during the project's final design period.

Resource Area	No Action Alternative	Proposed Action Alternative
Socioeconomics or Environmental Justice	No direct impacts are anticipated related to socioeconomics or environmental justice; however, a seismic event leading to a breach in the dam could create impacts as the lake is important in providing flood control, hydroelectric power, water supply, recreation, and navigation which are critical to the region's economy.	No direct or indirect impacts would occur related to environmental justice for the proposed action. There would be a potential temporary increase in employment during construction.
Cultural Resources	No direct impacts; however, a seismic event leading to a breach in the dam could create impacts as several resources exist in the Pickwick Landing Dam tailwaters.	The entire archaeological Area of Potential Effects has been previously disturbed. No adverse effects to historic properties or cultural resources are anticipated.
Noise	No direct or indirect impacts.	Minimal temporary impacts to noise levels would occur during construction.

2.5 Identification of Mitigation Measures

Mitigation measures are discussed by resource in Chapter 4. In addition to procuring any necessary permits, TVA would implement the following measures to avoid, minimize, or mitigate adverse impacts on the environment. All applicable permits would be acquired; therefore, associated permit-related mitigation measures and BMPs would be implemented to further minimize impacts and restore areas disturbed from construction and operations.

- Erosion controls and other BMPs to reduce stormwater runoff would be implemented, in accordance with a Stormwater Pollution Prevention Plan developed in coordination with TDEC. All erosion and sediment controls would be installed, placed, implemented, or constructed in accordance with the provisions of the Tennessee Erosion and Sediment Control Handbook.
- TVA would mitigate for impacts to the Indiana bat following compensatory mitigation guidance outlined in the USFWS Cookeville Ecological Services' Conservation Strategy for Forest-dwelling Bats in Tennessee. In addition, a tree clearing moratorium would be in effect from April 1 to October 14 of any year. No ground-disturbing activities would occur until TVA has completed consultation and fulfilled its obligations under Section 7.
- TVA would mitigate impacts to wetlands in the project area via compensatory mitigation as determined by U.S. Army Corps of Engineers permitting requirements.
- TVA would mitigate impacts to streams by purchasing an appropriate number of credits from the Tennessee In-Lieu-Fee Stream Mitigation Program, as determined during the permitting process.

- To address impacts to reservoir surface waters, floating silt barriers/turbidity curtains would be placed in reservoir waters adjacent to the project area to contain turbidity during construction activities. TVA or contract personnel would conduct regular sampling of adjacent waters and continual visual inspections of waters to monitor for turbidity. Additional measures would be considered if necessary to control turbidity, including the use of flocculants (after coordination and approval from TDEC).
- Prior to mobilization, TVA would develop an evacuation plan to relocate flood-damageable, loose, or valuable equipment out of the floodplain during a flood.
- The design of the seismic upgrade project would be modeled in the current Hardin County Flood Insurance Study hydraulic model. If needed, compensatory adjustments would be included in the cross section of the river where the project would take place, to prevent any increase in modeled upstream flood elevations. If compensatory adjustments are insufficient to prevent an increase in modeled upstream flood elevations, consultation with Hardin County floodplain officials would be initiated to determine the next steps in order to comply with the National Flood Insurance Program.
- Navigation notices concerning construction activities adjacent to the dam's navigational lock would be issued; navigation markers would be placed in the area of extended fill in the reservoir to denote boating hazards.
- Topsoil and riprap temporarily removed during construction would be stored on-site, by regrading it into the embankment.
- To comply with EO 13112 (Invasive Species), disturbed areas would be revegetated with native or non-native, non-invasive plant species to avoid the introduction or spread of invasive species.
- Prior to creating and using an access road from the southern end of the embankment, TVA would evaluate whether an existing underground water intake line of Packaging Corporation of America would be affected by heavy traffic; improvements or minor changes to the route (within the Study Area) would be made to ensure this water intake line is not adversely affected.
- During site preparation activities on the downstream side of the embankment, the burning of any vegetation removed and piled on site would occur under proper conditions to minimize or avoid smoke affecting nearby areas. TVA would comply with all local or state requirements for burning.
- Flaggers and signage would be utilized along State Highway 128 and North Carolina Landing Road to improve the safety of those traveling through the project area.

2.6 Environmental Resources Not Carried Forward

The detailed analysis provided in Chapter 3 focuses on those environmental resources with the potential to be affected by the Proposed Action Alternative. For the Proposed Action Alternative, TVA determined that there would be no impacts, or that potential impacts would be negligible or temporary, for the resources listed in Table 3. Therefore, TVA determined that detailed analysis was unnecessary for these resources, and they are not discussed further in this EA.

Table 3 Environmental Resource Areas with No, Negligible, or Temporary Impacts

Resource Area	No Action	Proposed Action Alternative
Prime Farmland	Prime farmland soils are located in portions of the Study Area; however, these areas are not used as farmland and it is unlikely that they would be used for farmland in the future.	Prime farmland soils are located in portions of the Study Area; however, these areas are not used as farmland and it is unlikely that they would be used for farmland in the future.
Hazardous Materials	No impacts are associated with hazardous materials.	During the proposed construction activities, minor increases in onsite storage of hazardous materials such as fuels and lubricants may occur. Best Management Practices (BMPs) such as secondary containment, waste minimization, and personnel training would be in place to minimize the possibility of spills and dictate appropriate measures in the event of a spill. Based on the small amounts of hazardous materials to be used, their temporary storage, and the BMPs to be implemented, impacts associated with hazardous materials were not considered further.
Greenhouse Gases/Climate Change	No impacts are associated with greenhouse gases/climate change.	No impacts related to climate change are anticipated. Concerning construction activities, operation of heavy equipment would be temporary and minor during project activities, and would not significantly increase greenhouse gases.
Wild and Scenic Rivers	No impacts are associated with Wild or Scenic Rivers, as they do not exist within the Study Area.	No impacts are associated with Wild or Scenic Rivers, as they do not exist within the Study Area.
Landscape Viewshed	No impacts are associated with the landscape viewshed unless the dam was to breach and the lake was drained.	Except for impacts to the adjacent Pickwick Landing State Park (addressed under Natural Areas, Parks and Recreation), impacts associated with the viewshed would be negligible as the impacted area on the upstream side of the embankment would not reach beyond the existing navigation lock and is a small area of the vast lake. On the downstream side, there would be clearing impacts associated with the berms and fill; however, portions would be capped with cover and revegetated making any impacts temporary and minimal.
Land Use	No impacts are associated with land use.	No impacts are associated with land uses because the general land use surrounding the proposed project footprint would not change.

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CHAPTER 3 - AFFECTED ENVIRONMENT

This chapter describes the Study Area's existing physical, biological, and cultural resources. As stated in Chapter 1, the Study Area for the project encompasses approximately 157 acres to the east and west of the existing south embankment along Pickwick Landing Dam, in Hardin County, Tennessee. Within the Study Area footprint, approximately 46 acres is proposed to be impacted directly with placement of fill material. A 100-foot buffer has been included around the fill and labeled as proposed impact area due to the need for an additional 50 feet to be cleared of vegetation beyond the proposed fill.

As presented in Chapter 2, TVA has evaluated the Action Alternative and determined that certain environmental resources would not be affected due to the proposed activities. Resources that could potentially be affected by the Proposed Action Alternative are considered further in this EA and include: floodplains, water supply, groundwater, surface water, wetlands, air quality, terrestrial wildlife, vegetation, aquatic communities, natural areas, transportation, utilities, socioeconomic conditions, environmental justice, cultural resources, and noise levels. TVA expects that most of the resources listed above would only be minimally affected by TVA's proposal, and thus, the EA analyses of these resources are concise. Most activities associated with the Proposed Action Alternative would occur on or adjacent to the earthen embankment, which is a previously disturbed area; therefore, impacts to most resources are anticipated to be minimal.

3.1 Physical Environment

The Study Area is located within the Southeastern Plains and Hills Level IV Ecoregion with elevations ranging from approximately 390 feet to 420 above mean sea level (Appendix A, Figure 3). This ecoregion is characterized by dissected irregular plains and some low hills with broad tops that have a mosaic of cropland, woodland, and forest. Natural vegetation consists of oak-hickory, oak-hickory-pine, and some bottomland hardwoods. Streams in this region have a relatively low to moderate gradients and are sandy-bottomed with fairly wide bottoms with broad undulating terraces (Griffith et al. 2002).

The Study Area contains deciduous, evergreen, and mixed forested areas, forested wetlands, reservoir shoreline, and open areas. Additional surrounding land uses include recreational, residential, and light industrial/commercial areas.

3.1.1 Geology

The Geologic Map of Tennessee indicates that the Study Area is located in the Gulf Coastal Plain physiographic providence. Surficial deposits and bedrock consists of Quaternary alluvial deposits including ferruginous sand, clayey fine sand, and massive clay decomposition residuum; chert-pebble gravel and sand; some colluvial and alluvial loess; Tertiary sand, clay, silty clay, and lignite. Cretaceous sand in this region is typically located in floodplains more than 100 feet thick or in small streams generally less that 20 feet thick (Hardeman et al. 1966).

3.1.2 Soils

The Natural Resources Conservation Service's (NRCS) Soil Survey of Hardin County, Tennessee, indicates that primary soil series consist of Beason silt loam, Captina silt loam, Lindside silt loam, Melvin and newark silt loams (melvins), Sequatchie loams, Waynesboro loams, and Wolftever loams. These soils are generally formed in silt/fine textured alluvium

and located on low stream terraces and floodplains. The NRCS's Hydric Soils List classified Beason silt loam and Melvin and newark silt loams (melvins) as hydric. NRCS soils located within the Study Area are illustrated on Figure 4 (Appendix A).

3.1.3 Floodplains

Floodplains are the relatively level land areas along streams and rivers that are 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.

The proposed project would take place between Tennessee River miles 206.3 and 206.8, left descending bank, in Hardin County, Tennessee, adjacent to Pickwick and Kentucky Reservoirs. Pickwick Dam is located at Tennessee River Mile 206.72. The proposed laydown area would be located between Tennessee River miles 206.3 and 206.5, although the site is approximately 1500 feet from the river. The downstream portion of the Study Area would be located between Tennessee River miles 206.6 and 206.71. The upstream portion of the Study Area would be located between Tennessee River miles 206.72 and 206.8.

The 100-year flood elevations and TVA Flood Risk Profile elevations vary in this reach of the river. The river miles and corresponding flood elevations are provided in Table 4.

Table 4 Project Activities - Tennessee River Miles and Flood Elevations

Project Activities	River Miles	100-year flood elevation, in feet, mean sea level	500-year flood elevation, in feet, mean sea level
Laydown Area	206.3-206.5	401.2-401.3	403.4-403.5
Downstream Impact Area	206.6-206.71	401.4	403.6
Crest of Dam	206.72	419.0	419.0
Upstream Impact Area	206.72-206.8	419.0	419.0

As shown in Figure 5, the Tennessee River in the Study Area contains a floodway. Except for minor portions of the south end of the Study Area, the entire project area lies within the 100-year floodplain and floodway of the Tennessee River. A floodway is the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height (44 CFR 59.1). Floodwaters generally are deepest and swiftest in the floodway, and anything in this area is in the greatest danger during a flood (FEMA 2007).

3.2 Water Resources

Water resources were identified using a combination of the U.S. Geological Survey (USGS) topographic maps, aerial photographs, USGS National Hydrography Dataset (NHD) digital data, the USFWS National Wetlands Inventory (NWI), and an on-site survey of jurisdictional waters. See Figure 6 in Appendix A.

3.2.1 General Setting

The Pickwick Landing Dam Project is located within two 8-digit Hydrologic Unit Code (HUC) watersheds: HUC 06040001 (Lower Tennessee-Beech. Mississippi, Tennessee) and HUC 06030005 (Pickwick Lake. Alabama, Mississippi, Tennessee). The dam impounds the Tennessee River within the Study Area. TVA operates Pickwick Reservoir for a variety of purposes including power production, flood control, navigation, recreation, water supply management, water quality, and aquatic habitat.

3.2.2 Groundwater

The Study Area is located in the Cretaceous aquifer system, which consists of unconsolidated sediments of the Late Cretaceous age. These sediments are comprised primarily of sands and gravel, with interbedded clays and marls. The sands and gravels have a high primary (intergranular) porosity and permeability. Groundwater is recharged by precipitation through overlying permeable deposits. This aquifer system has generally good water quality and is used as a source for domestic and public water supplies (Brahana et al. 1986).

3.2.3 Water Supply

Pickwick Reservoir supports two permitted water intakes in the vicinity of the upstream side of the dam's south embankment: a municipal water supply intake for the First Utility District of Hardin County and an industrial intake for the Packaging Corporation of America. The water supply line for the Packaging Corporation of America occurs within a small area at the southern portion of the Study Area.

3.2.4 Wetlands

As defined in the Section 404 of the CWA, wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas. Wetlands and wetland fringe areas can also be found along the edges of many watercourses and impounded waters (both natural and man-made). Wetlands also form the transitional boundary between terrestrial and aquatic ecosystems; as such, they tend to be highly productive and biologically diverse ecosystems. They provide a multitude of ecological and public benefits, including flood control, erosion control, reservoir shoreline stabilization, water quality improvement, recreation opportunities, and habitat for fish and wildlife resources.

Activities in wetlands are regulated by state and federal agencies to ensure no net loss of wetland resources. As noted in Section 1.4 above, under Section 404 of the Clean Water Act, activities resulting in the discharge of dredge or fill into waters of the U. S. must be authorized by the USACE through a Nationwide, Regional, or Individual Permit. Section 401 of the Clean Water Act requires state water quality certification for projects requiring USACE approval. In Tennessee, TDEC is responsible for issuing water quality certifications pursuant to Section 401 of the Federal Water Pollution Control Act (33 U.S.C 1251, 1341) regarding regulated waters of the State. Lastly, Executive Order 11990 requires federal agencies to minimize wetland destruction, loss, or degradation, and preserve and enhance natural and beneficial wetland values, while carrying out agency responsibilities.

The USFWS's NWI Geographic Information System (GIS) data was used to estimate the extent of wetlands and deepwater habitats in the Study Area. The NWI data indicated that there are approximately 29.7 acres of Pickwick Reservoir classified as lacustrine, limnetic, unconsolidated bottom, permanently flooded, or dike/impounded deepwater habitat within the Study Area (USFWS 2016a).

TVA biologists surveyed the Study Area for jurisdictional wetlands and identified four wetlands. As shown in Figure 6 of Appendix A, three palustrine forested wetlands and one palustrine emergent/scrub shrub wetlands not indicated on the NWI were identified in the Study Area and totaled approximately 12.5 acres.

3.2.5 Surface Water

Surface water is described as water flowing through a defined watercourse (e.g., rivers, streams, or creeks), or stored within a reservoir, pond, or lake. The Tennessee River, which is impounded by the Pickwick Landing Dam, is the only named stream within the Study Area. In addition to the upstream reservoir waters and the four wetlands noted above, TVA biologists delineated approximately 164 linear feet of wet weather conveyance (ephemeral channel), 1,228 linear feet of intermittent streams, and 3,439 linear feet of the perennial streams within the Study Area.

TVA biologists identified one wet weather conveyance as a small incised channel approximately 2 feet in width and depth ranging from 1 to 5 feet, two intermittent channels with widths ranging from 2 to 3 feet, and three perennial channels ranging from 3 to 10 feet in width and depths ranging from 1 to 6 feet. The substrate of the perennial streams appeared mostly comprised of silt and clay. In this area, the source of the perennial streams which originate at the base of the embankment is the dam's toe drainage system. Identified surface waters generally flow east towards Robinson Creek, which flows into the Tennessee River just downstream from Pickwick Landing Dam (see Figure 3).

3.2.6 Surface Water Quality

TDEC has established water quality standards and designated uses for streams and lakes across the state, and issues periodic reports on waterbodies not meeting these standards and uses. Generally, characteristics considered during the assessments are temperature, dissolved oxygen, pH, nutrients, sedimentation, siltation, loss of habitat, and contaminants. As part of this program, TDEC issues a list of impaired waters called the "303(d) List," referring to Section 303(d) of the federal Clean Water Act. No waterbodies within or near the Study Area are recorded on the current Year 2014 303(d) List. TDEC's 2014 stream and waterbody assessments classified the Tennessee River and Pickwick Reservoir as "fully supporting" designated uses (TDEC OIR – GIS Services). Designated uses are water quality goals specific to the beneficial use of waterbodies. Designated uses of the Tennessee River to River Mile 49.1 (Tennessee-Kentucky Line) to 215.1 (Tennessee-Mississippi Line) include domestic water supply, industrial water supply, fish and aquatic life, recreation, livestock watering and wildlife, irrigation, and navigation (TDEC 2013). Additional water quality information is noted in the following Section 3.3 as it relates to aquatic ecology.

3.3 Aquatic Ecology

As noted above, TVA specialists observed several surface water features in the Study Area downstream of the embankment: one wet weather conveyance with a small incised channel approximately 2 feet in width and depth ranging from 1 to 5 feet; two intermittent channels

with widths ranging from 2 to 3 feet; and three perennial channels (ranging from 3 to 10 feet in width and depths ranging from 1 to 6 feet) which originate at the base of the embankment as part of the dam's toe drainage system. The perennial streams appeared mostly comprised of silt and clay, and stagnant, pooling waters were common. The surface waters identified within the Study Area exhibited poor instream habitat for aquatic species.

In Pickwick Reservoir, in the upstream portion of the Study Area, TVA has monitored water quality and aquatic ecology conditions in the reservoirs on the Tennessee River system since 1990. The purpose of this monitoring program is to provide information on the "health" or integrity of Tennessee Valley reservoirs. The ecological health evaluation is based on five ecological indicators: dissolved oxygen, chlorophyll, sediment quality, fish assemblage, and benthic macroinvertebrates. Each indicator is evaluated separately based on expectations under reference conditions and assigned an ecological rating of "good," "fair," or "poor" (TVA 2016a).

From 1999 through 2008, physical and chemical monitoring was conducted on an annual basis while biological indicators continued to be monitored every other year. Biennial monitoring resumed for each indicator following 2008.

Monitoring takes place at four stations on Pickwick Reservoir including in the dam's forebay (the deep, still water near the dam). Because the dam's forebay is adjacent to the Study Area, monitoring results from the forebay provides relevant information about the ecological health of the reservoir waters within the Study Area. Other stations are mid-reservoir, at inflow regions within the main body of the reservoir (near Wilson Dam in Alabama), and at Bear Creek embayment (also in Alabama). Ratings for each ecological health indicator reported for the forebay monitoring location between 2000 and 2014 are provided in Table 5. These ratings are briefly explained in the paragraphs that follow.

Table 5 Pickwick Forebay Water Quality Results

	Monitoring Years														
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Pickwick Forebay															
Dissolved Oxygen	G	G	F	G	G	G	G	G	F	---	F	---	F	---	G
Chlorophyll	P	P	P	F	P	P	P	P	P	P	P	---	P	---	P
Sediment Quality	G	---	G	---	G	---	G	---	G	---	G	---	F	---	G
Fish Assemblage	F	---	F	---	G	---	F	---	F	---	F	---	G	---	G
Benthic Macroinvertebrates	G	---	F	---	F	---	G	---	F	---	F	---	F	---	G

NOTES:
G = Good; F = Fair; P = Poor
--- Ecological Health Indicator was not sampled in the given year

Dissolved Oxygen

Dissolved oxygen ratings have varied between good and fair in the forebay, generally in response to reservoir flow conditions. The fair ratings were the result of low concentrations (<2 mg/L) in the lower water column during some sample periods. Monitoring has been conducted under various weather and reservoir flow conditions and reduced dissolved oxygen concentrations tend to occur during extended hot, dry periods. In the years sampled, dissolved oxygen was measured throughout the water column monthly April through September.

Chlorophyll

Chlorophyll, a surrogate measure for the amount of algae (phytoplankton) in the water, is important because it provides insights into the level of primary productivity within a water body and can provide a measure of nutrient enrichment. High chlorophyll concentrations indicate excessive algal growth, which often signals nutrient enrichment. Chlorophyll concentrations in Pickwick Reservoir tend to be elevated, typically rating poor or at the low end of the fair range at the forebay monitoring location. Nutrient loadings (nitrogen and phosphorus) from the watershed play an important role in the growth of algae in the reservoir. Algal growth also varies in relation to season, prevailing weather patterns, the timing and amount of runoff (i.e., nutrient loads), as well as water flow through the system. Changes in water flow alter the retention times (length of time water spends in a reservoir); low-flow conditions tend to allow more time for algal populations to become established. In the years sampled, chlorophyll is measured in water samples collected from the upper water column monthly April through September.

Sediment Quality

Sediments provide habitat for many aquatic organisms and are a major repository for many of the more persistent chemicals that are introduced into the aquatic environment. Sediment quality has rated good in the forebay most years. The exception was the fair rating in 2012 due to the detection of low PCB levels in the sample.

Fish Health

Fisheries monitoring in Pickwick Reservoir has traditionally occurred during October and November. Monitoring occurs along established 300-meter transects, and fish are captured using boat electrofishing and sinking gill net techniques. TVA uses this data to calculate a Reservoir Fish Assemblage Index (RFAI) score (McDonough and Hickman 1999). This index is primarily based on species diversity and composition and takes into account the relative abundances of species from various feeding guilds, species tolerance thresholds, and the conditions of species (e.g., the presence of lesions, parasites, or abnormalities). The RFAI scores are translated into a qualitative ranking of good, fair, or poor.

The fish assemblage in the forebay of Pickwick Reservoir generally rates good or at the upper end of the fair range. Since 1993, TVA has collected 49 species of fish in Pickwick forebay and 72 species of fish reservoir-wide.

Benthic Macroinvertebrates

Benthic macroinvertebrate ratings have fluctuated between good and fair at the forebay monitoring location. The fair ratings generally occurred in years with extended periods of low dissolved oxygen concentration along the reservoir bottom, which results in lower overall abundance and diversity of animals.

State-Designated Impaired Waters

As noted Section 3.2.6 above, no waterbodies near the Study Area are identified by TDEC as impaired. The State of Alabama has designated portions of Pickwick Reservoir in Alabama as water quality impaired. These portions of the reservoir are considered impaired by pollution and not fully meeting designated uses, such as recreation (e.g., swimming and fishing), propagation of aquatic life or water supply. The reason for the impaired designation is elevated nutrient concentrations, with the likely source being agricultural run-off. The distance between the Study Area and the Alabama waters of Pickwick Reservoir is approximately 7 miles.

Fish Consumption Advisories

TVA maintains a program to examine contaminants in fish fillets from TVA reservoirs and their major tributary streams. TVA coordinates fish tissue studies in the Tennessee Valley region with state agencies that are responsible for advising the public of health risks from eating contaminated fish. TVA assists the states by collecting fish from TVA reservoirs and testing the tissue for metals, pesticides, PCBs, and other chemicals that could affect human health.

The State of Tennessee has not issued a fish tissue advisory for streams near the Study Area or for the reservoir, and no restrictions have been issued by the State of Alabama for Pickwick Reservoir.

3.4 Terrestrial Ecology

Vegetative communities in the Southeastern Plains and Hills ecoregion generally consist of oak-hickory, oak-hickory-pine forest, and bottomland hardwoods (sycamore, sweetgum, tupelo, oaks, and cypress). A field survey conducted by TVA biologists and recent aerial imagery indicate that the downstream portion of the Study Area is primarily intact forested uplands and bottomlands with several maintained areas.

3.4.1 Terrestrial Vegetation

TVA biologists conducted field surveys in April and May 2016 to document plant communities and the presence of invasive plants, and to search for any threatened or endangered plant species within the Study Area. Vegetative communities observed in the field are classified as a combination of deciduous, evergreen, mixed evergreen deciduous forest, and herbaceous vegetation according to the National Vegetation Classification System (Grossman et al. 1998). There are several mature forested stands with individual trees measuring up to 48 inches in diameter breast height (dbh), but without the structural characteristics indicative of an old growth forest (Leverett 1996).

Deciduous forest encompasses the majority of the Study Area. Cleared areas that have reverted naturally to forested areas are dominated by early successional woody herbaceous species including sugarberry (*Celtis laevigata*), black locust (*Robinia pseudoacacia*), red maple (*Acer rubrum*), spicebush (*Lindera benzoin*), river cane (*Arundinaria gigantea*), Japanese stilt grass (*Microstegium vimineum*), small flower baby blue eyes (*Nemophila aphylla*), jumpseed (*Persicaria virginiana*), and bedstraw (*Galium aparine*). More mature upland forests are less disturbed and had an average overstory ranging between 18 to 24 inches dbh with overstory trees consisting of willow oak (*Quercus phellos*), cherrybark oak (*Quercus pagoda*), shagbark hickory (*Carya ovata*), white ash (*Fraxinus americana*), and sweetgum (*Liquidambar styraciflua*). Understory species consist

of pawpaw (*Asimina triloba*), American beech (*Fagus grandifolia*), and winged elm (*Ulmus alata*). The understory in these habitats is not rich and includes a few common vine species including Virginia creeper (*Parthenocissus quinquefolia*) and common greenbrier (*Smilax rotundifolia*).

As noted in Section 3.2.4, high-quality forested wetlands are present and include mature bald cypress (*Taxodium distichum*) and water tupelo (*Nyssa aquatica*) in the wettest areas and willow oak, cherrybark oak, red maple, and sweetgum in the drier areas. The herbaceous layer includes fringed sedge (*Carex crinita*), white edge sedge (*Carex debilis*), low woodland sedge (*Carex socialis*), low spearwort (*Ranunculus pusillus*), lizard's tail (*Saururus cernuus*), and water horehound (*Lycopus* sp.).

Mixed deciduous forests include similar species listed in the communities above with a greater abundance of loblolly pine (*Pinus taeda*). Several small portions of evergreen forest documented by planted loblolly pine with a sparse herbaceous layer are present within the Study Area.

Open habitats dominated by herbaceous vegetation are present adjacent to the dam and along the periphery of the forested block. These plant communities are dominated by non-native species and have no conservation value.

The entirety of the proposed laydown area has been previously cleared and heavily disturbed by previous land use. The majority of the site is dominated by herbaceous vegetation comprised primarily of non-native plants, but small clusters of individual trees are found sporadically throughout the area. Common tree species include black locust, boxelder (*Acer negundo*), cottonwood (*Populus deltoides*), eastern red cedar (J*uniperus virginiana*), and yellow-poplar (*Liriodendron tulipifera*). Common herbaceous species include asters (*Symphyotrichum spp.*), broomsedge (*Andropogon virginicus*), Queen Anne's lace (*Daucus carota*), and sericea lespedeza (*Lespedeza cuneata*). The proposed laydown area does not support intact native plant communities.

3.4.2 Invasive Species

Agricultural land use has extensively altered the native vegetation of this region; consequently, invasive species occur throughout the Study Area. EO 13112 (Invasive Species) defines an invasive species as "any species, including its seeds, eggs, spores, or other biological material capable of propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause economic or environmental harm or harm to human health" (USDA 2014). Invasive plants include species of trees, shrubs, vines, grasses, ferns, and forbs. Some have been introduced into the region accidentally, but most were brought as ornamentals or for livestock forage. These robust plants arrived without their natural predators of insects and diseases that tend to keep native plants in natural balance. According to Morse et al. (2004), invasive species are the second-leading threat to imperiled native species. Purple loosestrife (*Lythrum salicaria/virgatum*) and tropical soda apple (*Solanum viarum*) are listed by the USDA as noxious weeds for Tennessee that are capable of being spread (USDA 2014). No state-listed noxious weeds were observed by TVA biologists during the terrestrial plant community surveys.

The Tennessee exotic pest list (Tennessee Exotic Pest Council 2009) recognizes plant species that, if present, would pose a severe threat to local plant communities because of their potential to spread rapidly and displace native vegetation. TVA biologists observed

that invasive plant species are well established throughout the Study Area with the exception of the high quality forested bald cypress wetlands. Common non-native plants in the forested and open/maintained areas included Japanese honeysuckle (*Lonicera japonica*), Japanese stilt grass (*Microstegium vimineum*), and autumn olive (*Elaeagnus umbellata*).

3.4.3 Terrestrial Wildlife

Terrestrial communities with the Study Area may support a diverse number of wildlife species. Representative mammal, bird, reptile, and amphibian species commonly occurring in oak-hickory dominated forests are listed below. Individual species and/or evidence of species observed during TVA biologist field surveys are indicated with an asterisk (*). Information on species that typically use these habitats was obtained from relevant literature, mainly the *Biodiversity of the Southeastern United States, Upland Terrestrial Communities* (Martin et al. 1993).

Mammal species that commonly occur in these habitats include white-footed mice (*Permyscus leucopus*), southern short-tailed shrews (*Blarina carolinensis*), eastern chipmunk (*Tamias striatus*), various bats, flying squirrels (*Glaucomys volans*), gray squirrels (*Sciurus carolinensis*), fox squirrels (*S. niger*), gray fox (*Urocyon cinereoargenteus*), raccoons (*Procyon lotor*)*, opossums (*Didelphis virginiana*), striped skunks (*Mephitis mephitis*), and white-tailed deer (*Odocoileus virginianus*)*.

Bird species that commonly use these habitats include osprey (*Pandion haliaetus*)*, American robin (*Turdus migratorius*)*, ovenbirds (*Seiurus aurocapilla*), black-throated blue warblers (*Setophaga caerulescens*), black and white warblers (*Mniotilta varia*), pine warbler (*Setophaga pinus*)*, northern parula (*Setophaga americana*)*, blue jays (*Cyanocitta cristata*)*, northern cardinal (*Cardinalis cardinalis*)*, blue-gray gnatcatcher (*Polioptila caerulea*)*, Louisiana water thrush (*Parkesia motacilla*)*, Carolina wren (*Thryothorus ludovicianus*)*, red-eyed vireo (*Vireo olivaceus*)*, wood thrush (*Hylocichla mustelina*), indigo bunting (*Passerina cyanea*)*, Carolina chickadee (*Poecile carolinensis*)*, hairy woodpecker (*Leuconotopicus villosus*)*, red-bellied woodpecker (*Melanerpes carolinus*)*, tufted titmouse (*Baeolophus bicolor*)*, white-throated sparrow (*Zonotrichia albicollis*)*, yellow-billed cukoo (*Coccyzus americanus*)*, and eastern wood pewee (*Contopus sordidulus*).

Reptile and amphibian species that may use these terrestrial communities include garter snakes (*Thamnophis sirtalis*)*, black racers (*Coluber constrictor*), black rat snakes (*Elaphe obsolete*)*, five-line skinks (*Eumeces fasciatus*), eastern fence lizard (Sceloporus undulatus), rough green snakes (*Opheodrys aestivus*), ring-necked snakes (*Diadophis punctatus*), hognose snakes (*Heterodon platirhinos*), slimy salamander (*Plethodon glutinosus*), dusky salamander (*Desmognathus fuscus*), American toad (*Anaxyrus americanus*), gray treefrog (*Hyla versicolor*)*, green frog (*Rana clamitans*)*, leopard frog (*Lithobates pipiens*)*, spring peeper (*Pseudacris crucifer*), and eastern box turtles (*Terrapene carolina*)*.

3.4.4 Migratory Birds

EO 13186 (Responsibilities of Federal Agencies to Protect Migratory Birds) directs certain federal agencies to take certain actions to further implement the Migratory Bird Treaty Act. This act prohibits “by any means or manner to pursue, hunt, take, capture [or] kill” any migratory birds except as permitted by regulations issued by the USFWS. TVA reviews proposed activities in order to meet the intent of the Executive Order.

The Study Area provides habitat for numerous migratory birds. Migratory birds commonly occurring in oak-hickory dominated forests like those in the Study Area include the American kestrel (*Falco sparverius paulus*), Bachman's sparrow (*Aimophila aestivalis*), bald eagle (*Haliaeetus leucocephalus*), chuck-will's-widow (*Caprimulgus carolinensis*), dickcissel (*Spiza americana*), fox sparrow (*Passerella iliaca*), Kentucky warbler (*Oporornis formosus*), least bittern (Ixobrychus exilis), loggerhead shrike (*Lanius ludovicianus*), prairie warbler (*Dendroica discolor*), prothonotary warbler (*Protonotaria citrea*), red-headed woodpecker (*Melanerpes erythrocephalus*), rusty blackbird (*Euphagus carolinus*), sedge wren (*Cistothorus platensis*), short-eared owl (*Asio flammeus*), Swainson's warbler (*Limnothlypis swainsonii*), wood thrush, and worm eating warbler (*Helmitheros vermivorum*) (USFWS 2016b).

3.5 Threatened and Endangered Species

The Endangered Species Act (ESA) provides broad protection for species of fish, wildlife and plants that are listed as threatened or endangered in the United States or elsewhere. The ESA outlines procedures for federal agencies to follow when taking actions that may affect federally listed species or their designated critical habitat. In addition, the state of Tennessee provides protection for species considered threatened, endangered or deemed in need of management within the state other than those already federally listed under the ESA. Plant species are protected in Tennessee through the Rare Plant Protection and Conservation Act of 1985. The listing of species is managed by TDEC. Additionally, the Tennessee Natural Heritage Program and TVA both maintain databases of aquatic and terrestrial plant and animal species that are considered threatened, endangered, of special concern, or are otherwise tracked in Tennessee because the species is rare and/or vulnerable within the state.

TVA biologists and natural resource specialists queried the TVA Regional Natural Heritage Database to assess the presence of threatened and endangered species within the proximity of the Study Area, which includes the proposed construction areas, access roads, laydown areas, existing public recreation areas, and the Tennessee River, and Pickwick Reservoir. The TVA Regional Natural Heritage database was created to ensure that environmental compliance activities are conducted in a consistent manner across the TVA region and that these activities meet the requirements of NEPA and ESA. Database searches were based on the following criteria: (1) proximity to Pickwick Landing Dam; (2) presence/absence of species; (3) element occurrence rank values; and (4) species or type of element present. Specific to proximity, plants were assessed within a 5-mile radius, aquatic species were assessed within a 10-mile radius, and terrestrial species were assessed within a 3-mile radius as well as at the county level. TVA’s Regional Natural Heritage Database layers are illustrated on Figure 7 (Appendix A).

3.5.1 Plants

TVA biologists indicated that no habitat for state- or federally listed plant species was observed within the Study Area during field surveys. A review of the TVA Natural Heritage Database indicated no state- or federally protected plant species have been observed in the Study Area. Recorded occurrences of 26 state-protected plant species were noted within a 5-mile radius of Pickwick Landing Dam (Table 6). No federally protected plant species are known to occur within the 5-mile-radius proximity; however, the Price’s potato-bean (*Apio priceana)*, a threatened plant species, has been known to or is believed to occur in Hardin County (USFWS 2016c).

Table 6 State-Protected Plant Species Documented within a 5-Mile Radius of Pickwick Landing Dam

Scientific Name	Common Name	Federal Status	State Status	State Rank
*Actaea racemosa**	Black bugbane	-	SLNS	S1S2
*Aquilegia canadensis**	Wild columbine	-	SLNS	S1S2
*Asarum canadense**	Canada wild-ginger	-	SLNS	S2S3
*Cheilanthes lanosa**	Hairy lipfern	-	SLNS	S2
*Chelone glabra**	White turtlehead	-	SLNS	S3
Erythronium rostratum	Yellow trout-lily	-	SPCO	S2
*Fraxinus quadrangulata**	Blue ash	-	SLNS	S2
*Heuchera villosa var. macrorhiza**	Giant alumroot	-	SLNS	S1
*Hybanthus concolor**	Green violet	-	SLNS	S2S3
Lysimachia fraseri	Fraser loosestrife	-	END	S2
*Muhlenbergia tenuiflora**	Muhly	-	SLNS	S1S2
*Pachysandra procumbens**	Allegheny-spurge	-	SLNS	S3
*Panax quinquefolius**	American ginseng	-	SLNS	S3
*Pellaea atropurpurea**	Purple cliff-brake	-	SLNS	S1S2
*Philadelphus hirsutus**	Streambank mock orange	-	SLNS	S1
*Pinus virginiana**	Virginia pine	-	SLNS	S2
*Polemonium reptans**	Greek valerian	-	SLNS	S2S3
Prenanthes barbata	Barbed rattlesnake-root	-	SPCO	S2
*Salix caroliniana**	Carolina willow	-	SLNS	S3
Salvia azurea var. grandiflora	Blue sage	-	SPCO	S3
*Sedum ternatum**	Stonecrop	-	SLNS	S2
Silene ovata	Ovate catchfly	-	END	S2
*Staphylea trifolia**	American bladdernut	-	SLNS	S3
Stylisma humistrata	Southern morning-glory	-	THR	S1
Symplocos tinctoria	Horsesugar	-	SPCO	S2
Tiarella cordifolia*	Heart-leaved foam-flower	-	SLNS	S2

NOTES:
* Species documented in Mississippi
– No status
State Status
END – State Endangered
SLNS – No State Status
SPCO – State Species of Special Concern
THR – State Threatened
State Rank
S1 – Extremely rare and critically imperiled in the state, 5 or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extinction.

S2 – Very rare and imperiled within the state, 6 to 20 occurrences, some factor(s) making it vulnerable to extinction.
S3 – Rare or uncommon in the state, from 21 to 100 occurrences.

3.5.2 Aquatic Animals

TVA biologists indicated that no habitat for state- or federally listed aquatic species was observed within the Study Area during field surveys. Reviews of the TVA Natural Heritage Database indicated that 18 state- and federally listed species have been observed in the Tennessee River within a 10-mile radius of Pickwick Landing Dam (Table 7).

Table 7 State and Federally Protected Aquatic Species Documented within a 10-Mile Radius of Pickwick Landing Dam

Scientific Name	Common Name	Federal Status	State Status	State Rank
Carpiodes velifer	Highfin carpsucker	-	NMGT	S2S3
Cryptobranchus alleganiensis	Hellbender	PS	NMGT	S3
Cumberlandia monodonta	Spectaclecase	LE	TRKD	S2S3
Cyprogenia stegaria	Fanshell	LE	END	S1
Hemistena lata	Cracking pearlymussel	LE	END	S1
Hemitremia flammea	Flame chub	-	NMGT	S3
Lampsilis abrupta	Pink mucket	LE	END	S2
Lithasia armigera	Armored rocksnail	-	TRKD	S1S2
Lithasia geniculata	Ornate rocksnail	-	TRKD	S2
Lithasia salebrosa	Muddy rocksnail	-	TRKD	S2
Macromia margarita	Margaret's river cruiser	-	TRKD	S2S3
Obovaria retusa	Ring pink	LE	END	S1
Orconectes wrighti	Hardin crayfish	-	END	S2
Plethobasus cicatricosus	White wartyback	LE	END	S1
Plethobasus cooperianus	Orangefoot pimpleback	LE	END	S1
Plethobasus cyphyus	Sheepnose	LE	TRKD	S2S3
Pleuronaia dolabelloides	Slabside pearlymussel	LE	END	S2
Quadrula cylindrica	Smooth rabbitsfoot	LT	NMGT	S3

NOTES:
– No status
Federal Status
LE – Listed Endangered
LT – Listed Threatened
PS – Partial Status
State Status
END – State Endangered
NMGT – In Need of Management
TRKD – State Tracked
State Rank
S1 – Extremely rare and critically imperiled in the state, 5 or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extinction.
S2 – Very rare, imperiled within the state, 6 to 20 occurrences, some factor(s) making it vulnerable to extinction.
S3 – Rare or uncommon in the state, from 21 to 100 occurrences.

3.5.3 Terrestrial Animals

Reviews of the TVA Natural Heritage Database indicated that one federally protected species and one state-threatened species occur within a 3-mile radius of Pickwick Landing Dam. These species are presented in Table 8. Additionally, TVA specialists determined during the field survey of the Study Area that portions of the area is suitable roosting and foraging habitat for three federally protected bat species. Although these species were not observed, TVA determined that the species could possibly exist in the Study Area.

Table 8 State and Federally Protected Terrestrial Species Documented within a 3-Mile Radius of Pickwick Landing Dam and Federally Protected Terrestrial Species with the potential to occur in Hardin County

Scientific Name	Common Name	Federal Status	State Status	State Rank
Haliaeetus leucocephalus	Bald eagle	DM	NMGT	S3
Myotis septentrionalis	Northern long-eared bat*	LT	-	S1S2
Myotis sodalis	Indiana bat*	LE	END	S1
Myotis grisescens	Gray bat*	LE	END	S2
Sistrurus miliarius streckeri	Western Pygmy Rattlesnake	-	THR	S2S3

NOTES:
– No status
Federal Status
DM – Delisted but still monitored
LE – Listed Endangered
LT – Listed Threatened
State Status
END – State Endangered
NMGT – In Need of Management
THR – State Threatened
State Rank
S1 – Extremely rare and critically imperiled in the state, 5 or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extinction.
S2 – Very rare and imperiled within the state, 6 to 20 occurrences, some factor(s) making it vulnerable to extinction.
S3 – Rare or uncommon in the state, from 21 to 100 occurrences.
*Although known occurrences have not been documented with a 3-mile radius of Pickwick Landing Dam, the USFWS has determined that these species have the potential to occur in Hardin County (USFWS, IPAC).

Bald Eagle

The bald eagle is one of the largest raptors in North America. Until recently, the species was protected under the ESA but was removed from the list in 2007 due to increasing populations nationwide. The species is still protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Bald eagles typically nest in forested areas adjacent to large bodies of water. The species is an opportunistic forager known to prey on a variety of mammalian, avian, and reptilian species; however, fish tends to be its favorite food item. The bald eagle has a range of foraging methods that include predation, scavenging (carrion), and pirating (stealing) food captured from other raptors such as osprey (Buehler 2010).

TVA biologists did not observe any bald eagles or bald eagle nests within the Study Area; however, suitable nesting habitat exists within the Study Area and suitable foraging habitat exists over the reservoir.

Northern Long-Eared Bat

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 (Lacki and Schwierjohann 2001, USFWS 2014). Roost selection by the northern long-eared bat is similar to the Indiana bat, however it is thought that northern long-eared bats are more opportunistic in roost site selection. This species also is known to roost in abandoned buildings and under bridges. Northern long-eared bats emerge at dusk to forage below the canopy of mature forests on hillsides and roads, and occasionally over forest clearings and along riparian areas (USFWS 2014).

No caves or other suitable winter roosting structures for this species occur within a 3-mile radius of the Study Area. Northern long-eared bat summer captures have been documented approximately 14.7 miles away in Hardin County, Tennessee. The reservoir, forested wetlands, riparian corridors along streams, and forested uplands within the Study Area offer suitable summer foraging habitat. TVA biologists observed approximately 30.4 acres of suitable summer roosting habitat including at least 14 snags, 10 shagbark hickories, and 4 live trees with crevices and hollows scattered throughout the Study Area along streams and wetlands. However only 6.0 acres of suitable summer roosting habitat and 16.5 acres of foraging habitat fall within the potential area of impact

Indiana Bat

Indiana bats occupy caves during winter months. During summer months, they use areas of mature deciduous forest that have open mid-stories with an abundance of trees with exfoliating (i.e., loose or peeling) bark. Suitable roost trees include dead trees of several species and live trees such as shagbark hickory and white oak. The greatest threats to Indiana bats posed by forestry activities are disturbance of hibernating colonies in caves and destruction of summer roosting and foraging habitat (Hammond and Sweeney 1997).

Known Indiana bat maternity roosting sites occur approximately 9.9 miles away from the Study Area in McNairy County, Tennessee. No caves or other suitable winter roosting structures for Indiana bat occur within the Study Area. No caves are known within a three-mile-radius of the Study Area. The reservoir, forested wetlands, riparian corridors along streams, and the forested uplands within the Study Area offer suitable summer foraging habitat. TVA biologists observed approximately 30.4 acres of suitable summer roosting habitat including at least 14 snags, 10 shagbark hickories, and 4 live trees with crevices and hollows scattered throughout the Study Area along streams and wetlands. However only 6.0 acres of suitable summer roosting habitat and 16.5 acres of foraging habitat fall within the potential area of impact.

Gray Bat

The gray bat is widely distributed throughout cave systems of the southeastern United States; however, 90 percent of their known population occurs in fewer than a dozen cave systems. Gray bats are insectivores and forage primarily over water and along lake and reservoir shorelines. Banding studies have indicated that gray bats prefer summer caves

within a mile of a feeding area (river or other reservoir of water), although they have been known to fly as far as 12 miles from their colony to feed (Kentucky Bat Working Group 1999, Tuttle 1976).

Gray bat summer captures have occurred approximately 10.6 miles from the Study Area in Hardin County, Tennessee. No caves or other suitable roosting structures for gray bats occur within the Study Area. Roosting habitat for this species would not be impacted by the Proposed Action Alternative. Forested wetlands, streams, and the reservoir offer suitable foraging habitat for this species.

Western Pygmy Rattlesnake

The western pygmy rattlesnake is a small, colorful rattlesnake with a thin tail and small rattle that feeds on amphibians, small snakes, and rodents. This species is typically found in floodplains and wetlands in close proximity to water, but is occasionally found in rock uplands, pine woods, and glades (TWRA 2016b).

The TVA Natural Heritage Database identified several known occurrences within a one-half-mile-radius of the Study Area. Suitable habitat is present throughout the Study Area in forested riparian and wetland areas; however, TVA biologists did not observe any rattlesnakes during field surveys.

3.6 Natural Areas, Parks and Recreation

TVA developed a Natural Areas land-use designation system to manage publicly owned land in and around its facilities and reservations. These sites are identified as Habitat Protection Areas, Small Wild Areas, Ecological Study Areas, or Wildlife Observation Areas. Their management includes restrictions on activities that might endanger significant natural features (TVA 2016b). TVA identifies 12 Natural Areas within a 5-mile radius of the Study Area, as shown on Figure 8 (Appendix A). Managed natural areas include agricultural conservation easements, Rabbitsfoot designated critical habitat, Kentucky Reservoir No. 2 State Mussel Sanctuary, Factory Hollow Registered State Natural Area, Kentucky Reservoir Reservation, Pickwick Landing State Park, Tishomingo County Game Refuge, Chambers Creek Wetland Wildlife Management Area, Dry Creek Wildlife Management Area, Lauderdale Wildlife Management Area, Bruton Branch Recreation Area, and Mississippi Wildlife and Recreation Land. Pickwick Landing State Park is adjacent to the Study Area to the south; a small area of State Park is located in the Study Area. At the park, there are two swimming beaches, picnic areas, and the park's inn and conference center located within 300 to 1000 feet of the project area. Other public or commercial recreation areas within 5 miles of the study area are also shown on Figure 8. These include recreation areas on both the north and south banks below Pickwick Dam, State Line Boat Ramp, Aqua Yacht Harbor, and Grand Harbor Marina.

3.7 Air Quality

The U.S. Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standard (NAAQS) to protect the public health and welfare with respect to six pollutants: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Particulate matter has two standards—one for particulate matter less than 2.5 microns in diameter size (PM2.5) and one for particulate matter less than 10 microns in diameter size (PM10). The Clean Air Act requires states to establish monitoring programs for these NAAQS and to determine existing areas of attainment (regions where these pollutant levels

are at or below the established NAAQS levels) and non-attainment (regions where these pollutant levels are above the established NAAQS levels). Hardin County is currently in attainment status for NAAQS pollutants (EPA 2016).

3.8 Transportation

There are approximately 2.3 miles of roads located within or along the perimeter of the Study Area. The only route within the Study Area with a Functional Classification is State Highway 128, which is classified as a Minor Arterial. The roads contained within the Study Area are listed below in Table 9.

Table 9 Roads within the Study Area

Road Name	Length within the Study Area	
	Feet	Miles
Tennessee State Highway 128	5,115	0.97
North Carolina Landing Road	4,332	0.82
Playground Loop	64	0.01
Unnamed Roads	2,653	0.51
Total	**12,164**	**2.31**

3.9 Navigation

Pickwick Reservoir was impounded by the construction of the Pickwick Landing Lock and Dam, and was opened to commercial navigation in 1938. Additional improvements, completed in 1948, provided a commercially navigable waterway up to Wilson Dam. Today, Pickwick Reservoir is an important link in the Tennessee River System which provides 800 miles of slack-water navigation from Paducah, Kentucky to Knoxville, Tennessee, and includes several navigable tributaries such as the Hiwassee and Clinch Rivers. The Tennessee-Tombigbee Waterway enters Pickwick Reservoir at River Mile 415.0. The Tennessee River Waterway is in turn linked to the 12,000 mile National Inland Waterway in several places, and supports local, national, and international commerce. Approximately 35 to 40 million tons of commodities move on the Tennessee River System annually. On average, nearly 17.5 million tons of that traffic locks through Pickwick Lock each year (USACE 2013). Approximately 8 miles upstream on the Tennessee River and 2 miles downstream on the Tennessee-Tombigbee Waterway lies Yellow Creek State Inland Port Authority near Iuka, Mississippi, which handles between 0.5 and 1 million tons of cargo each year, primarily iron and steel products.

The Pickwick Navigation Lock is part of the dam structure and is located adjacent to the Study Area. Located approximately 12 miles south of Savannah, Tennessee, at Tennessee River Mile 206.7 (see Exhibit 4), the dam has two locks: one measures 110 feet by 600 feet and the other measures 110 feet by 1,000 feet. The first lock was completed in 1937 by TVA and the second, larger lock was put into operation in 1984 to augment the first lock. The locks are capable of handling large commercial tows and have an approximate lift of 63 feet. Two Federal Mooring Cells are located just upstream of the lock at Tennessee River Mile 207.0 for securing barges, particularly during times of inclement weather or during periods of traffic delay. Additionally, two more Federal Mooring Cells are located nearby at Tennessee River Mile 209.0.

Exhibit 4 Pickwick Navigation Lock (Source: USACE 2016)

3.10 Utilities

Some utility infrastructure exists within the Study Area. Two water intakes are located in the vicinity of the Study Area in reservoir waters and are owned by First Utility District of Hardin County and Packaging Corporation of America. There is also a power utility along the west side of the embankment which supplies lighting along the State Highway 128. The TVA maintenance facility and shooting range on the downstream side of the embankment have utilities which align with North Carolina Landing Road.

3.11 Solid Waste

Solid waste may include a variety of components normally generated from construction activities, including biodegradable waste (e.g., food and kitchen waste), recyclable materials (e.g., paper, glass, metals, certain plastics), and inert materials (e.g., construction waste, dirt, rocks). Sources of solid waste include construction activities, construction equipment and maintenance, commercial and industrial facilities, and households and the generation of discarded items such as scrap metal, appliances, and furniture. Generally, solid waste is managed by reduction, reuse, recycling, and disposal in landfills.

The Study Area is located in Hardin County, Tennessee near the unincorporated communities of Counce and Pyburns. Hardin County is part of the Shiloh Municipal Solid Waste Planning Region, which consists of four counties; Chester, McNairy, Hardin, and Wayne. Hardin County has no active landfills. Solid wastes from Hardin County are deposited into one of three landfills: the Decatur Landfill, a Class I facility in neighboring Decatur County; the Northeast Mississippi Regional Landfill, a Class I Facility in Tippah County, Mississippi; and the McNairy County Demolition Landfill, a Class II/IV facility in McNairy County. There are 13 solid waste convenience centers located throughout Hardin County for residents outside the City of Savannah. Recyclables are taken to the Hardin County Solid Waste Shop for processing and cardboard is processed at the West Tennessee Regional Recycling Hub in Chester County (Southwest Tennessee Development District 2012).

3.12 Socioeconomic Conditions and Environmental Justice

Census data available online through U.S. Census Bureau is summarized in Table 10. The most recent 10-year census data (2010) was utilized for population statistics. Intermittent estimates conducted after the formal 2010 census are available, but the base year of 2010 was used for analysis (U.S. Census Bureau 2016).

Table 10 Demographics Data for Hardin County, Tennessee

Statistic	Hardin County	State of Tennessee	National
2010 Population	26,026	6,346,105	308,745,538
Median household income*	$34,084	$44,621	$53,482
Percent Minorities, 2010 Census	8.0%	22.4%	27.6%
Percent below poverty level*	22.2%	17.8%	15.6%
Unemployment rate**	4.8	4.1%	4.7%

*2014 American Community Survey 5-Year Estimates
**May 2016 Tennessee Department of Labor and Workforce Development.

Hardin County's median household income is $34,084, or 23.7 percent lower than the state's median income of $44,621 and 36.3 percent lower that nation median income of $53,482. Hardin County also experiences a lower percentage of minorities and higher poverty and unemployment rates as compared to state and national rates.

3.13 Cultural Resources

Cultural resources include prehistoric and historic archaeological sites, districts, buildings, structures, and objects, as well as locations of important historic events that lack material evidence of those events. Cultural resources that are listed, or considered eligible for listing, on the National Register of Historic Places (NRHP) are called historic properties. Cultural resources become historic properties when they possess both integrity and significance. A historic property's integrity is based on its location, design, setting, materials, workmanship, feeling, and association. The significance is established when historic properties meet at least one of the following criteria: (a) are associated with important historical events or are associated with the lives of significant historic persons; (b) embody distinctive characteristics of a type, period, or method of construction; (c) represent the work of a master or have high artistic value; or (d) have yielded or may yield information important in history or prehistory. The Pickwick Landing Dam is classified as an NRHP-eligible architectural resource.

Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consider the effects of their proposed undertakings on historic properties and provide the Advisory Council on Historic Preservation an opportunity to comment on those effects. TVA determined that the Proposed Action Alternative is an "undertaking" as defined by the regulations under NHPA. Once an action is determined to be an undertaking, the regulations require agencies to consider whether the proposed activity has the potential to impact historic properties. If the undertaking is such an activity, then the agency must follow the following steps: (1) involve the appropriate consulting parties; (2) define the area of

potential effects (APE); (3) identify historic properties in the APE; (4) evaluate possible effects of the undertaking on historic properties in the APE; and (5) resolve adverse effects (36 CFR § 800.4 through 800.13). An APE is defined as the “geographic area or areas within which the undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.” (36 CFR § 800.16.)

Section 106 of the NHPA also requires federal agencies to consult with the respective State Historic Preservation Officer when proposed federal actions could affect historic and cultural resources, including archaeological resources, which are also protected under the Archaeological Resources Protection Act, and the Native American Graves Protection and Repatriation Act, in addition to the NHPA.

With regards to cultural resources, the APE is taken as the affected environment for purposes of this EA. APE is defined at 36 CFR § 800.16(d) (a section of the federal regulations implementing Section 106 of the National Historic Preservation Act) as “the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist.” TVA defines the archaeological APE for the Proposed Action Alternative as the area in which the undertaking would result in ground-disturbing activities. TVA defined the architectural APE as to be the direct line of sight from the project area.

The Tennessee Valley region has been an area of human occupation for the last 12,000 years. This includes five broad cultural periods: Paleo-Indian (11,000-8,000 BC), Archaic (8000-1600 BC), Woodland (1600 BC-AD 1000), Mississippian (AD 1000-1700), and Historic (AD 1700-present). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on flood plains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. In the early historic period, this location was largely populated by members of the Cherokee and Chickasaw tribes. The influx of European settlers into the region forced cession of Cherokee and Chickasaw lands in the Treaty of 1816. Hardin County was founded in November 1819.

Hardin County was mostly rural and commerce was centered on agricultural or mills along the county’s many waterways. During the Civil War, allegiances were divided and the county saw several battles and skirmishes, including the 1862 Battle of Shiloh. Construction of the Pickwick Landing Dam by TVA began in in March 1935 and was completed in 1938. Labor was drawn from a pool of skilled workers from central and western Tennessee, Alabama, and Mississippi. To house these workers, an employee camp was constructed approximately 0.1 mile south of the 1935 construction site and TVA’s proposed project area. The camp was racially segregated and with separate areas referred to as the “White Village” and the “Negro Village”. The White Village was comprised of 15 permanent and 85 temporary houses, 4 men’s dormitories, a cafeteria, hospital, community building, general store, school, and office buildings. The Negro Village included 25 temporary houses, a dormitory, a community building/cafeteria, and a school. Within the Pickwick Landing Dam Reservation, the Civilian Conservation Corps (CCC) constructed a public park with associated facilities.

Archaeological Resources

TVA Cultural Compliance staff conducted a desktop study of available documents pertaining to the APE’s potential to contain archaeological sites or aboveground resources. This desktop study included TVA’s engineering reports on the construction of Pickwick

Landing Dam, historic photographs, and historic aerial photography. The topography of the APE has been heavily disturbed and terraformed during construction of the embankment. Two archaeological field surveys were conducted by TVA archaeologists and the University of Alabama Office of Archaeological Research in those locations that had inadequate documentation regarding prior disturbance. Both surveys concluded that these areas have also been heavily disturbed and no archaeological resources were identified.

Historic Structures

One previously recorded architectural resource, the NRHP-eligible Pickwick Landing Dam, is located within the architectural APE. TVA is currently in the process of listing the dam to the NRHP.

3.14 Noise Levels

Noise is unwanted or unwelcome sound usually caused by human activity and added to the natural acoustic setting of a locale. It is further defined as sound that disrupts normal activities and diminishes the quality of the environment. Community response to noise is dependent on the intensity of the sound source, its duration, the proximity of noise-sensitive land uses and the time of day the noise occurs (i.e., higher sensitivities would be expected during the quieter overnight periods). Noise sources relevant to the activities proposed by TVA include noise from construction activities and from transportation. Transportation noise primarily includes noise from highway traffic or from vessels supporting project activities.

No private residents occupy the Study Area or areas immediately adjacent to the area. To the west of the Study Area, the area is bordered by additional TVA dam reservation lands; to the south are the State Park golf course and an office property; and to the north are the dam, navigation locks, and river.

To the southeast is the Pickwick Land State Park; the State Park's hotel, conference center and restaurant is approximately 1,000 feet from the southern most portion of the Study Area. Ambient noise surrounding Pickwick Reservoir consists mainly of mild industrial (i.e., hydroelectric power operations, including sluice release and activities in the immediate vicinity of the dam), moderate vehicle use on the local road network, personal watercraft use associated with powered boats, rural and community noises (i.e., children playing, outdoor lawn equipment), and natural sounds (e.g. wind, wildlife, and similar sounds). Overall, the area surrounding the Study Area is primary forested and undeveloped land with recreational facilities.

Generally, noise levels in these types of areas range from 45 to 55 dBA, which are levels below U.S. Environmental Protection Agency (EPA 1974) recommendations for outdoor residential areas. Similarly, the U.S. Department of Housing and Urban Development considers 65 dBa or less to be compatible with residential areas (24 CFR 51.103). According to EPA, typical background day/night noise levels for rural areas range between 35 and 50 dBA whereas higher-density residential and urban areas background noise levels range from 43 dBA to 72 dBA (EPA 1974). Background noise levels greater than 65 dBA can interfere with normal conversation, watching television, using a telephone, listening to the radio and sleeping.

CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES

The anticipated potential effects of implementing the No Action Alternative and the Action Alternative are described below for each resource area. Under the No Action Alternative, TVA would take no action to improve the condition of the south embankment. TVA would continue to operate the dam and reservoir under normal operations. The risk of a dam breach and reservoir loss during or following a large seismic event would remain. The No Action Alternative is analyzed in the EA to establish a baseline for analyzing the environmental impacts of Proposed Action Alternative in accordance with NEPA regulations.

4.1 Physical Environment

4.1.1 Geology and Soils

4.1.1.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct impacts to geology or soils would occur. Without the seismic upgrades, however, the potential for a certain seismic event to cause a breach in the dam exists. A breach of the dam could severely impacts downstream soils and geologic resources.

4.1.1.2 Action Alternative

Under the Action Alternative, TVA would make seismic upgrades to the south embankment of the Pickwick Landing Dam. This would result in a direct impact on soil resources within the project footprint. Approximately 22 acres of land would be disturbed as clearing and grubbing of the forest occurs prior to placement of the rip rap fill to create the berm on the west side of the south embankment. In order to mitigate impacts due to the soil disturbance, TVA would employ appropriate sediment and erosion control devices, as required by TDEC, during the construction operation to limit soil loss, erosion, and the possibility of sedimentation or turbidity to receiving streams. To prevent future erosion, disturbed soils would also be stabilized with seed mixes appropriate for the existing conditions after construction is completed.

Minimal impacts to soil resources to the east side of the Pickwick Landing Dam would occur as a result of the seismic upgrades, as this portion is under water. The soils in this area have been previously disturbed from construction of the existing dam. Fill would be placed along the existing dam and proposed berms. No dredging activities would be required and minimal sedimentation is expected to result from the placement of the rip rap fill.

No impacts on geologic resources are anticipated because these resources would be covered but not made permanently unavailable.

4.1.2 Floodplains

As a federal agency, TVA is subject 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" (United States Water Resources Council 1978). 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. The EO requires that agencies avoid the 100-year floodplain unless there is no practicable alternative.

4.1.2.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct impacts would occur to floodplains. Without the seismic upgrades, however, the potential for a certain seismic event to cause a breach in the dam exists. A breach of the dam could create a public safety concern should the dam fail and downstream flooding occur.

4.1.2.2 Action Alternative

Under the Action Alternative, TVA would construct the proposed seismic upgrades at Pickwick Landing Dam, along the earthen embankment on both the upstream and downstream sides, as well as in a downstream laydown area. The upstream and downstream impact areas, including the laydown area, would be located within the 100-year floodplain of the Tennessee River.

The proposed project involves placing fill for berms; temporary relocation of topsoil and riprap; tree and stump removal; replacement of toe drain pipes; establishment and use of a laydown area (including placing gravel); and installation of instrumentation support structures. The tree and stump removal, instrumentation support structures, replacement of toe drain pipes, and the establishment and use of the laydown area, would be located within the 100-year floodplain.

Consistent with EO 11988, tree and stump removal would be considered a repetitive action in the floodplain that should result in minor impacts. Because the replaced toe drain pipes would be located underground, within the proposed downstream berm, the toe drain pipes would be considered a repetitive action in the floodplain, which would be consistent with EO 11988. The instrumentation support structures would have a negligible impact on 100-year flood elevations at this location. The topsoil and riprap temporarily removed during construction would be regraded into the embankment. These activities would not create an obstruction within the floodway of the Tennessee River, which would be consistent with EO 11988.

Up to 260 acre-feet of fill would be placed in the 100-year floodplain upstream of Pickwick Dam, and 263 acre-feet of fill would be placed in the 100-year floodplain downstream of Pickwick Dam to construct the berms necessary to protect Pickwick Dam during a certain type of earthquake. The proposed project would result in about 71 acre-feet of displaced flood control storage and about 53 acre-feet of displaced power storage within Pickwick Reservoir. The proposed project would result in about 240 acre-feet of displaced flood control storage and no displaced power storage within Kentucky Reservoir. Because Pickwick Dam is located in the floodplain, there is no practicable alternative to locating the fill within the floodplain. TVA evaluated several alternatives for improving the seismic stability of Pickwick Dam, and the Proposed Action Alternative would provide an acceptable level of seismic protection while assuring project success and minimizing overall environmental impacts and project costs. Therefore, the amount of fill for the berms has been minimized while achieving the project objective, which would be consistent with the TVA Flood Control Storage Loss Guideline.

Hardin County, Tennessee, participates in the National Flood Insurance Program (NFIP), and any development must be consistent with these regulations. The floodway adopted by Hardin County is that portion of the Tennessee River channel and floodplain that must

remain open and unobstructed to allow passage of floodwaters in order to prevent increases in upstream flood elevations.

A portion of the fill for the berms would be located within the published floodway on the Tennessee River. TVA would not place fill or other flow obstructions in the floodway portion of the floodplain unless compensatory adjustments are also included. Compensatory adjustments are modifications of the floodplain at the same river mile as the proposed obstruction that would prevent increases in upstream flood elevations. Upon completion of the final, detailed design of the seismic upgrade project, TVA would perform hydraulic modeling of the proposed project using the current hydraulic model in the Hardin County Flood Insurance Study of the Tennessee River. Should the proposed project result in increases in modeled flood elevations, material would be modeled as being removed from the floodplain until the model no longer shows any increase in flood elevations. This material would then be removed from the floodplain itself. The hydraulic model containing the proposed project, with compensatory removal of material in the floodplain to result in no increase in flood elevations, would serve as documentation that compensatory adjustments have been made, and therefore the project would be consistent with the NFIP and EO 11988.

Upon completion of the seismic upgrade project, the laydown area would be returned to pre-construction conditions, which would not create a permanent obstruction within the floodway. Other locations for the laydown area were considered; however, the sites were either smaller than would be needed, were too distant from the project site, or were on land not owned by TVA. Therefore, there is no practicable alternative to locating the laydown area within the floodplain. To minimize adverse impacts on property, TVA would develop an evacuation plan prior to mobilization to relocate flood-damageable, loose, or valuable equipment out of the floodplain during a flood.

To minimize adverse impacts on the floodplain, the final design of the seismic upgrade project would be modeled in the current Hardin County Flood Insurance Study hydraulic model and this analysis attached to the administrative record. If needed, compensatory adjustments would be included in the cross section of the river where the project would take place, to prevent any increase in modeled upstream flood elevations. If compensatory adjustments are insufficient to prevent an increase in modeled upstream flood elevations, consultation with Hardin County floodplain officials would determine the next steps in order to comply with the NFIP.

Based upon implementation of the mitigation measures listed in Section 2.5 and discussed above, the proposed project would have no significant impact on floodplains.

4.2 Water Resources

4.2.1 Groundwater

4.2.1.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to groundwater would occur.

4.2.1.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. There are minimal impacts anticipated to groundwater resources

from implementation of the Proposed Action Alternative. The Proposed Action Alternative not impact groundwater quantity as there would be no groundwater withdrawal.

The Proposed Action Alternative is anticipated to have little to no impact on water quality as there should be no injection of chemicals or hazardous materials from construction activities. Any hazardous materials (such as fuels and lubricants) stored onsite during construction would be stored appropriately in secondary containment, and site personnel would be trained in both spill prevention and response. Because of the small amounts of materials and implementation of BMPs, it is unlikely that the quality of groundwater would be affected by a spill of hazardous materials during construction.

4.2.2 Water Supply

4.2.2.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to water supply would occur. Without the seismic upgrades, however, the potential for a seismic event to cause a breach in the dam exists, which could result in a loss of the reservoir. Negative impacts could occur as the reservoir is an important source for local water supply.

4.2.2.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam; however, this would have minimal impacts to existing water supplies. The construction of the upgrades should have no impacts on the amount of water available for the water supplies and the two existing water supply intakes near the project area would receive minimal if any impacts. The likelihood of an increase in turbidity reaching the intakes from placement of fill on the eastern side of the dam is minimal. Should turbidity become a problem, TVA would implement mitigation measures such as turbidity curtains to minimize risks to the intakes. Also, the project does not include dredging of materials or other activities that would decrease water quality entering the intakes.

The water intake line for the Packaging Corporation of America occurs within a small area at the southern portion of the Study Area. This location is currently being evaluated as an optional access road and haul route to transport materials to the eastern impact area of the dam. Impacts to the water intake line are not anticipated; however, if TVA determines that it may be affected (e.g., by heavy traffic over the buried line), minor improvements and/or changes would be made to the access road to ensure this line is not adversely affected.

4.2.3 Wetlands

4.2.3.1 No Action Alternative

Under the No Action Alternative, the proposed would not be implemented and no direct or indirect impacts to wetlands would occur. Without the seismic upgrades the potential for a seismic event to cause a breach in the dam exists which could result in impacts to downstream wetlands. Impacts to or loss of vegetation, soils, or hydrology are all possible if a breach in the dam occurred.

4.2.3.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. This would result in impacts to wetlands within the Study Area.

Due to the location of the wetlands and the necessary placement of the proposed fill for the seismic upgrades, there is no practicable alternative that would avoid impacts to wetlands. Approximately 1.8 acres of forested wetlands and 0.7 acre of emergent/scrub shrub wetlands are located within the proposed impact area. Of the 1.8 acres of forested impact, 0.6 acre is within the high-quality wetlands described in Section 3.4.1. In compliance with the Clean Water Act, TVA would obtain a permit to disturbing these areas and would mitigate the impacts to these 2.5 acres of wetlands through compensatory mitigation payments, as determined by the U.S. Army Corps of Engineers during the permitting process.

Direct impacts to wetlands and streams would be regulated under a Clean Water Act Section 404 permit issued by USACE and a Section 401 Aquatic Resource Alternative Permit issued by TDEC. It is not anticipated that the proposed fill would have drainage impacts to the hydrology of the wetlands that would remain following construction. TVA staff would monitor hydrology to ensure that this is the case and would coordinate with the USACE should unforeseen drainage impacts occur.

4.2.4 Surface Water

4.2.4.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to surface water would occur. Without the seismic upgrades, the potential for a seismic event to cause a breach in the dam exists. A breach of the dam would change the water course at this location and alter the existing surface water pool behind the dam. Downstream impacts would also occur though initial flooding followed by long term changes in surface water flow as the dam would no longer be controlling the releases. The surface waters within the Study Area flowing to Robinson Creek are also likely to be impacted as these water courses originate from the toe drain of the dam and that may be altered if there is a breach.

4.2.4.2 Action Alternative

Under the Action Alternative, TVA would implement proposed seismic upgrades at Pickwick Landing Dam, resulting in impacts to surface waters within the Study Area. Approximately 370 linear feet of perennial stream would be directly impacted by placement of the berm/fill area on the downstream/west side of the dam. As noted in Section 3.2.5 above, the source of these perennial streams is the dam's toe drainage system. Under the proposal, the toe drain pipes would be replaced prior to construction and fill in the area, and new manholes passing through the berm would be constructed. At one location along the downstream side of the embankment, because the existing drainage swale that collects flow would be filled as part of the fill area, TVA would replace the swale with a buried pipe extending past the fill area. In total, approximately 370 linear feet of perennial streams in the Study Area would be encapsulated by the new toe drain system prior to being covered by the berm or fill.

On the upstream side of the dam, approximately 18.5 acres of fill material would be placed in the surface waters of the Pickwick Reservoir. The lake surface would be minimally impacted by the placement of the fill as it would be less than 1% of the total surface area of the lake. The placement of fill into surface waters typically results in increased turbidity. Though these impacts would be temporary and localized, TVA would place floating silt barriers/turbidity curtains in reservoir waters adjacent to the construction area to contain and filter sediment, thereby reducing the surface water areas affected by construction

activities. TVA would also monitor waters adjacent to the project area to ensure that turbidity is not being significantly increased by project activities. TVA or contract personnel would conduct regular sampling of adjacent waters and continual visual inspections of waters to monitor for turbidity. Additional measures would be considered if necessary to control turbidity, including the use of flocculants (after coordination and approval from TDEC).

Direct impacts to the impacted streams would be regulated under a USACE Clean Water Act Section 404 permit. TVA would mitigate these impacts by purchasing credits from the Tennessee In-Lieu Fee Stream Mitigation Program, in amounts determined appropriate through the permitting process. It is not anticipated that the proposed placement of fill would alter or create drainage impacts to the streams following construction. TVA staff would monitor the streams' hydrology to ensure impacts do not occur and would coordinate with the USACE should unforeseen drainage impacts occur.

Sediment loading increases would be minor and would occur only during initial construction activities while sediment and surface water BMP systems are installed pursuant to the NPDES permit. This change in sediment contribution would be insignificant and would be substantially reduced by sediment control methods. No other impacts to water quality for waters of the U.S. are anticipated.

4.3 Aquatic Ecology

4.3.1.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no impacts to aquatic ecology would occur; however, a seismic event resulting in a breach of the dam could alter the existing water courses and impact aquatic ecology. Impacts to aquatic ecology would occur during initial flooding followed by long term changes in surface water flow as the dam would no longer be controlling the releases in the river. Changes in the flow of the streams originating from the toe drain and flowing to Robinson Creek are also possible resulting in impacts to the aquatic ecology of those resources; however, the stream reaches exhibit poor instream habitat for aquatic fauna as documented in Section 3.2.5; therefore, impacts to aquatic ecology is expected to be minimal.

4.3.1.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Aquatic life could be temporarily affected by the alteration of habitat conditions within streams and changes to riparian conditions due to clearing and placement of fill for the proposed berms. The clearing and grubbing of the site prior to placement of the fill could result in increased erosion and siltation, loss of in-stream habitat, and increased stream temperatures. Siltation has a detrimental effect on many aquatic animals. Turbidity caused by suspended sediment can negatively impact spawning and feeding success of many fish species (Sutherland et al. 2002).

As noted above, approximately 370 linear feet of stream habitat loss is anticipated related to project construction on the downstream or west side of the dam; however, these stream reaches were noted in Section 3.2.5 as exhibiting poor instream habitat for aquatic species. Stream impacts due to project construction would be regulated by the USACE 404 permit. The impacts to aquatic habitat related to sediment loss and siltation would be minimized through sediment and erosion control BMPs. Impacts to aquatic ecology on the east side or

the pool side of the dam are anticipated, as turbidity and sedimentation are likely due to placement of fill in this location. As noted for minimization of the downstream impacts, BMPs (i.e. turbidity curtains) would be utilized to help contain turbidity within the pool area. Aquatic fauna in the area of the forebay would be impacted as placement of fill on the bottom of the reservoir would destroy habitat for benthic macroinvertebrates. Fish found within the forebay area are likely to move once construction activities begin.

4.4 Terrestrial Ecology

4.4.1 Terrestrial Vegetation

4.4.1.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no impacts to vegetative communities would occur; however, a seismic event resulting in a breach of the dam could result in a loss of vegetation as initial flooding occurs and changes to vegetative composition as the site conditions would be altered from the existing conditions.

4.4.1.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Dam. Disturbance of existing plant communities would occur in areas where the fill for the berms would be placed. Approximately 35 acres of vegetative communities would be impacted; however, minimal impacts to upland vegetation are anticipated because no uncommon terrestrial upland plant communities are known to occur on the lands to be disturbed. A small area of high-quality forested wetlands would be impacted by the project. This forested wetland is part of the wetlands described in Section 4.2.3 and will be addressed for during the USACE Clean Water Act Section 404 permitting process.

4.4.2 Invasive Species

4.4.2.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to invasive species would occur. Without the seismic upgrades, the potential for a seismic event to cause a breach in the dam exists. A breach of the dam would alter the existing conditions which could lead to potential changes in vegetative communities and provide opportunities for invasive species to colonize those areas.

4.4.2.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Many invasive species are opportunistic and may utilize the vegetative clearing associated with and adjacent to the area of proposed berms/fill areas. The construction activities and soil disturbances could potentially enable the introduction of invasive species or could facilitate the movement of regulated noxious weeds listed for Hardin County. To comply with EO 13112 (Invasive Species), disturbed areas would be revegetated with native or non-native, non-invasive plant species to avoid the introduction or spread of invasive species.

4.4.3 Terrestrial Wildlife

4.4.3.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no impacts to wildlife resources would occur. Without the seismic upgrades, the potential for a seismic event to cause a breach in the dam exists. A breach of the dam would result in initial flooding and potential species mortality followed by changes in the existing terrestrial communities which may impact wildlife species.

4.4.3.2 Action Alternative

The proposed action would permanently remove approximately 22.5 acres of forested wildlife habitat and result in the displacement of any wildlife (primarily common native or naturalized species) currently using the area. Direct mortality to some individuals would occur if those individuals are immobile during the vegetation clearing phase. Individuals would also be impacted if vegetation clearing occurred during their breeding/nesting seasons.

Habitat loss would likely disperse mobile wildlife into surrounding areas in an attempt to find new food and shelter and to reestablish territories, potentially resulting in added stress or energy use. In the event that the surrounding areas are already overpopulated, further stress to wildlife populations could occur to those individuals presently utilizing these areas as well as those attempting to relocate. Habitat fragmentation may impact wildlife that utilizes forest interiors more so than those that use forest edges. However, considering the amount of habitat of similar or higher quality in the immediate surrounding area that would not be impacted by proposed actions, it is likely that individuals would be able to relocate successfully. No known caves (potential bat habitat) or colonial wading bird colonies are known from the Study Area and would not be impacted under this alternative. Therefore, the proposed project would have minor impact on populations of common wildlife species.

Cumulative effects of the project on common wildlife species are expected to be negligible. The portions of the forested habitat to be impacted is not as high of quality for wildlife as the habitat immediately adjacent to the action area (larger mature trees, closed canopy, high quality tupelo gum and cypress wetland) to be left undisturbed. Proposed actions would permanently remove existing impacted forested habitat for common wildlife, however higher quality habitat is available in the immediate surrounding area.

4.4.4 Migratory Birds

4.4.4.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no impacts to migratory birds would occur; however, a seismic event resulting in a breach of the dam could result in a loss of the varied habitats that migratory birds are attracted to within the Study Area.

4.4.4.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. The project lies within the general boundaries of the Mississippi Flyway, a migratory bird route that extends from the Gulf of Mexico region to central Canada following the Mississippi River. Migratory birds are attracted to a variety of habitats including flooded fields, sandbars, large lakes, higher quality wetlands, riparian areas, and closed-canopy, mature forests. In this case, the Study Area includes several of these

habitat types (lake, wetlands, riparian areas, and mature forest); however, the impacted area does not include most of the high quality habitat preferred by these migratory birds. In addition, lower quality habitat similar to that proposed for removal is abundant in the surrounding area. The highest quality sections of the tupelo gum and cypress wetland and the majority of the areas with large diameter, mature trees in upland and riparian areas would not be impacted by the proposed actions. Although disturbance due to noise and ground disturbance would occur during construction of the proposed actions, these disturbances would be temporary. High quality, suitable, nesting habitat and stopover areas within the Study Area would not be significantly impacted.

4.5 Threatened and Endangered Species

4.5.1.1 Plants

4.5.1.1.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to protected plant species would occur.

4.5.1.1.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Both the state and federal lists of protected plant species were reviewed and habitats were evaluated within the Study Area. No state- or federally listed plant species were determined to be located in the Study Area; therefore, no permanent impacts are anticipated. No threatened or endangered plant species are expected to be impacted.

4.5.1.2 Aquatic Species

4.5.1.2.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to aquatic species would occur. Without the seismic upgrades, the potential for a seismic event to cause a breach in the dam exists. A breach of the dam would result in initial flooding and potential impacts to state- and federally listed species such as the hellbender and many mussel species downstream of the dam followed by long term changes in surface water flow as the dam would no longer be controlling the stream releases.

4.5.1.2.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Both the state and federal lists of protected aquatic species were reviewed and habitats were evaluated within the Study Area. No state- or federally listed aquatic species or their habitat was determined to be located in the Study Area so no takes or permanent impacts are expected. No threatened or endangered aquatic species are anticipated to be impacted. Use of BMPs to minimize erosion, sedimentation, and turbidity would reduce impacts to state- and federally listed aquatic species occurring downstream of the Study Area.

4.5.1.3 Terrestrial Animals

4.5.1.3.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to protected terrestrial animal species would occur; however, a seismic event resulting in a breach of the dam could result in a loss of the habitats preferred by the state- and federally listed species potentially located downstream of the dam.

4.5.1.3.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Both the state and federal lists of protected terrestrial animal species were reviewed and habitats were evaluated via field surveys conducted within the Study Area. As noted in Section 3.5, potential impacts to several listed terrestrial animal species could occur during construction, including the bald eagle; Indiana, gray, and northern long-eared bats; and western pygmy rattlesnake.

- Bald eagle – TVA biologists did not observe any bald eagles or bald eagle nests within the Study Area. Due to the absence of nests in the Study Area, it is not likely that the Proposed Action Alternative would impact bald eagles.
- Indiana bat – Approximately 22.5 acres of suitable summer habitat for Indiana bat would be impacted with the Action Alternative for this species.
- Northern long-eared bat – Approximately 22.5 acres of suitable summer habitat for northern long-eared bat would be impacted with the Action Alternative for this species.
- Gray bat – Forested wetlands, streams, and the Pickwick Reservoir offer suitable foraging habitat for this species. However, no gray bat roosting habitat would be impacted by the Action Alternative.
- Western pygmy rattlesnake – TVA biologists did not observe any rattlesnakes during the site visit, but because suitable habitat is present in the Study Area, individuals may be directly and indirectly impacted by the Proposed Action. Direct effects could occur to individuals that are immobile or slow moving at the time of construction (nests or juveniles). Mobile individuals would be driven out of the project area into adjacent forested areas that are also likely suitable for this species, therefore populations of these species are not likely to be impacted by proposed actions. Cumulative effects to this species are expected to be insignificant as populations of western pygmy rattlesnake are not expected to be impacted by the Proposed Action.

TVA biologists determined that 6.0 acres of the proposed action area could present suitable summer roosting habitat for Indiana and northern long-eared bats, and an additional 16.5 acres of forested habitat could be used as suitable foraging habitat for these two bat species.

In September 2016, TVA initiated consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act regarding the potential impacts to bat species within the project area. Included in this consultation, TVA proposed to mitigate indirect impacts to Indiana bat by contributing funds to support activities to conserve and/or promote the recovery of the species. In addition, TVA proposed to limit its clearing of trees in the project area to October 15 to March 31 of any year, when Indiana

bats are unlikely to be present in the area. TVA would mitigate for impacts to the Indiana bat following compensatory mitigation guidance outlined in the USFWS Cookeville Ecological Services' Conservation Strategy for Forest-dwelling Bats in Tennessee. In addition, a tree clearing moratorium will be in effect from April 1 to October 14 of any year. No ground-disturbing activities will occur until TVA has completed consultation and fulfilled its obligations under Section 7.

4.6 Natural Areas, Parks, and Recreation

4.6.1.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to natural areas, parks, or recreation would occur. Without the seismic upgrades, the potential for a seismic event to cause a breach in the dam exists. A breach of the dam would result in initial flooding downstream, loss of the reservoir, potential impacts to the State Park visitation, and impacts to recreational activities dependent on the reservoir pool.

4.6.1.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Approximately 3.5 acres of Pickwick Landing State Park is located within the Study Area. Impacts to the State Park would be minimal as construction activities may require use of existing access routes through the Park, but will not take place within the State Park. The Rabbitsfoot Designated Critical Habitat, Kentucky Reservoir Reservation, and State Mussel Sanctuary are also located adjacent to the Study Area. Potential direct impacts to these resources are not anticipated as they are beyond the clearing and fill areas for the project. Because the North Carolina Landing Road will remain open to the public, access to the fishing area on the south (left) bank below Pickwick Dam will not be impeded and no significant impacts on recreational use of this area would be expected. Likewise, recreation areas on the north bank below the dam should not be significantly impacted by the project.

The other natural areas detailed in Section 3.6 will not be impacted by the Proposed Action as they are located 2 miles beyond the Study Area and impact area footprint. Some of the facilities at Pickwick Landing State Park including two swimming beaches, picnic areas, and the park's inn and conference center are located within 300 – 1000 feet of the project area. However, the proposed activities would not impact the use of or access to the park facilities. Because of this proximity and the multi-year duration of the proposed project, the presence of construction activities near the park (particularly those along the upstream side of the dam's embankment) may adversely affect the aesthetic quality of the visitor experience in portions of the park, especially those nearest the embankment. Construction activities on the upstream side of the dam may diminish the quality of the park's viewshed, although such impacts would be minor because the current view of the embankment and dam can be characterized as an unnatural and man-made. Temporary and minor noise from vehicles or equipment may be audible from the park, including from trucks entering the southwestern corner of the park to access the dam's embankment (along the park's Playground Loop Road).

4.7 Air Quality

4.7.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to air quality would occur.

4.7.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. This would result in temporary and localized impacts to air quality from the use of construction equipment. Minor, temporary impacts would also occur during site preparation activities when vegetation is removed and piled on site for burning. Burning would occur under proper conditions to minimize or avoid smoke affecting nearby areas; TVA would comply with all local or state requirements for burning.

Operation of vehicles and equipment could lead to increases in criteria pollutant emissions, but air quality impacts from construction activities and transportation of materials to the construction areas would be temporary and manageable through adjustment of the intensity of activity and implementation of control measures such as dust suppression. Natural factors, such as wind speed, wind direction, soil moisture and localized landforms would also influence the impacts to air quality; however, even under unusually adverse conditions (i.e., thunderstorms, tornadoes, high wind events), these emissions would cause a minor and short-term impact on air quality and would not appreciably contribute to applicable ambient air quality standards. Overall, the direct air emissions impact of the Proposed Action Alternative would not be significant to local or regional air quality.

4.8 Transportation

4.8.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct impacts to transportation would occur. However, should a seismic event occur with a subsequent breach of the dam, negative impacts to the existing transportation system along State Highway 128 would occur due to loss of road and/or instability of the roadway base.

4.8.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Approximately 2.3 miles of roads are within the Study Area and could be temporarily impacted by a minor increase in traffic volume from construction vehicles or employees commuting to and from the project area. Construction traffic may impact Playground Loop and the State Park because these roads must be traversed to access the southern portion and upstream toe of the embankment. State Highway 128 is a through route within the project area and an adjacent haul/access road may be necessary for construction. TVA has committed to having a flagger available to avoid impeding traffic on this road with hauling activities should on-road trucks be used to deliver materials. TVA's flagger would let truck and equipment operators know when they can access the highway without endangering motorists or causing a stop condition. Signage would also be placed to alert drivers that they are entering the construction area.

North Carolina Landing Road, which receives less traffic than the State Highway 128, would also be impacted by the hauling of materials and equipment to the laydown and project area on the downstream side of the dam; flaggers and signage would also be used along

this road to minimize any impacts. Any impacts to transportation from project activities would be minimized with the flagging.

In addition, delivery of some materials on the eastern side of the dam may be made through the use of barges. If this is the case, transportation impacts would decrease as a haul route adjacent to State Highway 128 may not be necessary.

4.9 Navigation

4.9.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct impacts to navigation of the Tennessee River would occur. However, should a seismic event occur with a subsequent breach of the dam, navigation along the Tennessee River would be adversely impacted. Use of the dam's navigation locks would likely be halted due to the earthen embankment's failure (potentially for an extended period of time); without use of the locks, navigation and the transportation of goods along the Tennessee River and the Tombigbee Waterway would be lost for the period. In addition, the river's current navigational channel (directly upstream and downstream of the dam) may be affected or altered over time by the change to the river's water course.

4.9.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Although the project impact area is in close proximity to the navigational lock, the project would not impede navigational traffic through the lock. Construction activities would occur outside of the area necessary for navigation and care would be taken to ensure no obstructions to vessels navigating the lock occur. Barges and construction equipment would be clearly marked and would avoid the navigational lock.

The extended fill on the upstream berm located along the embankment adjacent to the dam's lock (see Exhibit 2) has the potential to create a boating hazard because it extends into the reservoir far beyond the upstream slope and would lie just below the water surface during summer and transitional pool levels. Therefore, navigation markers, including lighting, would be placed on all sides of the extended fill to alert boaters of its presence. Additionally, TVA would submit a Notice to Navigation to the USACE, Nashville District, Navigation Branch, at least 2 weeks prior to commencing work activities.

4.10 Utilities

4.10.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to utilities would occur. However, should a seismic event occur and the dam breach resulting in a loss of the reservoir, negative impacts could occur as the reservoir is important in providing services such as hydroelectric power and water supply.

4.10.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam; however, this would have minimal impacts to existing utilities in the area. No impacts would occur to hydroelectric power generation from the Proposed Action. The two existing water supply intakes would be minimally impacted, if at all, because the intakes are approximately 150 feet away from the Study Area, making the

likelihood of an increase in turbidity reaching the intakes from placement of fill on the eastern side of the dam minimal. Also, the project does not include dredging of materials or other activities that would decrease water quality entering the intake. Should turbidity become a problem, TVA would minimize risks to the intakes with mitigation measures such as turbidity curtains.

The water supply line for the Packaging Corporation of America occurs within a small area at the southern portion of the Study Area. This location is currently being evaluated as an optional access road and haul route to transport materials to the eastern impact area of the dam. As noted in section 4.2.3.2 above, impacts to the line are not anticipated; however, if TVA determines that it may be affected (e.g., by heavy traffic over the buried line), minor improvements and/or changes would be made to the access road to ensure this line is not adversely affected. This location is currently being evaluated as an optional access road and haul route to transport materials to the eastern impact area of the dam.

4.11 Solid Waste

4.11.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct impacts to solid waste management would occur.

4.11.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam. Construction associated with the Proposed Action would generate nonhazardous solid waste. Soils, rock, concrete, and other clean fill materials would be removed and reused where possible. BMPs such as secondary containment for oils/lubricants/fuels, on-site spill containment and remediation supplies, and recurring personnel training would be implemented throughout the duration of the construction to minimize the possibility of spills and to dictate appropriate measures in the event of a spill.

Overall, adverse direct and indirect impacts on solid waste management would be minor and temporary because of the nonhazardous nature of the fill materials (i.e., rock) associated with the Proposed Action. Implementation of BMPs and employee/construction contractor training for spill avoidance and spill response/clean-up as a component of the construction work plan would further reduce adverse impacts on solid waste management associated with the Proposed Action.

4.12 Socioeconomic Conditions and Environmental Justice

4.12.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct impacts to socioeconomic conditions or environmental justice would occur. However, should a seismic event occur and the dam breach resulting in a loss of the reservoir, negative impacts could occur as the reservoir is important in providing services including flood control, hydroelectric power, water supply, and recreation, which are critical to the region’s economy. In addition, the loss of navigation of the river from a dam breach would have a severe impact on the region’s economy as well, given the importance of the Tennessee River and the Tombigbee Waterway as a transportation route of goods.

4.12.2 Action Alternative

Under the Action Alternative, TVA would move forward with the proposed seismic upgrades at Pickwick Landing Dam; however, this would have no impact to socioeconomic conditions or environmental justice. Temporary increases in employment may occur as a result of job opportunities during construction, but these are not likely to contribute significantly toward the economy of the region. It is anticipated that 50 vendor haul road trucks/drivers and up to 60 employees would be needed daily during peak construction periods. Because of the nature and location of the proposed project, there would be no potential for disproportionate health or environmental effects on minorities or low-income populations or communities.

4.13 Cultural Resources

4.13.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct impacts to cultural resources would be anticipated. However, many archaeological sites and historic structures are located in the Pickwick Landing Dam tailwaters; an increased risk of a dam breach associated with the No Action Alternative has the increased risk of impacting these resources should the dam be breached.

4.13.2 Action Alternative

Adoption of TVA's proposed action would result in ground disturbance and would have similar visual impacts to historic properties, should they be present. However, based on a combination of archaeological surveys and photo and historical documentation, the entire archaeological APE was determined to be previously disturbed and unlikely to contain intact archaeological deposits. Furthermore, no historical structures associated with the Dam villages were identified.

In addition, no visual impacts to historic properties are anticipated. Pickwick Landing Dam itself is considered eligible for listing to the NRHP. TVA conducted an assessment of the effects of the proposed seismic improvements to the dam. Based on the altered condition of the south embankment dam, coupled with the nature of the proposed modification, which would utilize earth and natural rock fill, materials used in the original construction of the south embankment dam, TVA finds that the proposed south embankment improvements would not compromise the integrity of the NRHP-eligible dam or diminish its architectural and historic significance for which it has been determined eligible for the NRHP.

In a letter dated March 7, 2016, the Tennessee SHPO concurred with TVA findings of no adverse effect to historic properties. Subsequent to this consultation, TVA identified an additional laydown area to the west of the south embankment and North Carolina Road. TVA archaeologists and the University of Alabama Office of Archaeological Research conducted an archaeological field reconnaissance at these laydown areas. No cultural resources were identified, and in a letter dated June 28, 2016, the Tennessee SHPO concurred with TVA's no effect finding for these two additional locations. Pursuant to 36 CFR § 800.3(f)(2), TVA consulted with federally recognized Indian tribes regarding historic properties within the proposed project's APE that may be of religious and cultural significance and are eligible for the NRHP. TVA received one response from the Eastern Shawnee Tribe with no objections to the project.

4.14 Noise Levels

4.14.1 No Action Alternative

Under the No Action Alternative, the proposed project would not be implemented and no direct or indirect impacts to noise levels would occur.

4.14.2 Action Alternative

Under the Action Alternative, TVA would implement the proposed seismic upgrades at Pickwick Landing Dam. Elevated noise levels would also occur during clearing and grubbing activities associated with removal of trees and vegetation on the west side of the dam. Additional noise sources would occur with construction equipment delivering fill material to the site and equipment necessary for placement of the materials. The noise levels associated with the activities would periodically increase or decrease in intensity as the construction activities vary. The noise from some construction activities and truck/equipment usage would be similar in nature to the noise currently generated from roadway traffic along State Highway 128 and/or from motorized watercraft on the reservoir. The Action Alternative would increase the duration and frequency of such noise during project activities.

As illustrated in Table 11, typical noise levels from construction equipment are expected to be 85 dBA or less at a distance of 50 feet from the construction site. Construction noise would cause temporary and short-term adverse impacts on the ambient sound environment in the vicinity of the Study Area. These noise levels would typically diminish with distance from the project site at a rate of approximately 6 dBA per each doubling of distance. Therefore, noise would be expected to attenuate to the recommended HUD noise guideline of 65 dBA at approximately 500 feet; however, the levels at this distance would be greater than the EPA guideline of 55 dBA.

Table 11 Maximum Noise Levels at 50 feet for Common Construction Equipment

Equipment Type	Maximum Noise Level at 50 feet (dBA)
Air compressor	80
Auger drill	85
Backhoe	80
Boring jack power unit	80
Compactor (ground)	80
Concrete truck	85
Crane – boom truck	85

Source: USDOT 2006

The elevations in noise levels beyond the ambient noise levels in the area of the dam would be intermittent and temporary and cease when construction is complete. TVA anticipates that the construction and activities associated with implementing the Proposed Action would occur during daylight hours (about 10 hours a day) of the 5-day work week. Activities may occur on weekend days and within nighttime hours if TVA and its contractors determine that work is necessary to meet time-critical construction activities. It is estimated that it will take approximately 4 years to complete the project construction. TVA and its contractors have discretion to establish the start, end, and duration of work days.

Although the area surrounding the Study Area is primarily forested and undeveloped land with no residential properties, there are several noise receptors including recreational facilities at Pickwick Landing State Park that would be temporarily affected by construction noise. The State Park picnic area and swim beach are approximately 300 feet and the conference center and inn are approximately 1000 feet from the southeastern edge of the Study Area. Noise levels impacting the State Park would primarily originate from activities on the west side of the dam, rather than the east/downstream side of the dam because the embankment would form a barrier of noise attenuation to the west. Noise levels would be greatest at times when activities occur in the southeastern edge of the Study Area. During this period, intermittent and temporary noise levels at the swim area may slightly exceed the HUD guidelines for a residential area (65 dBA). However, levels at the inn (at 1000 feet distance) would be below the HUD guideline of 65 dBA. While noticeable, these levels are expected to be minor given that they would be temporary, intermittent, and occur only during the daytime.

The great distance from the construction area to the nearest residences, other park facilities, and other noise receptors would reduce the minor and temporary adverse impacts on noise levels. The expanse of the reservoir, fencing, and existing land coverage would serve as a buffer to most noise receptors adjacent to the Study Area. Restricting construction activities to daylight hours further reduces the potential impacts to park visitors.

Upon completion of construction activities under the Proposed Action, noise levels associated with construction would cease and the ambient sound environment is expected to return to pre-construction levels. Therefore, the Proposed Action would not affect noise levels after construction is complete.

4.15 Cumulative Impacts

Cumulative effects are those environmental effects that, on their own, may not be significant, but when combined with similar effects over time, result in significant effects. Cumulative impacts are an important part of the environmental analysis because they allow decision makers to evaluate not only the impacts of an individual proposed project, but the overall impacts on a specific resource, ecosystem, or human community over time from several different projects. TVA is aware of one project occurring in the vicinity of the project area with the potential to contribute to cumulative impacts associated with the proposed seismic upgrade project.

The Packaging Corporation of America, located on land adjacent to the TVA reservation southwest of the project area, is proposing to expand their industrial facility by constructing a new road, parking lots, and additional buildings on the east side of the facility. Construction would require the discharge of fill material into almost 1/2 acre of wetlands and approximately 2,200 linear feet of streams that are tributaries to Robinson Creek (like the streams impacted by the proposed seismic upgrade project). These impacts would be mitigated in the same manner impacts associated with impacts of TVA’s seismic upgrade project. The Packaging Corporation of America’s project is currently being reviewed by the U.S. Army Corps of Engineers and mitigation measures will be required to address impacts to surface waters; thus, only minor cumulative impacts to surface waters would be anticipated. In addition, the Packaging Corporation of America’s project may also result in minor

increases in truck traffic on local roads during construction, although such cumulative impacts are expected to be minor.

There are no other actions proposed that would result in additional direct or cumulative impacts when combined with the Proposed Action. Therefore, TVA's seismic upgrade project is anticipated to have only minor cumulative impacts, when considering the foreseeable action proposed in the project's vicinity. The previous sections of this EA detail the direct impacts of the Proposed Action and are summarized in Table 2.

4.16 Unavoidable Adverse Environmental Impacts

Unavoidable impacts constitute a substantial adverse change to existing environmental conditions that cannot be fully mitigated by implementing mitigation measures. TVA has committed to implementing BMPs to minimize or eliminate potential impacts from constructing the Proposed Project. If additional impacts are identified through other federal, state, or county permitting processes, TVA would develop appropriate mitigation measures in consultation with the requesting agency (i.e., USFWS and USACE).

Some biological resources, including some wetland areas, vegetation, and potential bat habitat, would be lost due to the construction of the proposed seismic upgrade project. Construction of the project would result in the permanent loss of a relatively small amount of native vegetation, wetlands, and wildlife habitat. As noted in the previous sections which discuss these resources, mitigation will be provided for impacts to wetlands and streams downstream of the dam and for habitat loss for federally protected bat species.

4.17 Relationship of Short-Term Uses and Long-Term Productivity

The proposed project would permanently impact approximately 46 acres with the proposed fill areas and berms. An additional 9.5 acres of forest on the west side of the embankment adjacent to the berms and extended fill would be cleared for construction. There would be short-term impacts from the temporary use of the laydown area for material/equipment storage.

Surface disturbance would produce short-term disruption of the ecosystem and soils. Ecological productivity would be reduced temporarily during construction activities, but such impacts would not continue in the long term. There would be some short-term alteration of surface-water drainage patterns, but natural drainage patterns would be restored following construction. Some temporary mobile-source emissions would be produced in the short term from construction activities, but there would be no long-term effects.

4.18 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources include the use or consumption of non-renewable resources as a result of a decision or implementing a proposed action. The use of fuel and electric energy to operate the equipment necessary for construction of the Proposed Action represents an irreversible use of resources.

At elevation 418, Pickwick Reservoir contains about 1,100,000 acre-feet of flood control storage. At elevation 401, the Tennessee River could store between 1,300,000 and 2,000,000 acre-feet of water in profile storage on Kentucky Reservoir. Within Pickwick Reservoir, up to 234 acre-feet of flood control storage and a much smaller amount of power

storage would be lost due to the proposed project. Within Kentucky Reservoir, on the downstream side of Pickwick Landing Dam, about 100 acre-feet of flood control storage and a much smaller amount of power storage would be lost due to the proposed project. These amounts are insignificant when compared to the amounts of flood control storage available within each reservoir.

Irretrievable resource commitments involve the use or commitment of resources for a period of time, even a long period. In the case of this project, the conversion of existing forest to the proposed berms/fill areas would represent an irretrievable resource commitment in the loss of potential timber production in a previously forested area or the loss of habitat for wildlife species including those which are or may be federally listed

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CHAPTER 5 - LIST OF PREPARERS

Table 12 summarizes the expertise and contribution made to the EA by the Project Team.

Table 12 Environmental Assessment Project Team

Name/Education	Experience	Project Role
TVA		
Bernie Auld *M.S. Civil/Environmental Engineering; B.S. Civil Engineering*	30 years in civil engineering, water resources	Dam safety and regulatory compliance
Tyler F. Baker *M.S., Ecology; B.S., Wildlife and Fisheries Science*	26 years in aquatic resources monitoring and assessment	Water quality
Nicole Berger *M.S., Engineering Management; B.S., Civil/Environmental*	14 years in river forecasting; 1 year in navigation	Navigation
Michelle Cagley *B.S. Civil Engineering*	23 years in environmental engineering compliance	Permitting and NEPA compliance
Adam J. Dattilo *M.S., Forestry; B.S., Natural Resource Conservation Management*	15 years in ecological restoration and plant ecology; 8 years in botany	Vegetation
Jerry G. Fouse *M.B.A.; B.S., Forestry and Wildlife*	41 years in natural resources, recreation planning and economic development	Recreation
Elizabeth B. Hamrick *M.S., Wildlife,* *B.S. Biology*	8 years in biological surveys and environmental reviews	Threatened and Endangered Species (terrestrial animals), ecological resources (wildlife)
Michaelyn Harle *Ph.D. Anthropology*	16 years in archaeology and cultural resource management	Archaeology and Cultural Resources
Matthew Higdon *M.S., Environmental Planning; B.A., History*	13 years in natural resources planning and NEPA compliance	NEPA compliance, document preparation
Charles Howard *M.S., Zoology; B.S., Biology*	24 years in aquatic ecology research, impact assessment, and endangered species conservation.	Aquatic Ecology
Tim L. Keeling *B.S., Computer Science*	38 years in application and database design	Heritage data viewer, data quality
Robert Marker *B.S. Recreation Resources Management*	45 years in recreation planning and management	Recreation

Name/Education	Experience	Project Role
Kim Pilarski-Hall *M.S., Geography, Minor Ecology*	20 years in wetlands assessment and delineation	Wetlands, Natural Areas
Craig Phillips *M.S. and B.S Wildlife and Fisheries Science*	7 years in stream sampling and hydrological determinations; 5 years in environmental reviews	Aquatic Ecology
Amos Smith *B.S., Geology*	32 years in solid and hazardous waste management	Solid and Hazardous Waste
Charles L. McEntyre *M.S. Environmental Engineering; B.A., Biology, Minor Chemistry*	38 years in water and wastewater engineering	Surface Water
Carrie C. Williamson, PE, CFM *M.S. and B.S., Civil Engineering*	3 years in Floodplains and Flood Risk; 3 years in river forecasting; 11 years in compliance monitoring	Floodplains and Flood Risk
HDR		
Shane Womack, PE *B.S. Civil Engineering*	23+ Years in project management and engineering services	Project management and coordination
Vickie Miller, AICP, PWS *B.S. Environmental Science, M.S. Natural Resources*	18+ years in NEPA planning and environmental services	NEPA compliance and document preparation
Eric Mularski, PWS *B.S. Biology*	15+ years in environmental services and planning	NEPA compliance and document preparation

CHAPTER 6 - ENVIRONMENTAL ASSESSMENT RECIPIENTS (AGENCIES AND ORGANIZATIONS)

6.1 Federal Agencies

- U.S. Army Corps of Engineers, Nashville District
- U.S. Army Corps of Engineers, Nashville Regulatory Branch
- U.S. Coast Guard
- U.S. Department of Agriculture, Natural Resource Conservation Service
- U.S. Fish and Wildlife Service, Cookeville, Tennessee
- U.S. National Park Service, Shiloh National Military Park

6.2 State Agencies

- Southwest Tennessee Development District
- Tennessee Department of Agriculture
- Tennessee Department of Economic and Community Development
- Tennessee Department of Environment and Conservation
  - Bureau of Parks and Conservation
  - Bureau of Environment
  - Division of Natural Areas
  - Division of Natural Heritage
  - Pickwick Landing State Park
  - State Parks
- Tennessee Department of Transportation
- Tennessee Emergency Management Agency
- Tennessee Historical Commission
- Tennessee Wildlife Resources Agency

6.3 Local Governments and Organizations

- City of Crump, Tennessee
- City of Saltillo, Tennessee
- City of Savannah, Tennessee
- Government of Hardin County, Tennessee
- Director, Hardin County Emergency Management Agency

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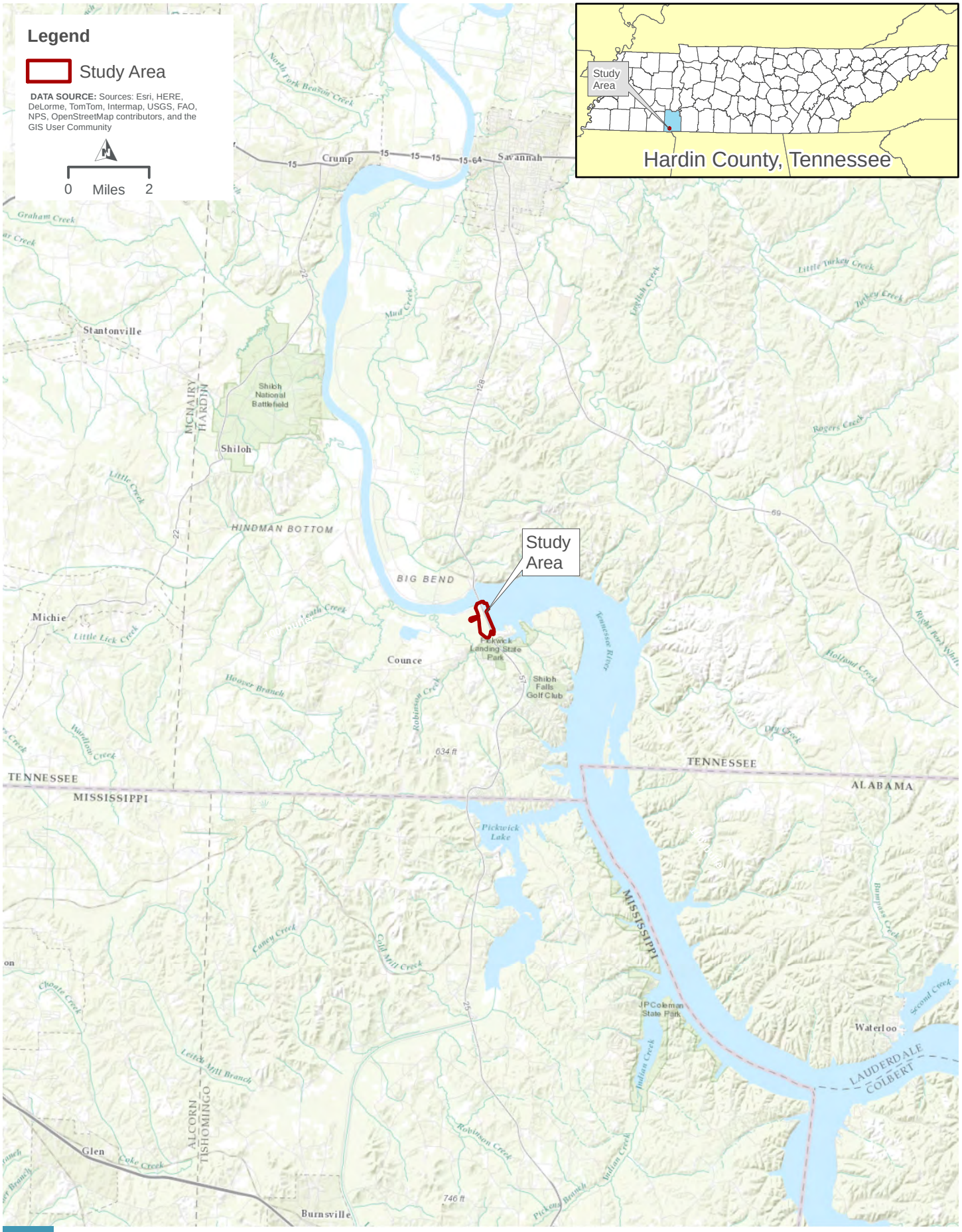
APPENDIX A

Figures



TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

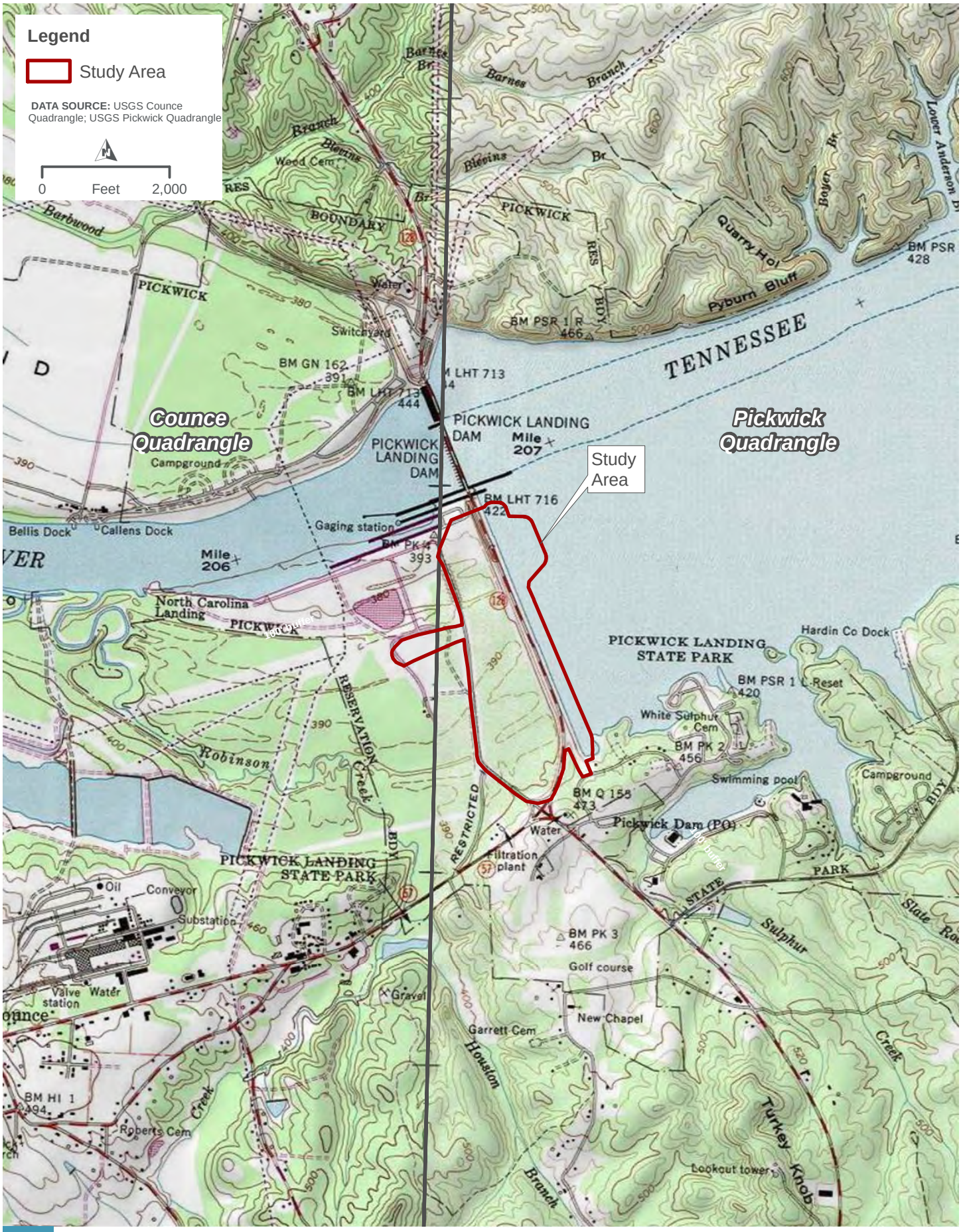
PROJECT VICINITY

FIGURE 1

TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

STUDY AREA

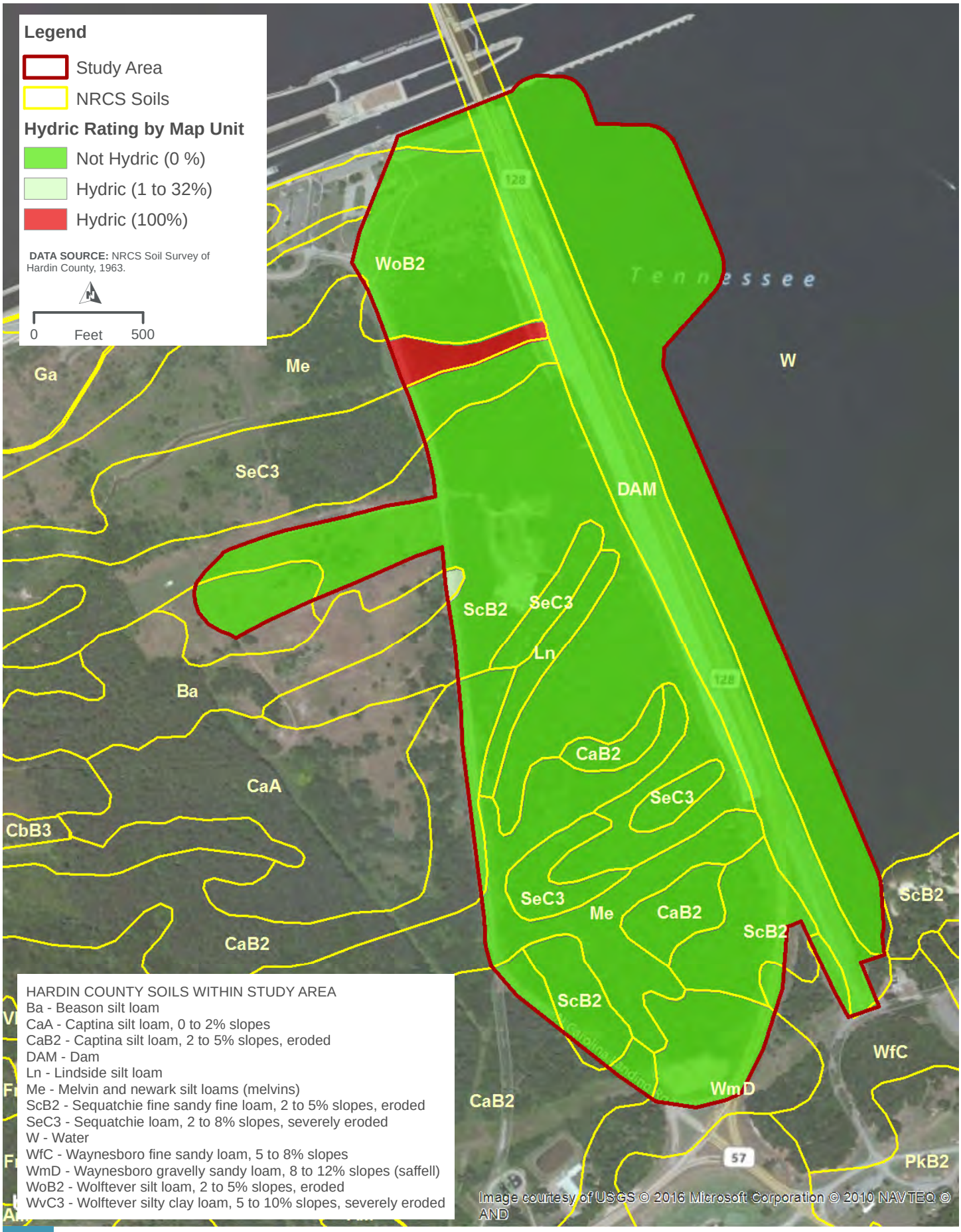
FIGURE 2



TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

USGS QUADRANGLES

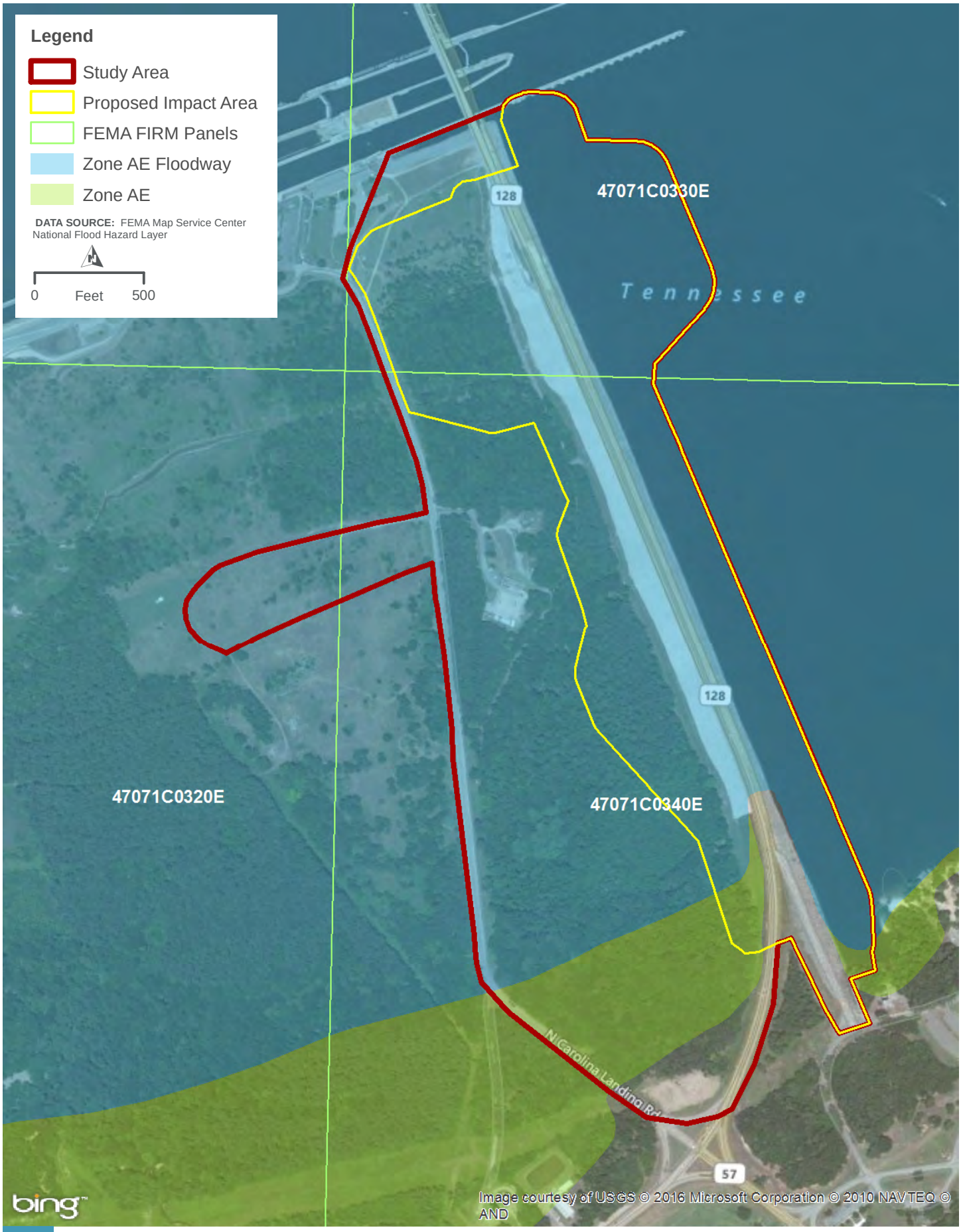
FIGURE 3



TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

NRCS SOILS SURVEY

FIGURE 4



TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

FEMA SPECIAL FLOOD HAZARD AREAS

FIGURE 5

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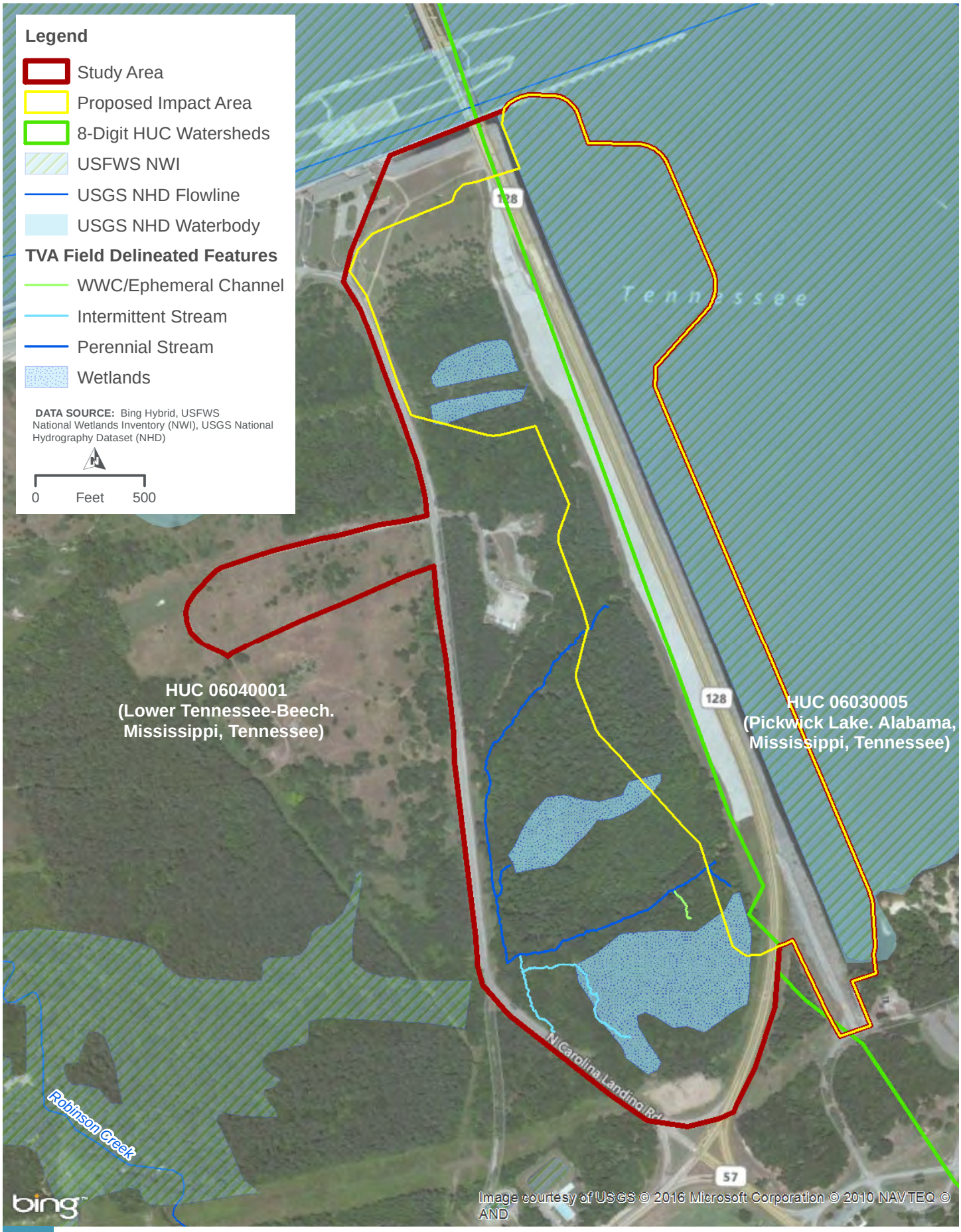


TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

SURFACE WATERS AND WETLANDS

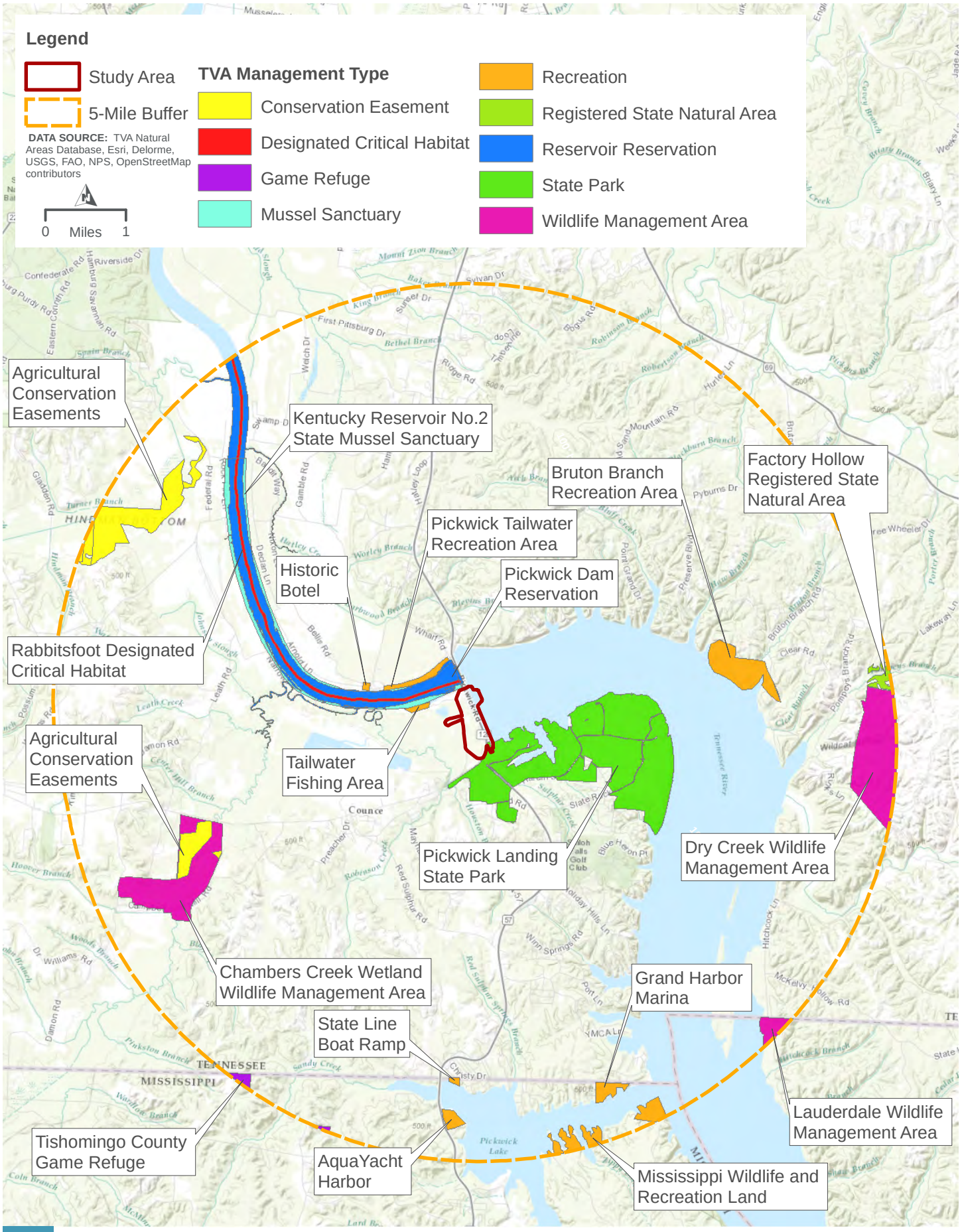
FIGURE 6

TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

IDENTIFIED BAT HABITAT

FIGURE 7

PATH: Q:\PROJECTS\TVA\280105_PKH_DAMSEISMICUPGRADE\MXD\REV\TVAPICKWICKDAMEA_IDENTIFIEDBATHABITAT.MXD - USER: EMULARSK - DATE: 7/26/2016



TVA - PICKWICK DAM SOUTH EMBANKMENT SEISMIC UPGRADE

RESERVOIR RECREATION AREAS AND TVA DESIGNATED NATURAL AREAS

FIGURE 8

PATH: Q:\PROJECTS\TVA\280105_PKH_DAMSEISMICUPGRADE\MXD\REV\TVAPICKWICKDAMEA_NATURALAREASREV.MXD - USER: EMULARSK - DATE: 7/15/2016

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APPENDIX B

Responses to Comments Received on the Draft Environmental Assessment

Appendix B - Responses to Comments Received on the Draft Environmental Assessment

Commenter	Statement	TVA Response
Jim Kerr Savannah, TN	*"Thank you for looking into the possible Earthquake problems that could arise at Pickwick Dam. I am assuming that the rock will be barged in from the up stream side if there is to be no traffic problems on the Dam itself while this construction takes place and the downstream side will be trucked in."*	As stated in the EA (section 2.1.2.4), TVA is considering three options for accessing and working along the upstream embankment side. The first option includes using barges to bring in fill material and equipment. The second option is to have an access road from the southern end of the embankment originating from either Playground Loop Road or State Highway 128, with one or more locations along the embankment where trucks could reenter the highway using flaggers for safety and to minimize impacts to traffic. The last option would be to use a combination of barges on the reservoir and truck hauling operations along State Highway 128. TVA would use trucks to transport fill materials to the downstream portion of the project area.
J. Kerr	*"If this is as big of concern as it well could be I would question why you take this project to 2021?"*	Soon after completing its study of the embankment in late 2014, TVA began planning and developing a proposal to strengthen the dam's embankment. In 2015, TVA informed the public of the potential seismic issues and installed an early warning and monitoring system to address public safety until the project is completed. TVA's proposed construction is the result of extensive study and careful consideration. Upon completion of this EA and a Finding of No Significant Impact, TVA would finalize the engineering design and begin initial site preparation work in early 2017, with construction activities starting in mid-2017 and extending to 2021. Constructing the proposed berms and extended fill areas along an earthen embankment would be a complicated and prolonged process, given the need to continuously monitor and evaluate the performance of the

Commenter	Statement	TVA Response
		embankment when weight is added to the structure. During construction, TVA would evaluate the compressive soils within the dam and layers below the footprint of the embankment to determine whether any movement the dam may incur during the construction process. These monitoring and evaluation steps extend the period of construction.
J. Kerr	*"If you are going to do a big control of draw down this could well affect the productive farm land that will be affected for such a long time below the dam."*	Under the Proposed Action, TVA would continue normal reservoir operations of Pickwick Landing Dam during construction, in accordance with its 2004 Reservoir Operations Study (i.e., lake levels and flood control would not be affected by the project).
J. Kerr	*"I am assuming that the upstream will be one phase and the downstream be the second phase."*	TVA has not yet determined precisely when and where specific construction activities would occur. It is most likely that construction activities would generally occur on both sides of the dam at the same time so we would be applying heavy loads along the embankment evenly to ensure stability.
J. Kerr	*"Will either of the berms have reinforced steel and concrete along with the rock?"*	No.
J. Kerr	*"Is there a reason the extended fill area does not match up with the dam wall and beside the lock wall?"*	TVA would place extended fill only at select locations along the embankment that were identified during the seismic study as having foundational soils vulnerable to failure due to a severe earthquake. To address the embankment's vulnerabilities, it is not necessary to expand the area of extended fill to adjoin the dam or lock walls. Minimizing the project footprint reduces the extent of potential environmental impacts, reduces the period of time required to complete the project, and eliminates unnecessary costs.
J. Kerr	*"We sure do not want to put our self in a situation like TVA experienced in the*	TVA's proposal is intended to address these safety concerns and ensure that

Commenter	Statement	TVA Response
	big ash spill. I know lake levels will have to be maintained for barge traffic as well as water levels that can keep our farm acreage above the flood stages. I know that we must protect our dam and just hope the situation never comes to where this concern appears."	the Pickwick Landing Dam continues to serve the needs of the region, including the continuation of navigation and flood control.
Packaging Corporation of America (PCA) Counce, TN	*"Section 2.1.2.2 states "TVA does not propose to alter reservoir operations at Pickwick Landing Dam during the construction period."* *As noted elsewhere in the document, PCA's water intake is located in Pickwick Lake. PCA assumes the above statement indicates that the lake level will not be changed significantly during the project (excluding normal seasonal variation). Please clarify if there will be any significant changes in lake elevation."*	Under the Proposed Action, TVA would continue normal reservoir operations of Pickwick Landing Dam during construction, in accordance with its 2004 Reservoir Operations Study (i.e., lake levels would not be affected by the project).
PCA	*"Section 2.1.2.5 indicates that TVA will construct a 7.5 acre material and storage area in the vicinity of "an old target shooting range".* *There is a gate West of North Carolina Landing Road (leading to the shooting range) that PCA uses to access PCA owned property directly West of TVA property. PCA staff have worked with TVA Security personnel to obtain permission to use the gate and the road leading past the shooting range to access PCA property. PCA requests that, when designing the storage area, TVA continue to provide a means for PCA to travel through the area when necessary."*	TVA does not propose to alter the existing road that leads to and beyond the shooting range. The laydown area would be adjacent to the road. TVA would continue to work closely with PCA to accommodate requests for accessing the area directly west of TVA property.
PCA	*"Section 3.10 references that "Two water intakes are located in the vicinity … owned by First Utility District of Hardin County and Packaging Corporation of America". Section 4.2.2.2 states that "construction … should have no impacts to the amount of water available" and that "the likelihood of an increase in turbidity … is minimal. This section goes on to state "Should turbidity become a*	During implementation of the project, TVA would implement all best practice measures in accordance with the TDEC Aquatic Resource Alteration Permit and the USACE Section 404 permit requirements. This would include but is not limited to turbidity curtains or silt barriers to increase settling times and prevent the spread of suspended particles. Should turbidity monitoring indicate TVA's

Commenter	Statement	TVA Response
	problem, TVA would implement mitigation measures …" *PCA appreciates TVA's recognition of water supply intakes in the area and the commitment that mitigation will be implemented if needed.* *A portion of the water that PCA withdraws from Pickwick Lake is treated and used for boiler make-up. Any increase in turbidity at the water intake could cause major impacts to the treatment process. PCA requests that TVA consider implementing a water quality monitoring program during construction activities so mitigation actions can take place expeditiously if needed."*	construction activity is significantly increasing turbidity above upstream levels, TVA would consider implementing additional measures, including the use of flocculants (after coordinating and approval from TDEC). TVA and/or contract personnel would conduct regular sampling of adjacent waters and continual visual turbidity monitoring. TVA project staff met with representatives of PCA on September 9, 2016, to discuss the proposed project and concerns raised by PCA in its comment letter. TVA would maintain communication with PCA regarding water quality and other issues or concerns that may arise during construction.
PCA	*"Section 4.1.2.2 indicates that up to 523 acre-feet of fill may be utilized during the project. Section 4.2.2.2 acknowledges that "the waterline for the Packaging Corporation of America occurs within a small portion of the Study Area". This Section also states "if TVA determines that the waterline may be affected (e.g., by heavy traffic over the buried waterline), minor improvements and/or changes would be made to the access road to ensure this line is not adversely affected."* *The PCA waterline originates near the Southern terminus of the Pickwick Landing Dam embankment, crosses under Highway #128, across TVA property, underneath North Carolina Landing Road and again across TVA property.* *The report indicates that the delivery of the fill material will necessitate "heavy traffic over the buried waterline". A failure of this water line would cause a total shut down of the entire PCA facility. While PCA appreciates TVA's recognition of the presence of this waterline and its commitment to insure its uninterrupted operation, we believe*	TVA is committed to avoiding impacts to the two water intakes that are within the project area, including the intake to the PCA facilities. Prior to conducting any project activities, TVA would perform side sonar scans of the PCA and Hardin County water intake lines and use the recorded information when finalizing its project design. TVA's final design would avoid impacting these intakes. The sonar scans are scheduled to occur in October 2016 and TVA will provide PCA with the survey scan of the ground surface to help PCA assess the condition of the water line.

Commenter	Statement	TVA Response
	TVA must work with PCA to investigate the condition of the water line (depth of line, type of fill material around the pipe, etc.) before beginning this project. PCA requests that TVA contact PCA before beginning any work so that our Engineering staff may participate in the investigation of the condition of the line."	
PCA	*"Section 4.10.2 summarizes statements already incorporated concerning commitments to mitigate turbidity issues and to "ensure the (water)line is not adversely affected".* *PCA appreciates TVA's recognition of these possible adverse issues and its commitment to make corrections if needed."*	Mitigation measures identified by TVA to reduce, minimize or avoid impacts from its proposal are found in Section 2.5 of the EA. This list has been updated to include TVA's commitment to minimize potential effects to the PCA water intake line. Also included in the list is TVA's commitment to implement water quality monitoring and other protection measures. These measures are also listed in TVA's Finding of No Significant Impact.
PCA	*"The safety of the Pickwick Landing Dam is certainly of vital importance to PCA. PCA encourages TVA to take appropriate action to correct any identified safety deficiencies."*	TVA acknowledges the comment and prioritizes the safety of downstream communities, industries and our employees. During construction activities, TVA would welcome input from PCA and other stakeholders on steps that may be taken to improve everyone's safety.
Alex Forsbach	*"This email is in regard to the public comment period concerning the Pickwick Dam Stabilization effort. First, TVA should be commended for the work they have completed installing an early warning system. I work below the Dam along the TN river almost daily during the spring, summer and fall months. It is good to know the Dam is constantly being monitored and in the unforeseen event of a breach the public down stream would be notified."*	The safety of downstream communities, industries, and our employees remains TVA's top priority.
A. Forsbach	*"Second, there is no mention of the effect on lake levels during the construction process. The area below Pickwick Dam is a bottleneck in the entire TVA system for water flows. Flood storage on the lake side is critical during heavy rain events. Any*	Under the Proposed Action, TVA would continue normal reservoir operations of Pickwick Landing Dam during construction, in accordance with its 2004 Reservoir Operations Study (i.e., lake levels and flood control would not be affected by the

Commenter	Statement	TVA Response
	and all extra lake capacity can be used to store water and reduce the flood crest below the dam."	project). The fill needed to strengthen the dam would be evaluated in a hydraulic model as discussed in Section 4.1.2.2. Depending on the results of the hydraulic model, TVA would follow the process outlined in Section 4.1.2.2 to minimize adverse impacts.
A. Forsbach	*"Third, the time period of 4 years to complete construction seems very long for the task at hand. Not saying the project should be rushed or corners be cut, but there is a timeliness factor at needs to be considered."*	As stated in a previous response above, the extended construction period reflects the large-scale and complex nature of the proposed project. Construction of the berms is a complex and prolonged process and how the embankment dam performs during construction would require continuous monitoring and evaluation. During construction, TVA would continually evaluate the compressive soils within the dam and layers below the footprint of the embankment to determine whether any movement the dam may incur during the construction process. These monitoring and evaluation steps extend the period of construction. Since first learning of the embankment's vulnerabilities, TVA has worked diligently to study the issue and develop the right design to strengthen the dam. A number of measures have been implemented to address public safety until the project is completed, in the unlikely event that a large earthquake occurs.
Karl and Erika Forsbach Savannah, TN	*"As a property owner below the PW Landing Dam, between Mile Marker 196 - 192, East shoreline, I would like to submit the following comments:* *Protection of our farm land: Operating our family farm below PW Landing Dam for over 30 years, the upgrade to the South Embankment is extremely important to our business. In case of a seismic disaster, we stand to loose our lives working in the fields, stand to loose millions of $ in equipment and growing crops.*	TVA's primary objective is the safety of the lives and property of the people who live along the river and our employees working on the project. We are aware of the extensive impact if the dam breached. That is why we are moving safely forward with this project. Also, TVA has installed multiple layers of seismic detection equipment along the embankment that will send a notification to TVA and the National Weather Service of any change in the embankment. If

Commenter	Statement	TVA Response
	A breach of the dam would cause a tremendous erosion problem to our fields and shoreline."	necessary, a notification for downstream residents or workers to seek higher ground will be sent via the National Weather Service.
K. and E. Forsbach	*"Flood control: PW Landing Dam is part of an integrated Flood control system of the TN river. TVA River Operation depends on a functional PW Landing Dam to manage the flow of water during heavy rain events to minimize flood elevation / duration on our fields and crops.* *My biggest concern here is the duration of the planned upgrade and the possible impact it may have on flood control."*	Under the Proposed Action, TVA would continue normal reservoir operations of Pickwick Landing Dam during construction, in accordance with its 2004 Reservoir Operations Study (i.e., lake levels and flood control would not be affected by the project).
K. and E. Forsbach	*"Navigation/Electric Power Generation: The loss of navigation and power generation by a breach of PW Landing Dam would have strong economic ripple effects to the local agricultural community, mainly due to lower commodity prices and increase in electric power rates."*	TVA is undertaking this project to avoid impacts to the lives of the community and region. TVA noted these economic impacts in sections 2.1.1 and 4.12.1 of the EA.
K. and E. Forsbach	*"In summary I would like to commend TVA for the initiative to improve the strength and safety of PW Landing Dam. I strongly support the planned project. The issue of Flood control cannot and should not be compromised during this lengthy project."*	Under the Proposed Action, TVA would continue normal reservoir operations of Pickwick Landing Dam during construction, in accordance with its 2004 Reservoir Operations Study (i.e., lake levels and flood control would not be affected by the project).
Kendra Abkowitz, Ph.D. Director of Policy and Planning Tennessee Department of Environment and Conservation	*"TDEC's Tennessee State Parks and Real Property Management and the Tennessee Geological Survey (TGS) have reviewed the Draft EA and have no specific comments regarding the proposed action or its alternatives.* *TDEC's Division of Natural Areas (DNA) has reviewed the Draft EA and the location of the proposed project with respect to rare species and critical habitat. DNA finds that there is limited suitable habitat for rare, threatened, or endangered plant species within the project area, and as such does not anticipate any impacts to rare, threatened, or endangered plant*	As noted in section 1.4 of the EA, TVA would coordinate with TDEC prior to implementing the proposed action in order to obtain the necessary approval for this project.

Commenter	Statement	TVA Response
	species. *TDEC's Office of Energy Program (OEP) has reviewed the Draft EA and commends TVA for strengthening the resiliency of Tennessee's flood control and infrastructure in the event of a large seismic event in the New Madrid Seismic Zone.* *TDEC appreciates the opportunity to comment on this Draft EA. Please note that these comments are not indicative of approval or disapproval of the proposed action or its alternatives, nor should they be interpreted as an indication regarding future permitting decisions by TDEC."*	
Mary E. Jennings Field Supervisor USFWS, Tennessee Ecological Services Office	*"The draft EA addressed potential environmental impacts, including possible effects of the proposed project on aquatic resources and federally listed species. We understand that TVA will coordinate with the U.S. Army Corps of Engineers to address wetlands and aquatic resources impacts, including best management practices to maintain downstream water quality. Further, TVA has initiated consultation with the Service to address potential effects to federally listed species in accordance with requirements of the Endangered Species Act (ESA). The consultation will include measures proposed by TVA to compensate for long-term loss of suitable Indiana bat habitat. Therefore, we consider the scope of the EA to be complete for the purpose of compliance with the National Environmental Policy Act."*	TVA's consultation with the USFWS is described in Section 1.4 of the EA. As addressed in Section 4.5 (Threatened and Endangered Species), the proposed project would impact suitable bat habitat and TVA has identified measures to mitigate these impacts (section 2.5).

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