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FINAL ENVIRONMENTAL ASSESSMENT

NICKAJACK HYDRO PLANT MODERNIZATION OF HYDROTURBINES

Marion County, Tennessee

TENNESSEE VALLEY AUTHORITY

JANUARY 2008

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

AAC	Alexander Archaeological Consultants
AL	Alabama
APE	Area of Potential Effect
ARAP	Aquatic Resources Alteration Permit
BMP(s)	Best Management Practice(s)
cfs	Cubic Foot (Feet) per Second
CFR	Code of Federal Regulations
DEA	Draft Environmental Assessment
DO	Dissolved Oxygen
EA	Environmental Assessment
EIS	Environmental Impact Statement
FEA	Final Environmental Assessment
FONSI	Finding of No Significant Impact
ft/s	Foot (Feet) per Second
GA	Georgia
HEPOMP	Hydro Environmental Project/Outage Management Plan
HMOD	Hydromodernization
HPA	Habitat Protection Area
HUC	Hydrologic Unit Code
IRP	Integrated Resource Plan
LLC	Limited Liability Corporation
MOA	Memorandum of Agreement
MSA	Metropolitan Statistical Area
MSL	Maximum Sustainable Load
MW	Megawatt
NAAQS	National Ambient Air Quality Standards
n.d.	Indicates “no date,” or date Web site accessed is unknown
NEPA	National Environmental Policy Act
NRHP	National Register of Historic Places
NJH	Nickajack Hydro Plant

NRI	Nationwide Rivers Inventory
NWI	National Wetlands Inventory
OWC	Overall Weighted Capacity
$PM_{2.5}$	Particulate Matter With an Aerodynamic Diameter of 2.5 Microns or Less
PCB	Polychlorinated Biphenyls
PSD	Prevention of Significant Deterioration
ROD	Record of Decision
ROS	Reservoir Operations Study
SEA	Supplemental Environmental Assessment
SHPO	State Historic Preservation Officer
SRM	Sequatchie River Mile
SWA	Small Wild Area
TDEC	Tennessee Department of Environment and Conservation
TN	Tennessee
TRI	Toxic Release Inventory
TRM	Tennessee River Mile
TWRA	Tennessee Wildlife Resources Agency
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
WMP	Waste Management Plan
WOA	Wildlife Observation Area

CHAPTER 1

1.0 PURPOSE OF AND NEED FOR ACTION

1.1. The Proposed Action and Need

The Tennessee Valley Authority (TVA) has undertaken the rehabilitation and modernization of the turbines at 10 of its aging hydro plants to date. Hydromodernization (HMOD) is needed at the Nickajack Hydro Plant (NJH) to ensure continued safe and reliable peak power generation and potentially to provide an additional 14 megawatts (MW) of generating capacity for the TVA power system. Capacity gains and efficiency improvements at NJH would help meet projected increased demand for peaking power on the TVA system. The increased generating capacity would help offset the need for more costly TVA generation or purchased power during periods of peak electrical power demand and improve operational efficiency, as well as increase TVA's net income from the power system. The four hydropower units at Nickajack Dam are proposed for HMOD some time between the years 2009 through 2016.

This final environmental assessment (FEA) is being prepared in accordance with the National Environmental Policy Act (NEPA) and TVA's implementing procedures. It describes the potential environmental consequences associated with hydromodernization of the turbines at NJH. In TVA's *Energy Vision 2020 - An Integrated Resource Plan and Programmatic Environmental Impact Statement* (IRP EIS), HMOD was identified as one of TVA's preferred means of adding generating capacity on its system and was included in TVA's portfolio of adopted supply- and demand-side options (TVA 1995). The effects of the HMOD program was also considered in the *TVA Reservoir Operations Study Final Environmental Impact Statement* (TVA 2004a) (ROS EIS). This FEA incorporates by reference and tiers from the IRP and ROS EISs.

1.2. Background

Nickajack Dam is located in Marion County, Tennessee, at Tennessee River Mile (TRM) 424.7, approximately 17 miles west of Chattanooga and 5 miles east of South Pittsburg, Tennessee (Figure 1-1). It was built over a period of three years, from 1964 to 1967. Nickajack Dam, with its 600-foot-long lock, improved river navigation by replacing the old Hales Bar Dam, which leaked and limited barge traffic on the river. Unembedded parts of Units 15 and 16 from the old Hales Bar Dam were removed and reinstalled at Nickajack Dam, becoming NJH Units 1 and 2. Units 3 and 4 were purchased new. Commercial electric power generation began at the four hydropower units at Nickajack Dam between February and April 1968.

Operational objectives for Nickajack Dam include flood control, navigation, hydropower production, recreation, water quality, fishery and wildlife management, water supply, and economic development. Nickajack is operated as a flow-through reservoir, i.e., it is not designed for retention of flows. Flows from the next upstream dam, Chickamauga Dam, serve as one of the main flow control points through the mid to lower Tennessee River system. Since TVA implemented the preferred alternative from the ROS EIS, June 1 through Labor Day flows at Chickamauga Dam upstream follow the guidelines shown in Table 1-1, and the releases from Nickajack Dam follow a similar pattern.

Figure 1-1. Nickajack Dam and Hydro Plant Location

Table 1-1. System Flow Requirements at Chickamauga Dam (June 1 - Labor Day)

Weekly Average Minimum Flow at Chickamauga Dam (cubic feet per second [cfs])		
If the volume of water stored in tributary reservoirs is:	**June 1 - July 31**	**August 1 - Labor Day**
Below the minimum operations guide	13,000 cfs	25,000 cfs
Above the minimum operations guide	Increases from 14,000 cfs the first week of June to 25,000 cfs the last week in July	29,000 cfs

Due to its flow-through function, water levels in Nickajack Reservoir are not subject to seasonal drawdowns. The water surface elevation in Nickajack Reservoir is maintained between elevations 632.5 and 634.5 feet above mean sea level year-round. The Nickajack tailwater portion of the Tennessee River (i.e., the upper portion of Guntersville Reservoir) extends from Nickajack Dam at TRM 424.7 to about TRM 410, where flow variations from dam discharges have been effectively damped by the Guntersville Reservoir pool. There are no specifically mandated or required minimum flows through the Nickajack Dam tailwater area. The minimum flow through the dam and tailwater area is determined by the flow needs for reservoir surface elevation control and navigation channel depth, including any water flow from power generation needs.

The releases from Nickajack Dam flow into Guntersville Reservoir. Elevation levels within Guntersville Reservoir are controlled by releases from both Nickajack and Guntersville dams. As described in the ROS EIS, water levels in Guntersville Reservoir are maintained at summer pool elevations from mid-April through Labor Day, but the elevation difference between average summer and winter pools is only about 2 feet as shown in Figure 1-2.

Nickajack hydropower units are presently operated for varying lengths of time and at varying discharge rates, in accordance with needs for the integrated operation of the river system identified in the IRP and ROS EISs. When not affected by these requirements, the generating units at NJH are typically operated to meet daily peaks in power demand. During the winter, NJH typically increases to a maximum number of units in operation for the peak power loading period each morning and again in the late afternoon. During the summer, peak power demand (and unit flow) typically occurs in the late afternoon and early evening.

When flows needing to pass through Nickajack Dam exceed the available turbine capacity, the excess water passes over the spillways (i.e., “spills”). Historically, this situation has occurred quite frequently. For the previous four years, which included three years under the flow guidelines specified by the ROS EIS, spilling at NJH occurred an average of 161 days per year. Prior to implementation of the ROS, spilling days ranged from five days in 1988 to 199 days in 1989, averaging 92 days per year from 1985 to 2005. Spilling occurs at Nickajack Dam year-round. At present, for four-unit operation, 32,000 to 46,000 cubic feet per second (cfs) of water can be passed through the NJH turbines. When flows exceed this range, spilling occurs.

The proposed upgrades would increase the total turbine capacity into the range of 38,000 cfs to 51,000 cfs.

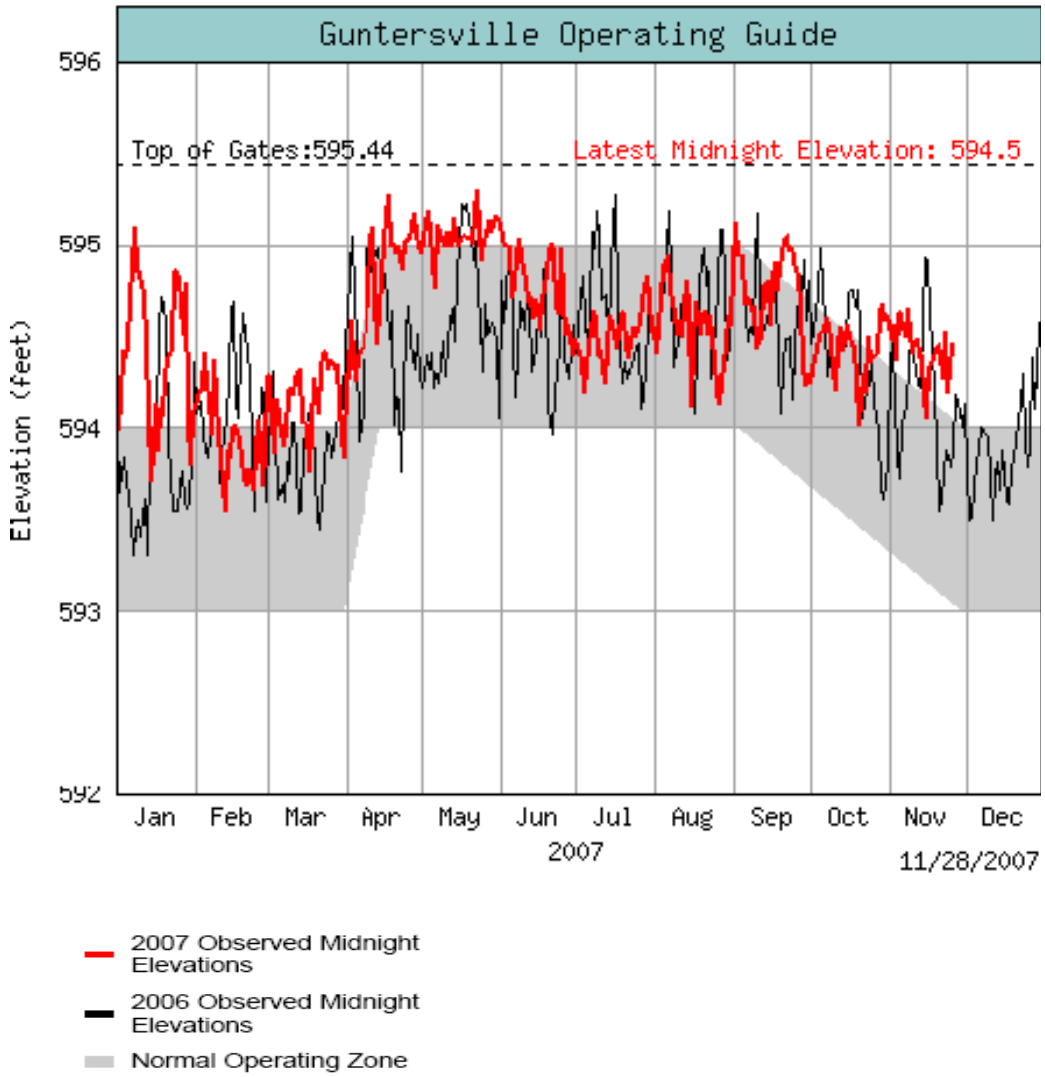

Figure 1-2. Guntersville Reservoir Water Elevation Operating Guide

Maximum daily discharge measured in the most recent major flood event was 258,900 cfs (average) on May 9, 2003. The peak hourly flow associated with the 2003 flood was 274,653 cfs at midnight May 8, 2003. Under normal flood control and power generation operations, TVA discharge volumes are managed to maintain a minimum 11-foot draft navigation channel below Nickajack Dam in the upper reach of Guntersville Reservoir.

1.3. Other Pertinent Environmental Reviews or Documentation

TVA has prepared 10 EAs and five supplemental EAs for HMOD projects at TVA dams. Table 1-2 lists similar HMOD EAs on main stem reservoirs, environmental reviews recently completed on projects in the vicinity of Nickajack Dam, and other relevant documents.

Table 1-2. Related Environmental Reviews in Past 10 Years

Type	Title	Date	Relevance for this Review
EA/FONSI	*Wilson Hydro Plant Modernization of Hydroturbines* (TVA 2005a)	January 2005	Comparable, in that Wilson Dam is also a main stem dam
SEA/FONSI	*Proposed Development of Tract XNJR-3PT (Nickajack Shores), Nickajack Reservoir, Marion County, Tennessee* (TVA 2005b)	September 2005	Description of environment 1 to 2 miles upstream of Nickajack Dam, with references to Burns Island
Programmatic EIS/ROD	*Reservoir Operations Study* (TVA 2004a)	February 2004 May 2004	Examination of TVA river operation policies to determine whether changes would produce greater overall public value
EA/FONSI	*Nickajack Marina Land Use Approval for Proposed Commercial Upland Recreation Development and Section 26a Approval for Marina Expansion at Mile 431.1-Left Bank, Tennessee River* (TVA 2004b)	January 2004	Description of environment about 6 miles upstream of Nickajack Dam
EIS/ROD	*Guntersville Reservoir Land Management Plan, Jackson and Marshall Counties, Alabama, and Marion County, Tennessee* (TVA 2001a)	August 2001	Land use plan for TVA-owned land around Guntersville Reservoir, including the tailwaters of Nickajack Dam
EA/FONSI	*Modernization of Turbines at Watts Bar Hydro Plant, Rhea County, Tennessee* (TVA 2001b)	December 2001	Comparable, in that Watts Bar Dam is also a main stem dam
EA	*Lower Sequatchie River Management Unit Plan and Environmental Assessment* (TVA 1999)	September 1999	Selection of a management strategy for the Lower Sequatchie River Management Unit
EA/FONSI	*Recreation Development Alternatives for the Little Cedar Mountain Tracts Nickajack Reservoir, Marion County, Tennessee* (TVA 1997)	January 1997	Description of environment 1 to 2 miles upstream of Nickajack Dam
Programmatic EIS/ROD	*Energy Vision 2020-Integrated Resource Management Plan* (TVA 1995)	July 1995 February 1996	Long-range strategy to enable TVA to meet the additional needs of its customers for electricity from 1996-2020

EA = Environmental Assessment
EIS = Environmental Impact Statement
FONSI = Finding of No Significant Impact
ROD = Record of Decision
SEA = Supplemental Environmental Assessment

One project with particular relevance to the Nickajack HMOD proposal is Little Cedar Mountain/Nickajack Shores (proposed development of Tract XNJR-3PT). Upon completion of that EA and finding of no significant impact (FONSI), TVA agreed under its maintain and gain policy (TVA 1999) to sell and swap TVA property above Nickajack Dam known as Little Cedar Mountain for three tracts of privately owned land including Burns Island, which is located at approximately TRM 421 about 4 miles downstream of the dam (shown on Figure 1-1). As a part of the Agreement of Purchase and Sale, dated February 28, 2006, Nickajack Shores Holdings LLC (Nickajack Shores) agreed to stabilize a portion of the shoreline of Burns Island to TVA's satisfaction by the end of May 2008 to protect cultural resources. To that end, portions of the shoreline are being armored with riprap. This FEA references the ongoing Burns Island stabilization effort

1.4. Scoping and Intergovernmental Review

TVA interdisciplinary teams met several times in 2006 and 2007 to identify and discuss resources that could potentially be impacted by the proposed HMOD of the turbines at Nickajack Dam. The following issues and resources were identified as needing evaluation: stream bank erosion, surface water quality, groundwater, aquatic life, terrestrial plants, terrestrial animals, endangered and threatened species, wetlands, managed areas and ecologically significant sites, recreation, visual resources, air quality, cultural resources, socioeconomics, environmental justice, waste generation, and potential cumulative impacts.

In addition to posting the draft environmental assessment (DEA) on the TVA Web site at **www.tva.gov/environment/reports/NickajackHMOD**, electronic and/or hard copies or e-mail notifications of availability of the DEA were sent to the following agencies:

- Tennessee Department of Environment and Conservation
- Tennessee State Historic Preservation Office
- Tennessee Wildlife Resources Agency
- United Keetoowah Band of the Cherokee Indians
- United States Army Corps of Engineers, Nashville District (USACE-Nashville)
- United States Fish and Wildlife Service, Cookeville Office (USFWS)

The review period for the DEA began on November 30, 2007, and ended January 7, 2008. Comments were received from USACE-Nashville and the USFWS. Copies of these comments are included in Appendix A. The USFWS letter suggested that the DEA be modified to ensure that habitat for the federally listed as endangered pink mucket and Anthony's river snail in the Nickajack Dam tailwater is adequately protected. After further study, TVA determined that the elevation, flow, and water quality conditions predicted by modeling results are valid. A copy of TVA's response to USFWS is included in Appendix A.

The FEA will be posted on the TVA Web site at the above Web address.

1.5. Necessary Permits or Licenses

As mentioned above in Section 1.3, portions of the banks of Burns Island are currently being stabilized through the application of riprap as a result of another unrelated TVA action. Since the proposed action is expected to result in only a small, insignificant change in erosion in the tailwaters of Nickajack Dam (Section 3.1.2), the need for the application of additional riprap on the stream banks bordering the tailwaters of Nickajack Dam is unlikely.

If operating experience indicated a need to stabilize further the riverbank by the addition of more riprap, TVA would apply the riprap under existing Aquatic Resources Alteration Permits (ARAP) from the Tennessee Department of Environment and Conservation (TDEC) or would obtain a new ARAP as necessary.

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CHAPTER 2

2.0 ALTERNATIVES INCLUDING THE PROPOSED ACTION

This chapter describes alternatives available to TVA and the consequences of implementing the alternatives.

2.1. Alternatives

Two alternatives were considered, the No Action Alternative and the Nickajack HMOD Alternative of implementing the Nickajack HMOD for Hydro Units 1-4.

2.1.1. The No Action Alternative

Under the No Action Alternative, TVA would continue to maintain and/or replace the existing generating components at NJH on an as-needed basis. Maintenance would include reworking, refurbishing, and/or replacing turbine, switchyard, and generating components (not including the actual turbines). No increase in generating capacity from the current overall weighted capacity (OWC) of approximately 100 MW would be expected. Although the overall operating efficiency of the two groups of units (Units 1-2 and Units 3-4) would not change under the No Action Alternative, maintenance activities could possibly restore plant turbine flow to 46,000 cfs. However, design maximum sustainable load (MSL) would not increase from the present 46,000 cfs with only routine maintenance. Since MSL would not be increased, no change in present environmental conditions and trends would be expected. Any rehabilitation not already assessed for the Nickajack HMOD Alternative undertaken in the future would be the subject of subsequent environmental reviews.

2.1.2. Nickajack HMOD Alternative

Under the Nickajack HMOD Alternative, TVA would hydromodernize Units 1 through 4 at NJH between the years 2009 through 2016. TVA would replace runners, stator windings, neutral grounding, generator cooling system, generator cooling water piping, main exciter, and generator protective relaying system on Units 1 and 2. Components to be rehabilitated would include rotor pole insulation, turbine/generator bearings, turbine/generator shaft, brake system, distribution ring, head cover, bottom ring, main exciter, thrust runner, and wicket gates. For Units 3 and 4, principal components to be replaced would be runners, stator windings, neutral grounding, generator cooling system, generator cooling water piping, main exciter, and generator protective relay system. Principal components to be rehabilitated would be rotor pole insulation, turbine/generator bearings, turbine/generator shaft, brake system, distribution ring, head cover, bottom ring, main exciter, thrust runner, and wicket gates.

This action would increase the OWC for Units 1 and 2 from the present 45 MW to 52 MW. The OWC rating for Units 3 and 4 would increase from the current 56 MW to 63 MW, for a total increase of 14 MW (i.e., from 101 MW to 115 MW). After HMOD, the system would run at 51,000 cfs with four units operating whenever water is being moved downstream past Nickajack. However, because total daily flows would not be increased, the turbines would run fewer hours per day than in the past. Since the system does not currently run at MSL (i.e., 46,000 cfs), the effective increase would be from typical sustainable flow of 42,000 cfs to 51,000 cfs, as shown in Figure 2-1.

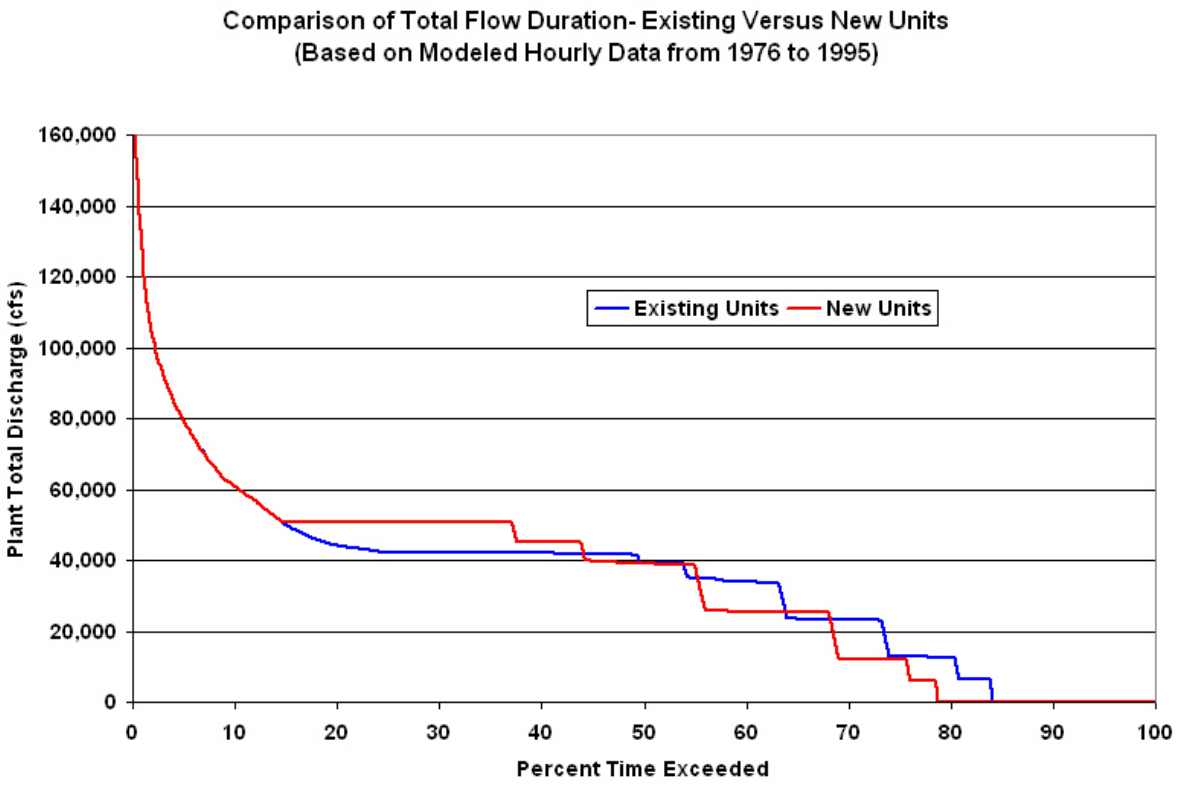

Figure 2-1. Comparison of Current Versus Post-HMOD Turbine Flows

HMOD work would be scheduled such that one to two units would be modernized each spring and fall. During each unit's outage period for HMOD, the other operational units at NJH may be run for slightly longer durations to meet operational objectives. Total flows through the turbines would remain within typical or slightly reduced ranges during the outage periods because, as discussed above, the same volume of water would still need to pass through Nickajack Dam.

Construction and Maintenance Activities and Operational Characteristics of the Units After HMOD

Essentially all replacement and/or rehabilitation activities for the No Action Alternative or the Nickajack HMOD Alternative would occur inside the plant, transformer areas, and some additional previously disturbed areas (for laydown) on the plant site. The existing overhead crane would be used to remove and replace the parts of the turbines. Mobile cranes might be brought on site during the construction period for either alternative. Existing outside laydown/storage areas at the plant site would be used to store temporarily the larger components. The maximum additional workforce present on the site to complete either alternative would be approximately 50-75 persons.

Equipment and materials would be transported to the site by truck and/or rail. Waste materials and outdated equipment would be recycled by a local or regional firm, scrapped, or, for eligible historic equipment, retained by TVA as part of the agency's historical collection. Some removed components may be used as spares at other TVA hydro plants.

Waste oil, grease, and any hazardous materials, such as asbestos and mercury, would be disposed in accordance with state and federal regulations.

Computer modeling of the increased hydroturbine flows anticipated to result from completion of the Nickajack HMOD project indicate that slight increases in tailwater elevations would be expected to result from generation after HMOD. These increases are well within current reservoir operating guidelines for Guntersville Reservoir and much less than the increases that presently occur in conjunction with the frequently occurring spill events. HMOD would not increase total flows in the tailwater, but it would change the duration and amount of flows passed through the turbine and would reduce spilling.

Due to current plant limitations, NJH typically operates at around 42,000 cfs, with four-unit operation ranging from around 40,000 cfs to 45,000 cfs. This is approximately 4,000 cfs less than the MSL flow of 46,000 cfs. **For the purpose of evaluating the maximum anticipated effects of HMOD on nonspilling days, summer pool tailwater elevations at an operating level of 40,000 cfs were compared to the tailwater elevations that would result from anticipated maximum turbine flows after HMOD (i.e., 51,000 cfs).** This approach brackets the widest potential range of environmental impacts that could be expected from HMOD.

Modeling analysis indicates that most of the higher peak-flow capacity would be provided by a decrease in time at lower flows. As shown in Figure 2-1, the time at zero flows would increase about 5 percent. The duration of flows above 51,000 cfs would not change. This analysis was performed by modeling current and proposed turbine characteristics for a 20-year period of historic river flows.

Figure 2-2 compares the tailwater elevations that would result from existing summer turbine flows of about 40,000 cfs to the proposed HMOD maximum sustainable flow of 51,000 cfs. Summer elevations are used to show the maximum possible change, since the increase in tailwater elevation is less in the winter than the summer. Starting at the dam, the Nickajack tailwater elevation is expected to exceed current tailwater elevations by about 1 foot, diminishing to less than 0.5 foot at TRM 420.5. TRM 420.5, indicated by the vertical dashed line on the graph, is located at about the midpoint on the length of Burns Island.

At 51,000 cfs, bottom velocities in the Nickajack tailwater are expected to increase slightly, about 0.2 foot per second (ft/s) at TRM 422. As illustrated in Figure 2-3, bottom velocity is a function of flows. Before HMOD, at 40,000 cfs, bottom velocity is approximately 0.6 ft/s. After HMOD, the model shows a bottom velocity of approximately 0.8 ft/s.

Based on the results of tailwater elevation modeling, the area of potential effect (APE) of the proposed HMOD has been determined to be between TRM 419.7 and 424.7, and Sequatchie River Miles (SRMs) 0.0-2.7. For compliance with Section 106 of the National Historic Preservation Act, a Phase 1 Archaeological Survey would need to be completed at the elevations on the shorelines of the Tennessee and Sequatchie rivers within the APE. Since the Phase 1 Archaeological Survey cannot be completed at summer pool elevations, TVA Cultural Heritage staff recommends a phased approach for Section 106 compliance. A memorandum of agreement (MOA) has been executed between TVA and the Tennessee State Historic Preservation Officer (SHPO) and is awaiting the signature of the United Keetoowah Band of the Cherokee Indians as a consulting party. Archaeological fieldwork is

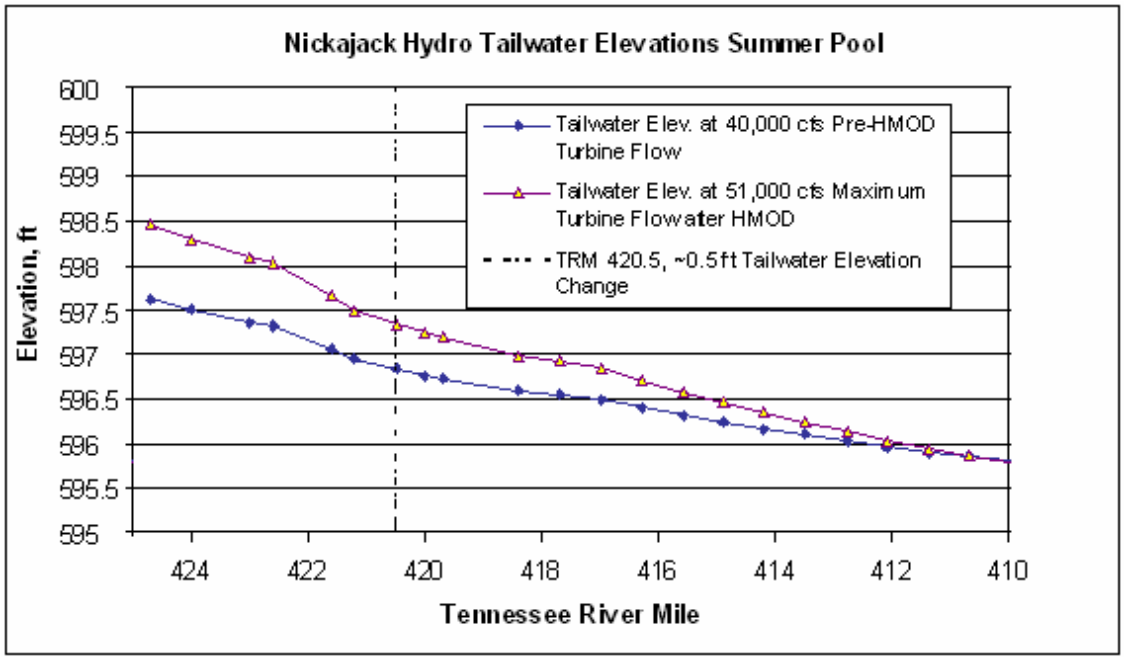

Figure 2-2. Nickajack Hydro Plant Tailwater Elevations for Summer Pool Operations at Present and After Implementation of Proposed HMOD - Beginning at the Dam (TRM 424.7)

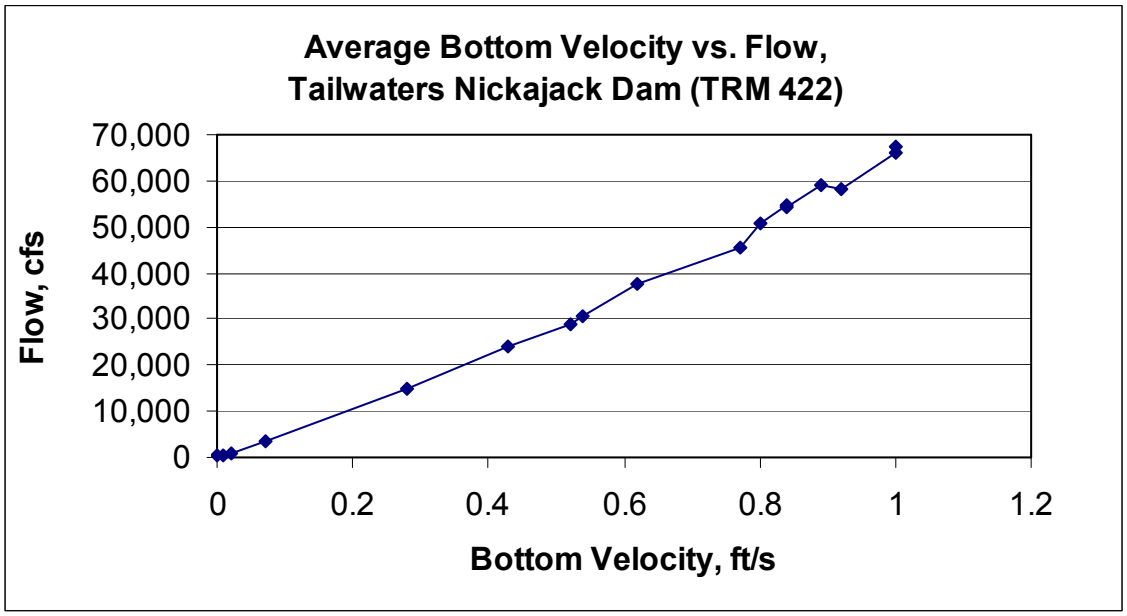

Figure 2-3. Average Bottom Velocity (ft/s) in Nickajack Dam Tailwaters Shown as a Function of Flows (cfs)

scheduled for winter of 2008, when Guntersville pool elevations are less than elevation 594 feet. The commitment to the phased approach to Section 106 compliance is a commitment of this FEA and FONSI. Additional information about historic and archaeological resources that could be affected by the proposed action, potential for effects and the proposed mitigation is provided in Section 3.12.

2.2. Comparison of Alternatives

Under the No Action Alternative, routine maintenance and upgrades would continue to occur, but tailwater flows, elevations, and operating regimes would not change. Some minor construction impacts would occur, but there would be no changes to patterns or amounts of erosion. TVA would have to replace the 14 MW of clean hydropower that would be realized from HMOD with purchased power or power from another TVA generation source.

Under the Nickajack HMOD Alternative, minor effects would occur related to erosion, surface water, groundwater, aquatic life, wetlands, managed areas, visual resources, air quality, socioeconomic conditions, and generation of waste from either construction and /or operations. As fully discussed in Chapter 3, these effects would be small and insignificant. No impacts are anticipated regarding terrestrial ecology, threatened and endangered species, ecologically significant sites, recreation, and environmental justice. Hydro operations after HMOD would have the potential to affect cultural resources on the riverbanks of the Tennessee and Sequatchie rivers.

2.3. The Preferred Alternative

TVA's preferred alternative is the Nickajack HMOD Alternative.

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CHAPTER 3

3.0 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1. Erosion

3.1.1. Affected Environment

Through most of the tailwater section below Nickajack Dam (approximately TRM 425 to TRM 410), the river flows through a relatively level floodplain, where most of the soils are moderately easily eroded alluvial loams (Huntington series) (Elder 1958). The same alluvial soils are present on the islands that are distributed through the main channel in much of this reach. The land use on most of the immediate shoreline in this area is agricultural.

As with main stem tailwaters in general, this area is subject to seasonal variation in surface elevation (2-foot winter drawdown in Guntersville Reservoir), wave action from wind and from recreational boats and commercial barge traffic, and varying water surface elevation and flow velocity on a daily basis from dam discharges (water surface elevation difference between no discharge and full generation capacity is about 3.5 feet at the dam). The changes in water surface elevation prevent the establishment of vegetation in the drawdown zone, so the erosion-prevention ability of vegetation is compromised. This leaves bare soil with low root density exposed to flowing water and wave action. Since sediment transported by the river remains in upstream reservoirs, eroded material is not replaced by natural sedimentation processes.

TVA conducted a survey of shoreline conditions in this area in 2000. Between the dam and TRM 420 (downstream end of Burns Island), 81 percent of the shoreline was given the lowest rating of 1. This indicates that within these low-rated segments, “erosion [is] extensive, [and] exposed or collapsing banks occur along more than 30 percent of [the] shoreline” (TVA Shoreline Aquatic Habitat Index). Three percent of the Tennessee River shoreline and all of the Sequatchie River shoreline were rated 3 (“areas of erosion small and infrequent”), and 16 percent was assigned a rating of 5 (“little or no evidence of erosion or bank failure”). Nearly all of the more highly rated areas were considered to have an adequate strip of riparian woody vegetation.

3.1.2. Environmental Consequences

Under the No Action Alternative, there would be no change in operation, so there would be no change in erosion rates in the Nickajack tailwater.

Under the Nickajack HMOD Alternative, the proposed increase in maximum discharge during generation would increase all of the forces that affect erosion in proportion to the increase in flow rate. Modeling shows that there would be a water surface elevation increase of just less than 1.0 foot at the dam at summer pool, diminishing to 0.5 foot at TRM 420.5, as shown in Figure 2-2. This increase is smaller when Guntersville is at winter pool. Typical velocity increases in the tailwater are around 0.2 ft/s. Shear stress, which is proportional to depth of flow, would increase by about 6 percent near the dam and less that 3 percent at TRM 420.5. These differences are small and would tend to cause a minor increase in shoreline erosion from the increase in shear stress. An indirect increase in

erosion because of an increase in mortality of woody vegetation from prolonged inundation is possible. However, the increase in wetted area is small, so this impact would also be small.

3.2. Surface Water Quality

3.2.1. Affected Environment

Two reaches of Nickajack Reservoir upstream of Nickajack Dam, a portion of the Sequatchie River, and a section of the Nickajack tailwaters are on Tennessee's list of waters of exceptional quality (TDEC 2004). Table 3-1 summarizes the areas listed as high-quality waters near Nickajack Dam (TDEC 2007).

Guntersville Reservoir from the tailwaters of Nickajack Dam to Poplar Spring Branch is listed as a water body of exceptional water quality for the same reasons as the lower reach of the Sequatchie River and also because it supports the federally listed as endangered pink mucket mussel.

Table 3-1. Listed High-Quality Waters Near Nickajack Dam, Tennessee

HUC*	Watershed	Water Body	County	Description	Basis for Inclusion
06020001	Nickajack, Chickamauga reservoirs (Lower Tennessee)	Nickajack Reservoir	Hamilton	From South Chickamauga Creek (TRM 468.1) upstream to Chickamauga Dam (TRM 471)	Snail darter, federally listed as threatened
06020001	Nickajack, Chickamauga reservoirs (Lower Tennessee)	Nickajack Reservoir	Marion, Hamilton	From Highway 41 (River Mile 429.7) upstream to tip of Williams Island (River Mile 454.6)	Bounded by Prentice Cooper State Forest and lands protected by the Tennessee River Gorge Trust
06020004	Sequatchie	Sequatchie River	Marion	Sequatchie River (TRM 422.6) from Guntersville Lake upstream to the confluence of Woodcock Creek	Anthony's river snail, federally listed as endangered and the snail darter
06030001	Guntersville Reservoir	Guntersville Reservoir	Marion	From Poplar Spring Branch (in the vicinity of TRM 417) to Nickajack Dam (TRM 424.7)	Anthony's river snail, snail darter, and the pink mucket, federally listed as endangered

* HUC = Hydrologic Unit Code

The Tennessee River from TRM 416.5 at the Tennessee-Alabama state line to TRM 448, just upstream of Raccoon Mountain Pumped Storage Plant, includes the portions of both Guntersville and Nickajack reservoirs on both sides of Nickajack Dam. This river reach has the following designated uses: domestic water supply, industrial water supply, fish and aquatic life, recreation, livestock watering and wildlife, irrigation, and navigation. The Sequatchie River from its confluence with the Tennessee River (TRM 422.6) to Sequatchie River Mile (SRM) 3.5 has all of the same designated uses. Based on data from TVA's

Reservoir Vital Signs Monitoring program, Nickajack Reservoir was assigned an ecological health rating of good in 2005. The dissolved oxygen (DO) content in the forebay portion of Nickajack Reservoir—the portion immediately upstream of the impounding dam—was also rated "good" in 2005. TVA continues to monitor water discharged from Nickajack Dam to ensure DO targets for hydro plant discharges are met.

TVA sampling and analysis of sediments from Nickajack Reservoir indicate concentrations of contaminants in sediments have been declining since 2001. There is, however, a concern that legacy contamination remains, and Nickajack Reservoir is on Tennessee's 2006 303(d) list due to sediment contamination with polychlorinated biphenyls (PCBs) and dioxins. The 303(d) list is a priority list for protecting streams from further degradation. The State of Tennessee has issued a precautionary fish consumption advisory for channel catfish from Nickajack Reservoir because of PCB contamination (TDEC 2006).

Based on data from TVA's Reservoir Vital Signs Monitoring Program, Guntersville Reservoir was assigned an ecological health rating of good in 2006. There are no fish consumption advisories on Guntersville Reservoir.

3.2.2. Environmental Consequences

Under the No Action Alternative, there would be no changes in the operation of Nickajack Dam, no changes in flow patterns, and thus no impact on water quality.

Following the proposed HMOD of Units 1 through 4, the flow during generation could be increased by up to 9,000 cfs from the present typical flow of 42,000 cfs described in Section 2.1 and shown in Figure 2-1. This variation in flow is trivial compared to existing daily and seasonal variations in flow. Minor increases in the tailwater elevations and tailwater velocities would occur, but as discussed above, the effects on erosion and scour would be small. Therefore, no significant impacts on water quality, turbidity, or scour would occur. No significant changes in the pool levels of Nickajack Reservoir or Guntersville Reservoir would occur. TVA would continue to meet DO targets in the tailwaters of Nickajack Dam.

3.3. Groundwater

3.3.1. Affected Environment

The area of interest includes a relatively narrow region bordering the Tennessee River tailwater below Nickajack Dam, between TRMs 414 and 425. This area lies in the Cumberland Plateau physiographic province, and is underlain (in ascending stratigraphic order) by alluvial and residual soils (Quaternary age), interbedded shale and limestone of the Rockwood (Silurian Age) and Sequatchie formations (Ordovician age) (TVA 1963).

The principal aquifers of the area include the Cumberland Plateau aquifer (formerly known as the Pennsylvanian sandstone aquifer) (United States Geological Survey 1990). Groundwater occurs principally in the Warsaw and St. Louis limestones of Mississippian age. Groundwater recharge is derived from precipitation and, in certain areas, by infiltration of streamflow (Newcome and Smith 1958).

Groundwater is utilized in the area for both public and private supply, though the true extent is uncertain. Well records available from the State of Tennessee, Division of Water Supply (Marshall 2007), indicate at least four private wells fall within approximately 1,000 feet of

the river reach of interest. The only recorded public wells adjacent to the area of interest are municipal wells in the city of Bridgeport, Alabama, 5 miles south of Nickajack Dam and approximately 2,000 feet from the boundaries of the Tennessee River (TRM 414).

3.3.2. Environmental Consequences

Under the No Action Alternative, no impacts to groundwater resources or users would be expected.

For the purposes of this FEA, impacts on groundwater is considered to be any change in groundwater levels directly attributable to the HMOD. Changes in groundwater levels due to the HMOD correspond to elevation changes in the Nickajack tailwater levels. Groundwater quality should not be impacted by implementation of the HMOD.

Under the Nickajack HMOD Alternative, construction activities would have no significant impacts to groundwater, since all the equipment replacement/rehabilitation activities would occur inside the dam. Potential operational impacts of the Nickajack HMOD Alternative on groundwater would be limited to proposed changes in tailwater releases that, in turn, would be expected to affect groundwater levels in areas bordering the river below the dam. The effect of reducing the number of spilling days should be minimal considering the short duration of spilling events and the relatively small increase in tailwater levels (see Figures 2-1 and 2-2).

Private wells in the area should experience negligible or no effects from any groundwater fluctuations resulting from HMOD changes. Groundwater level changes cannot be any greater than expected river changes (less than 2 feet), and area wells should not be impacted by such a small fluctuation.

TVA has concluded that groundwater levels in the area would remain similar to pre-HMOD levels. Any fluctuations in the water table should be short term, small scale, and limited to the area immediately adjacent to the reservoir boundaries. There would be no significant operational impacts on groundwater.

3.4. Aquatic Life

3.4.1. Affected Environment

Aquatic communities in the Nickajack Reservoir forebay and in the Nickajack tailwater encompass the areas that could be impacted by the proposed Nickajack HMOD Alternative. TVA monitored Nickajack Reservoir annually from 1991 through 1995 to establish baseline data on the reservoir's ecological health under a range of weather and flow conditions. Nickajack is now monitored every other year.

As in previous years, Nickajack Reservoir rated "good" in 2005. The ecological health score for Nickajack has consistently been among the highest of all the reservoirs monitored by TVA. Nickajack is a small, narrow reservoir with a short retention time; that is, it usually takes only three or four days for water to flow through the reservoir. The relatively brief retention time helps keep the water mixed, preventing it from separating into layers of different temperatures during the summer. This allows DO in the lower water column to be replenished and limits algal productivity. No DO problems occur in the Nickajack discharge. Algae consume oxygen during the nighttime hours and can lower DO levels.

Nickajack Reservoir Fisheries - The fish community of Nickajack Reservoir, most recently sampled in the fall of 2005, exhibited a reservoir rating of "fair" compared to the fisheries of other TVA mainstream reservoir forebays (2006 unpublished TVA data). Ratings are based primarily on species diversity and composition. Also considered in the rating is the percentage of the sample represented by omnivores and insectivores, overall number of fish collected, and the occurrence of fish with anomalies such as diseases, lesions, parasites, and deformities (Dycus and Baker 2001).

Tailwater Fisheries - The fish community of Nickajack tailwater most recently sampled by TVA in the fall of 2000 exhibited an overall ecological health rating of "fair" compared to other TVA mainstream reservoir tailwaters (2006 unpublished TVA data). Ratings for bottom life were similar to those for previous years. The fair rating for the benthic community at the inflow was due to the collection of fewer animals and, in particular, fewer mayflies, compared to other years.

Mussels - The mussel fauna in this general area of the Tennessee River has changed over the last century. Many species have been lost due to impoundment, while some mussel species have increased in numbers on overbank habitats (i.e., areas where a fine sediment has been deposited on the floodplain of a river outside the main channel, away from faster flow). Riverine habitat is now found only in tailwaters, but overbank habitat is available in some impounded reaches of the reservoir. The approximately 8.2-mile portion of the Tennessee River downstream of Nickajack Dam to the Tennessee-Alabama state line (TRM 416.5) is designated as a state mussel sanctuary by the Tennessee Wildlife Resources Agency (TWRA). A mussel sanctuary designation prohibits the taking of aquatic mollusks by any means and/or willful destruction of their habitat.

3.4.2. Environmental Consequences

Adoption of the No Action Alternative would result in no changes to current aquatic conditions and would not have any effects on the Nickajack forebay or Nickajack tailwater aquatic life, including fisheries and mussels

Under the Nickajack HMOD Alternative, only minor and insignificant effects on the reservoir forebay fishery are expected. Intake hydro generation volume would increase approximately 25 percent from pre-HMOD volume. This would increase intake flow velocities near the penstock openings, which could lead to a minor increase in fish entrainment during periods of highest hydro generation flow. This small, overall effect would result in insignificant impacts to the fisheries of the Nickajack Reservoir forebay.

Adoption of the Nickajack HMOD Alternative would increase tailwater flow velocities slightly and thus could have some effect on habitat for tailwater fisheries. In addition to the HMOD volumetric increases, water velocities are dependent on tailwater surface elevation (i.e., Guntersville Reservoir pool). In the near-dam area (TRM 424.7), average velocities modeled for the surface and bottom at HMOD flows would increase only slightly from pre-HMOD velocities. These velocity increases resulting from the proposed Nickajack HMOD flows diminish progressively farther downstream. Flow alterations of this magnitude may have some small but insignificant effect on some tailwater-spawning species (e.g., sauger, white bass, and various buffalo and redhorse species) in areas immediately downstream of

Nickajack Dam, and potential effects on these species over the entire tailwater are also expected to be insignificant.

The proposed Nickajack HMOD Alternative would result in only minor and insignificant effects on resident fish, mussel, and snail resources in the Nickajack tailwater. No indirect or cumulative effects are expected. The potential increase in average water velocities (shown in Figure 2-3) would result in minimal changes in downstream bottom velocities. As can be seen in Figure 2-2, the Nickajack tailwater summer pool elevation changes occurring with the onset of generation would be expected to increase tailwater elevations as much as 1 foot at the dam diminishing to 0.5 feet at TRM 420.5, which is located at about the midpoint on the length of Burns Island. There would be no significant changes to tailwater elevations or bottom velocities beyond that point. Shoreline erosion and in-stream sedimentation would not increase significantly (Section 3.1.2). Since the bottom habitat would not be noticeably changed, there would be no reason to expect any change to the resident fish, mussel, or snail populations of the Nickajack tailwater, and no noticeable impacts would occur. Likewise, these changes would not noticeably affect habitat in the state-designated mussel sanctuary.

3.5. Terrestrial Ecology - Plants

3.5.1. Affected Environment

The proposed project at Nickajack Dam and tailwaters occurs within the Level III Southern Appalachians ecoregion, which stretches from Kentucky to Alabama with open low mountains containing a mosaic of forest, woodlands, and some cropland and pastures (Griffith et al. 2001). In Tennessee, the Southern Appalachian ecoregion is further subdivided into three Level IV ecoregions, all of which are present in Marion County, Tennessee: The Cumberland Plateau, The Sequatchie Valley, and The Plateau Escarpment. The eastern boundary of the ecoregion in Tennessee has an abrupt escarpment where it meets the Ridge and Valley and is relatively smooth and only slightly notched by small eastward-flowing stream drainages. The western boundary, next to the Interior Plateau's Eastern Highland Rim is more crenulated with a rougher escarpment that is more deeply incised. The Sequatchie Valley bisects the Southern Appalachian ecoregion and provides a productive area for agriculture. Upland forests dominated by mixed oaks with shortleaf pine and mixed mesophytic forests, restricted mostly to the deeper ravines and escarpment slopes, are commonly found on the Plateau Escarpment, and the Cumberland Plateau.

Three classes of plants were observed in the project area including herbaceous vegetation, evergreen-deciduous forest, and deciduous woodlands. Much of the forested areas occupy a narrow strip of land above the steep shoreline and a few riparian areas along the river channel between the dam and Burns Island.

> **Herbaceous vegetation:** Agricultural fields, in the form of crop and pasture lands occupy over 70 percent of the area near the shoreline between Nickajack Dam and Burns Island. Common weedy species found are Bermuda grass, Johnson grass, orchard grass, tall fescue, and various broadleaved species. In addition, several nonnative species are present. These include Chinese privet, Japanese honeysuckle, sericea lespedeza, and Japanese stilt grass.

Evergreen-deciduous forest and deciduous woodlands: The remaining acreage along the shoreline between Nickajack Dam and Burns Island is forested. The forested riparian areas are mostly deciduous woodlands directly adjacent to the river and contain boxelder, chalk maple, green ash, red maple, river birch, silky dogwood, silver maple, and sycamore. The more upland evergreen-deciduous forests are predominately an oak-hickory-pine association with loblolly pine and shortleaf pine present along with basswood, black cherry, hickories, sourwood, white ash, and various oak species. Understory includes Chinese privet, Japanese honeysuckle, muscadine, poison ivy, and Virginia creeper.

There are no uncommon terrestrial plant communities, designated critical plant habitat, or otherwise noteworthy botanical areas occurring on or adjacent to the project area.

Almost 100 percent of the project footprint occurs on land with previous and current levels of disturbance to the native plant communities in the form of managed agricultural practices and timber harvesting. Invasive exotic plant species occurring within and near the project area include Chinese privet, Japanese honeysuckle, Japanese stilt grass, Johnson grass, kudzu, multiflora rose, and sericea lespedeza. All of these species have the potential to adversely impact the native plant communities because of their potential to spread rapidly and displace native vegetation. Essentially the entire proposed project is on land in which the native vegetation has been extensively altered as a result of previous land use history (e.g., dam construction, road maintenance, timber harvesting, and agricultural practices). All of these invasive species are Rank 1 (severe threat) and are of high priority to TVA (James 2002).

3.5.2. Environmental Consequences

Adoption of the No Action Alternative would not result in any project-related impacts to the terrestrial ecology of the region. The herbaceous and woody vegetation growing adjacent to the river between Nickajack Dam and Burns Island will continue to grow and will be affected occasionally by stream bank erosion from water level fluctuations. Adoption of the No Action Alternative would not result in any project-related impacts due to the introduction or spread of invasive terrestrial plant species. Current management practices would continue to prevent the spread of exotic/invasive species.

When completed, the Nickajack HMOD Alternative would result in an increase in the current typical sustainable flow of 42,000 cfs to an MSL of 51,000 cfs and between a 0.5-foot and 1.0-foot increase in tailwater elevation between the dam and Burns Island during times when the system is generating at 51,000 cfs. The changes in water volume, velocity, downstream surface elevation, and flood duration under this alternative appear to be within the normal annual and seasonal variability for these parameters. Since the proposed increase in elevation and flow of the river would not adversely affect the terrestrial plant communities found within the project area—which in any case are common and representative of the region—the direct, indirect, and cumulative impacts of the proposed Nickajack HMOD Alternative on terrestrial plants would be insignificant. Additionally, HMOD is not expected to result in the spread of invasive plants, as long as best management practices (BMPs) for invasive/exotic weed removal are continued.

3.6. Terrestrial Ecology - Animals

3.6.1. Affected Environment

Habitats observed in the project area have been heavily impacted by previous agricultural practices, and 70 percent of the project area consists of early successional habitats dominated by herbaceous vegetation. The remaining area includes deciduous forest and mixed evergreen-deciduous forest. Much of the forested areas occur in narrow strips on steep shorelines along the Nickajack tailwaters and Sequatchie River, as well as within a few riparian areas. Few wetlands occur along the shoreline below the dam because of associated steep banks, but wetlands exist on adjacent upland areas and on Burns Island. Refer to Section 3.5.1 for a more detailed vegetative description.

Early successional habitats make up the vast majority of the area surrounding the river channels below Nickajack Dam, consisting primarily of agricultural fields, some pastures, and small sections of early successional woody growth in the form of shrubs and small trees. Birds common in early successional habitats include Carolina wren, eastern bluebird, brown thrasher, white-eyed vireo, eastern towhee, northern cardinal, indigo bunting, common yellowthroat, field and song sparrows, mourning dove, and many other common songbirds. Mammals frequently observed in these habitats include Virginia opossum, eastern cottontail, striped skunk, white-tailed deer, coyote, and rodents such as white-footed mouse and hispid cotton rat. Common reptiles include black racer, rat snake, brown snake, and eastern garter snake. Wetlands within early successional habitats provide habitats for many amphibians such as American and Fowler's toads, green frog, northern cricket frog, spring peeper, upland chorus frog, and red-spotted newts. Other animals observed using these wetlands are Wilson's snipe, great blue herons, wood duck, beaver, muskrat, and raccoon.

The remaining habitat is deciduous forest, found mostly adjacent to the river channels below Nickajack Dam, and a more upland, mixed evergreen-deciduous forest component. Deciduous forest provides habitat for numerous birds including blue jay, red-eyed vireo, white-breasted nuthatch, tufted titmouse, Carolina chickadee, eastern wood-pewee, downy woodpecker, pileated woodpecker, and eastern screech-owl. Northern slimy salamanders also occur on these forest floors. Common reptiles found in deciduous forests include eastern box turtle, worm snake, ring-necked snake, kingsnake, and copperhead. Mammals such as eastern chipmunk and eastern gray squirrel are also observed in this forest type. The mixed evergreen-deciduous forest provides habitat for many of the same species listed for upland deciduous forests. Additional bird species present in this forest type include sharp-shinned hawk, chipping sparrow, pine warbler, and yellow-throated warbler.

The riparian zone of the Nickajack Dam tailwaters includes both early successional and forested habitats, and provides habitat for many bird species such as tree swallow, cliff swallow, wood duck, double-crested cormorant, great blue heron, belted kingfisher, osprey, spotted sandpiper, killdeer, mallard, and numerous gull species. Other animals known from this habitat are midland water snake, false map turtle, eastern mud turtle, muskrat, and beaver.

Two heron colonies and nine caves occur within 3 miles of the proposed area that may be affected. One small heron colony occurs 2.7 miles upstream of the dam on Nickajack Reservoir; the other exists on the eastern tip of Burns Island, 2.7 miles downstream from Nickajack Dam. Of the nine caves, all occur greater than 1 mile from the proposed affected

area except Nickajack Cave, which is 0.8 mile above the dam. Nickajack Cave is located on and partially inundated by Nickajack Reservoir.

3.6.2. Environmental Consequences

Under the No Action Alternative, TVA would continue to maintain and/or replace the existing generating components at Nickajack Dam on an as-needed basis, and turbine flow capacity would not change. Wildlife habitats surrounding the tailwaters of Nickajack Dam would likely remain in their current condition, and no impacts would occur to wildlife habitats or wildlife populations.

Under the Nickajack HMOD Alternative, TVA would modify the four existing hydro units within the dam and increase turbine flow during MSL to 51,000 cfs. The changes in water volume, velocity, downstream surface elevation, and flood duration under this alternative appear to be within the normal annual and seasonal variability for these parameters. Some individual trees could be lost, but the increased erosion would not cause significant losses of any terrestrial habitats or affect wildlife in the tailwater or adjacent areas.

The HMOD project would not affect the heron colony located above the dam. No impacts to the heron colony below the dam at Burns Island would occur because portions of the shoreline on Burns Island are currently being stabilized (see Section 1.3), and significant erosion of this island from the increased flows is not expected.

Nine caves occur within 3 miles of the proposed affected area, but none are adjacent to the tailwaters and all are 0.8 mile or greater in distance. The Nickajack HMOD Alternative would not impact these caves because they are outside the influence of the tailwater. No other unique or important terrestrial animal habitats were identified during field investigations, and no impacts to these habitats are expected from project-related activities. The Nickajack HMOD Alternative would not result in significant direct, indirect, or cumulative adverse impacts to terrestrial animals or their habitats.

3.7. Endangered and Threatened Species

3.7.1. Affected Environment

Aquatic Animals

The TVA Natural Heritage database indicated that numerous federally and state-listed aquatic animal species are present in Marion County, Tennessee, and Jackson County, Alabama. Additionally, several species considered sensitive by Tennessee and Alabama are reported from streams in these two counties. Table 3-2 lists the aquatic species found in Marion and Jackson counties. The majority of these species are found only in the Paint Rock River system and do not occur in the Tennessee River or Sequatchie River in the areas potentially affected by HMOD activities. Additional federally and state-listed aquatic species have been historically reported in these counties, but are no longer believed to occur (Table B-1, Appendix B). No federally designated critical habitat areas are present within the project area. The state mussel sanctuary present in Nickajack tailwater is managed by TWRA.

Table 3-2. Listed Aquatic Animals in Marion County, Tennessee, and Jackson County, Alabama

Common Name	Scientific Name	Federal Status	State Status/ Rank
Fish			
Southern cavefish	*Typhlichthys subterraneus**	-	NMGT/S3 (TN)
Highfin carpsucker	*Carpiodes velifer**	-	NMGT/S2S3 (TN)
Flame chub	*Hemitremia flammea**		NMGT/S3 (TN)
Palezone shiner	*Notropis albizonatus*	END	PROT/S1 (AL)
Snail darter	*Percina tanasi**	THR	THR/S2S3 (TN)
Blotchside logperch	*Percina burtoni*	-	NOST/S1 (AL)
Golden darter	*Etheostoma denoncourti**	-	NMGT/S2 (TN)
Snail darter	*Percina tanasi*	THR	THR/S2S3 (TN)
Insects			
Owen spring limnephilid caddis	*Glyphopsyche sequatchie**	CAND	POTL/S1 (TN)
Mussels			
Snuffbox	*Epioblasma triquetra*	-	NOST/S1 (AL)
Tennessee pigtoe	*Fusconaia barnesiana*	-	NOST/S1 (AL)
Shiny pigtoe pearlymussel	*Fusconaia cor*	END	PROT/S1 (AL)
Fine-rayed pigtoe	*Fusconaia cuneolus*	END	PROT/S1 (AL)
Wavy-rayed lampmussel	*Lampsilis fasciola*	-	NOST/S1S2 (AL)
Pink mucket	*Lampsilis abrupta**	END	END/S2 (TN)
Alabama lampmussel	*Lampsilis virescens*	END	PROT/S1 (AL)
Tennessee heelsplitter	*Lasmigona holstonia*	-	NOST/S1S2 (AL)
Slabside pearlymussel	*Lexingtonia dolabelloides*	CAND	PROT/S1 (AL)
Cumberland moccasinshell	*Medionidus conradicus*	-	PROT/S1 (AL)
Round hickorynut	*Obovaria subrotunda*	-	NOST/S2 (AL)
Tennessee clubshell	*Pleurobema oviforme*	-	NOST/S1 (AL)
Kidneyshell	*Ptychobranchus fasciolaris*	-	NOST/S1 (AL)
Rabbitsfoot	*Quadrula c. cylindrica*		PROT/S1 (AL)
Pale lilliput	*Toxolasma cylindrellus*	END	PROT/S1 (AL)
Purple lilliput	*Toxolasma lividus*	-	NOST/S2 (AL)
Deertoe	*Truncilla truncata*	-	NOST/S1 (AL)
Rainbow	*Villosa iris*	-	NOST/S3 (AL)
Painted creekshell	*Villosa taeniata*	-	NOST/S3 (AL)
Snails			
Royal marstonia	*Pyrgulopsis ogmorhaphe**	END	END/S1 (TN)
Spiny riversnail	*Io fluvialis**	-	NOST/S2 (TN)
Anthony's river snail	*Athearnia anthonyi**	END	PROT/S1 (AL)
Varicose rocksnail	*Lithasia verrucosa**	-	NOST/S3 (AL)
Corpulent hornsnail	*Pleurocera corpulenta**	-	NOST/S1 (AL)

* Indicates presence in the HMOD APE

- Indicates not applicable

Status/Rank Codes:

CAND = Candidate for federal listing
END = Endangered
NMGT = In need of management
NOST = No legal status, but tracked by the Tennessee or Alabama Natural Heritage programs
THR = Threatened

S1 = Critically imperiled with 5 or fewer occurrences
S2 = Imperiled with 6 to 20 occurrences
S3 = Rare or uncommon with 21 to 100 occurrences

Terrestrial Plants

The TVA Natural Heritage database indicated there are no federally listed and 11 state-listed species recorded from within 5 miles of the Nickajack Dam. Six federally listed species are known from Marion County, Tennessee (Table 3-3). Current rankings of federally and state-listed species were verified through NatureServe Web site (NatureServe 2007).

TVA biologists conducted a field survey by boat from Nickajack Dam to Burns Island in March 2005 as part of the fieldwork conducted for the Nickajack Shores project to evaluate Burns Island and the Boyd's farmland tract (Boyd's farm). The only rare species observed was chalk maple (state-listed species of special concern) occurring along the shoreline.

Table 3-3. State-Listed Plant Species Reported From Within 5 Miles of the Nickajack Dam and Federally Listed Species Known From Marion County, Tennessee

Common Name	Scientific Name	Federal Rank	State Status/ Rank
Chalk maple	*Acer saccharum* ssp *leucoderme*		SPCO/S3
Creeping St. John's wort	*Hypericum adpressum*		END/S1
Eggert's sunflower	*Helianthus eggertii*	DM	THR/S3
Featherfoil	*Hottonia inflata*		SPCO/S2
Hairy false gromwell	*Onosmodium molle spp. hispidissimum*		END/S1
Hart's tongue fern	*Asplenium scolopendrum* var. *americanum*	LT	END/S1
Huntsville vasevine	*Clematis morefieldii*	LE	END/S1
Lance-leaf Trillium	*Trillium lancifolium*		END/S1
Large-flowered skullcap	*Scutellaria montana*	LT	THR/S2
Michigan lily	*Lilium michiganense*		THR/S3
Monkey-face orchid	*Platanthera integrilabia*	C	END/S2S3
Nevius' stonecrop	*Sedum nevii*		END/S1
Price's potato-bean	*Apios priceana*	LT	THR/S2
Slender blazing star	*Liatris cylindracea*		THR/S2
Smoke tree	*Cotinus obovatus*		SPCO/S2
Spreading rockcress	*Arabis patens*		END/S1
Three-parted Violet	*Viola tripartata*		SPCO/S2S3

Status/Rank Codes:

C = Candidate
DM = Delisted-monitoring
END = Endangered
LE = Listed endangered
LT = Listed threatened
THR = Threatened
SPCO = Special concern

S1 = Critically imperiled with 5 or fewer occurrences
S2 = Imperiled with 6 to 20 occurrences
S3 = Rare or uncommon with 21 to 100 occurrences
S#S# = Occurrence numbers are uncertain

Chalk maple is an uncommon, small deciduous tree 20-30 feet tall with white chalk-like bark and smaller leaves than the sugar maple. The undersurface of the leaf is usually yellowish-green with moderate to dense pubescence. Chalk maple is typically found on rocky slopes and bluffs associated with calcareous soils (Weakley 2007). However, as noted above, it was observed growing along the shoreline in the Nickajack Dam tailwater area.

Terrestrial Animals Species

During June 2007, the TVA Natural Heritage database indicated records of five Tennessee state-listed species within 3 miles of Nickajack Dam and affected tailwaters. One species that is not state-listed, but tracked by the Tennessee Natural Heritage Program, has also been recorded within 3 miles. In addition, three federally listed species have been reported from Marion County, Tennessee (Table 3-4). No designated critical habitats for federally listed terrestrial animal species are known from Marion County.

Table 3-4. Federally Listed Terrestrial Animal Species Reported From Marion County and State-Listed Terrestrial Animal Species Reported From Within 3 Miles of the Project Site

Common Name	Scientific Name	Federal Rank	State Status/ Rank
Amphibians			
Tennessee cave salamander	*Gyrinophilus palleucus*	--	THR (S2)
Barking treefrog	*Hyla gratiosa*	--	NMGT (S3)
Birds			
Common raven	*Corvus corax*	--	THR (S2)
Bald eagle	*Haliaeetus leucocephalus*	THR	NMGT (S3)
Mammals			
Gray bat	*Myotis grisescens*	END	END (S2)
Eastern small-footed bat	*Myotis leibii*	--	NMGT (S2S3)
Indiana bat	*Myotis sodalis*	END	END (S1)
Allegheny woodrat	*Neotoma magister*	--	NMGT (S3)
Invertebrates			
Nickajack Cave beetle	*Pseudanophthalmus nickajckensis*	--	NOST (S1)

-- Indicates not applicable

Status/Rank Codes

END = Endangered
NMGT = In need of management
NOST = No legal status, but tracked by the Tennessee or Alabama Natural Heritage programs
THR = Threatened
S1 = Critically imperiled
S2 = Imperiled
S3 = Rare or uncommon

Tennessee cave salamanders occur in caves with streams free of sedimentation. There are historical records of this salamander from Nickajack Cave before it was flooded by the reservoir. Suitable habitat still exists in portions of Nickajack Cave beyond the influence of Nickajack Reservoir. All other cave records are greater than 1 mile from this site, and suitable habitat for this species does not occur within the affected project area.

Barking treefrogs occur in wetlands, and a population is known from the town of New Hope, just northwest of Nickajack Dam. Although not recorded immediately adjacent to the Nickajack and Sequatchie tailwaters, some wetlands offering moderately suitable habitat occur on Burns Island and in the vicinity.

Common ravens have historically occurred throughout Tennessee, including the hills north of South Pittsburgh where there are nesting records from 1914. Currently, however, the closest raven nests are in the Great Smoky Mountains National Park, and ravens no longer occur in the project area.

Bald eagles have recently been removed from the endangered species list, but are still protected by the Bald and Golden Eagle Act and the National Bald Eagle Management Guidelines. This species typically nests in forested habitats near large bodies of waters such as reservoirs and rivers. Nesting and post-breeding bald eagles are regularly observed throughout the reservoir system, and numerous nests occur along Nickajack and Guntersville reservoirs. Three bald eagles nests occur downstream of Nickajack Dam; these nests are 1.3, 1.4, and 2.3 miles away. Two of these nests occur within the tailwaters of Nickajack Dam, and one occurs along the Sequatchie River. The project area and vicinity provide ample suitable habitat for this species.

The federally listed **gray bat** roosts in caves year-round, particularly along the Tennessee River over which they forage. A very large summer colony of this species occurs in Nickajack Cave, approximately 0.8 mile above Nickajack Dam. This species also occasionally uses Little Cedar Mountain Cave, 1.8 miles above Nickajack Dam, transitionally during migration and after the breeding season. All other caves offering suitable roosting habitat are greater than 1 mile from the affected project area. This species may forage up to 15-35 kilometers from their roost (Thomas and Best 2000) and forage above and below Nickajack Dam. Abundant foraging habitat occurs throughout Nickajack and Guntersville reservoirs, as well as the Sequatchie River.

Eastern small-footed bats roost in rock crevices, bridges, and other rocky habitats and usually hibernate in caves. This species has been reported from Nickajack Cave. Suitable roosting habitat exists for this species in several other caves. All of these caves are greater than 1 mile from the affected project area and are in areas that would not be influenced by the tailwaters or construction activities.

The federally listed **Indiana bat** hibernates in caves but roosts under tree bark and occasionally in tree cavities during the rest of the year. Optimal summer roosting habitat usually consists of mature forest with an open subcanopy and near aquatic foraging habitat. Although Nickajack Cave is the type locality for this species, Indiana bats have not been recorded from this cave during recent TVA surveys. Abundant suitable summer habitat occurs in the area.

Allegheny woodrats inhabit rocky outcrops, caves, and occasionally piles of boulders, brush, or other debris. This species has been reported from Nickajack Cave, approximately 0.8 mile from Nickajack Dam; all other caves are greater than 1 mile from the affected project area. Brush piles or similar poor-quality habitat may exist adjacent to the Nickajack tailwaters and Sequatchie River.

The **Nickajack Cave beetle** is restricted to cave habitats and has been recorded from Nickajack Cave, approximately 0.8 mile above Nickajack Dam. All other caves are greater than 1 mile from this site, and suitable habitat for this species does not occur within the affected project area.

3.7.2. Environmental Consequences

Aquatic Animals

The proposed Nickajack HMOD Alternative would result in only minor and insignificant effects on aquatic habitat in the Nickajack tailwater. Turbine repair and rehabilitation

activities under the No Action Alternative would not have any effect on listed aquatic species. The changes within NJH would not result in noticeable modification in the flow regime or bottom habitats in the river.

Under the Nickajack HMOD Alternative, activities associated with plant modernization and resultant changes in downstream flow patterns also would not result in a noticeable effect on listed aquatic species. As shown in Figure 2-3 and described in Section 3.4, the modernization of the turbines would result in very small increases in bottom velocities (approximately 0.1 ft/s) downstream from Nickajack Dam. The projected change in bottom velocities associated with the plant modernization is not enough to affect the habitats or the behavior of the protected fish, mussels (or their fish hosts), or snails downstream from Nickajack Dam. No DO problems are present in the tailwater. No change to DO conditions in the Nickajack tailwater would result from this action.

It is TVA's determination that actions related to the Nickajack Dam HMOD would have no effect on federally listed species present in the Nickajack tailwater (Tennessee River main stem) or the Sequatchie River.

Terrestrial Plants

One state-listed species of concern, *Acer saccharum* ssp *leucoderme* (chalk maple) was observed along the shoreline of the Tennessee River within the project area. No other known populations of federally or state-listed species are known to occur within the area of Nickajack tailwater between the dam and Burns Island.

Under the No Action Alternative, water flow capacity would not change; therefore, no project-related impacts to protected or rare plant species would result from this action.

Under the Nickajack HMOD Alternative, the replacement and or rehabilitation of the generation components of the four units would occur during the spring and fall, and the action would increase the flow and elevation of the tailwater area between the dam and Burns Island. The action would increase the current typical sustainable load of the turbines from 42,000 cfs to a MSL of 51,000 cfs, which could increase tailwater elevations as much as 1 foot at the dam diminishing to 0.5 feet at TRM 420.5. The potential increase in current and elevation, which would occur during periods of high power demand or flood events, could cause changes in erosion patterns along the banks of the river and could potentially cause temporary and local impacts to chalk maple. Habitat for chalk maple is abundant within the Southern Appalachians ecoregion III, and small local disturbances would not cause significant impacts to populations occurring within the proposed project area.

Terrestrial Animals

Under the No Action Alternative, TVA would continue to maintain and/or replace the existing generating components at Nickajack Dam on an as-needed basis, and turbine flow capacity would not change. Because the present flow capacity does not currently affect protected terrestrial animals or their habitats, an adoption of the No Action Alternative would not affect protected terrestrial animals or their habitats.

The Nickajack HMOD Alternative has a small potential to affect tailwater habitat. Numerous bald eagles nest along Nickajack and Guntersville reservoirs. Two nests are currently active in the forested shoreline along the proposed affected tailwaters below Nickajack Dam. A third pair of eagles has also been active near the Sequatchie River since 1996. As stated above, the Nickajack HMOD Alternative may slightly alter erosion patterns along the

shorelines of the Nickajack tailwaters down to Burns Island, as well as along the Sequatchie River (see Section 3.1.2), which could result in removal of some individual trees along the shorelines below the dam. However, because none of the bald eagle nests occur directly on the shoreline and abundant roosting trees occur in the area, the proposed action alternative is not expected to impact these or other bald eagles. Increased flow is also not expected to result in impacts to bald eagle foraging habitat.

Since there is no suitable habitat at the proposed affected area for Tennessee cave salamander, common raven, eastern small-footed bats, and/or the Nickajack Cave beetle, none of these state-listed species would be affected under the Nickajack HMOD Alternative. Although suitable Indiana bat habitat exists in the vicinity, the proposed project would not remove potential Indiana bat habitat and would not result in impacts to this species. Some moderately suitable habitats exist for barking treefrogs (wetlands), and Allegheny woodrats (brush piles, rocky habitats) in the proposed affected area. The Nickajack HMOD Alternative is not expected to affect or decrease the availability of any of these habitats to either species, and neither species would be impacted.

Gray bats occur in Nickajack Cave and occasionally use Little Cedar Mountain Cave. All caves are 0.8 mile or greater from the proposed affected area. Foraging habitat exists over Nickajack and Guntersville reservoirs and adjacent rivers and streams. The Nickajack HMOD Alternative would not impact Nickajack or Little Cedar Mountain caves, nor result in impacts to gray bat foraging areas due to the abundance of available foraging habitat and the tendency for gray bats to forage over large distances. No designated critical habitats for federally listed terrestrial animal species are known from Marion County. The Nickajack HMOD Alternative would not result in direct, indirect, or cumulative impacts to Indiana bat, gray bat, or bald eagles, or to other protected terrestrial animals or their habitats.

3.8. Wetlands

3.8.1. Affected Environment

Wetland resources in the immediate project area were evaluated using National Wetlands Inventory (NWI) data, land use/land cover data, and field survey data for the shoreline from Nickajack Dam to the southern end of Burns Island (TRM 420.5) and upstream to SRM 2.7. This geographic extent was used because the potential effects of changes in water volume, velocity, downstream surface elevation, and flood duration would be most likely to occur in the tailwater areas close to the dam, before any increased flows would be attenuated. The definition of wetlands used for the NWI (Cowardin et al. 1979), and federal jurisdictional wetland criteria applied by the United States Army Corps of Engineers (Environmental Laboratory 1987) for wetlands regulated under the Clean Water Act were considered for this review. Other definitions of wetlands, such as the TVA Environmental Review Procedures wetland definition (TVA 1983), were also considered.

Due to the topography and channel morphology in the tailwater area, there are limited potential areas for wetland occurrence and wetland development along the immediate shoreline area of the reservoir. Large areas of forested wetlands (approximately 40 acres) are present in the floodplain of the Sequatchie River south of Interstate-24, and smaller areas of forested wetlands and emergent/farmed wetlands are associated with unnamed tributaries of Glover Branch north of Burns Island. Burns Island itself has approximately 83 acres of wetlands that have developed within the last 20 years as the result of impoundments constructed for waterfowl habitat.

The development and maintenance of wetlands within the APE is associated with tributary floodplain hydrology, with some limited groundwater influence.

3.8.2. Environmental Consequences

Under the No Action Alternative, TVA would continue to maintain and/or replace the existing generating components at NJH on an as-needed basis, and there would be no change in turbine capacity. No wetland impacts would be associated with the No Action Alternative.

Adoption of the Nickajack HMOD Alternative is expected to have insignificant or no direct, indirect, or cumulative effects on the wetlands in the Nickajack Dam tailwater. The changes in water volume, velocity, downstream surface elevation, and flood duration under this alternative appear to be within the normal annual and seasonal variability for these parameters. These changes are within the range of hydrologic variability of the wetlands that have developed in the floodplain areas of the Sequatchie River. There would be no effect on the wetlands on Burns Island, as these are maintained by man-made impoundments.

3.9. Managed Areas, Ecologically Significant Sites, and Recreation

3.9.1. Affected Environment

The TVA Natural Heritage database indicated that the potentially affected areas of the proposed action are within one natural area, the Guntersville Reservoir State Mussel Sanctuary, and one Nationwide Rivers Inventory (NRI) stream, the Sequatchie River. The proposed action is within 0.5 mile of one natural area, the Nickajack Cave TVA Habitat Protection Area (HPA)/Small Wild Area (SWA)/State Wildlife Observation Area (WOA). Three additional natural areas are within 3 miles of the proposed action: Nickajack Oak Wetland TVA HPA, Little Cedar Mountain TVA HPA/SWA, and Shellmound Road Bluff TVA HPA. No Wild and Scenic Rivers are in the vicinity of the proposed action.

Guntersville Reservoir State Mussel Sanctuary is the section of the Tennessee River from Nickajack Dam (TRM 424.7) downstream to the Tennessee-Alabama state line (TRM 416.5). The area within these river miles is designated as sanctuary by TWRA, which prohibits the taking of aquatic mollusks or the destruction of their habitat. Over half of this designated area, to TRM 420.5, is within the proposed project area.

Sequatchie River, from SRM 0 at the confluence with Tennessee River to SRM 109 at the headwaters, is listed on the NRI. The National Park Service recognizes this stream for its scenic, recreational, geologic, and fish and wildlife values. The confluence point is approximately at TRM 422.7, which is within the proposed project area.

Nickajack Cave TVA HPA/SWA/State WOA is a 255-acre tract that provides a wooded buffer for Nickajack Cave. The cave supports and provides protected habitat for a summer population of gray bats, wintering Indiana bats, eastern small-footed bats, Tennessee cave salamanders, and other cave-related species. In addition to habitat protection, the tract serves as a WOA and an SWA. This tract is approximately 0.5 mile south of and above Nickajack Dam.

Nickajack Oak Wetland TVA HPA is a 44-acre, oak-forested, headwater wetland. It provides habitat for the southern rein orchid. This HPA is 0.7 mile northeast of the Tennessee River at approximately TRM 423.0.

Little Cedar Mountain TVA HPA/SWA, a 319-acre area, is a predominantly forested peninsula along the Tennessee River that features glade-like openings, quarries, caves, and limestone bluffs. Rich in both natural and cultural resources, the area is currently undergoing trail development to encourage greater public use of the scenic and historic area. This HPA/SWA is 2.0 miles northeast of and above Nickajack Dam.

Shellmound Road Bluff TVA HPA, an approximately 103-acre linear tract, is comprised of a steep, forested slope and bluff. It supports a mature stand of American smoke tree. This HPA is 2.7 miles northeast of and above Nickajack Dam.

There are four public boat ramps in the vicinity of the dam, two above the dam and two below. With year-round minimum flows adequate to sustain commercial navigation and the many natural features accessible by water described above, recreational boating is a popular activity. Because Chattanooga, South Pittsburg, and Jasper are nearby, there are considerable land-based and water-based recreational activities occurring on both Nickajack and Guntersville reservoirs, near Nickajack Dam, including wildlife observation, pleasure walking, hunting and fishing (bank and boat), skiing, and pleasure boating.

3.9.2. Environmental Consequences

Under the No Action alternative, TVA would make changes or repairs as needed to generating components, and there would be no change in turbine capacity. No impacts to natural areas or recreational opportunities in the vicinity would result from the No Action Alternative.

Under the Nickajack HMOD Alternative, TVA would replace or rehabilitate generating components over a designated time period. The action would result in increased hydroturbine flow and slight increases in tailwater elevations and velocity. Because changes in tailwater elevations in the Tennessee River would be slight (approximately 0.5 foot or more over current conditions) and the change in average water bottom velocities would be minimal, the proposed Nickajack HMOD Alternative would result in only negligible impacts on mussels and their habitat in the Guntersville Reservoir Mussel Sanctuary (see Section 3.7.2). Likewise, no appreciable changes are expected in water elevation and velocities of the Sequatchie River. Impacts to this NRI stream would be negligible and insignificant. No adverse impacts are anticipated for Nickajack Oak Wetland, as it is a sufficient distance from the proposed activity (0.7 mile). Because Shellmound Road Bluff TVA HPA, Little Cedar Mountain TVA HPA/SWA, and Nickajack Cave HPA/SWA/State WOA are above Nickajack Dam, these protected habitats would not be impacted by tailwater flow changes. General recreational use of these natural areas and other recreational resources would not be affected by the proposed action.

3.10. Visual Resources

3.10.1. Affected Environment

Visual resources are evaluated based on existing landscape character, distances of available views, sensitivity of viewing points, human perceptions of landscape beauty/sense of place (scenic attractiveness), and the degree of visual unity and wholeness of the natural landscape through the course of human alteration (scenic integrity).

The landscape downstream of NJH ranges from steeply sloping forestland to pastoral fields. There is very little developed shoreline along the narrow reaches of Guntersville Reservoir downstream of NJH. Views are limited to primarily the foreground (up to 0.5 mile from the observer) viewing distance, due to existing vegetation, topography, surrounding land use patterns, and the narrow winding reservoir itself. The shoreline areas within the APE range from well-forested steep slopes to eroding and undercut banks where thin bands of vegetation separate the water body from agricultural operations landward.

Viewing positions are limited downstream of NJH due to land uses along the opposing shorelines. The primary viewing positions lie immediately downstream along the reservoir and at the TVA formal recreation area where TVA operates an access ramp, restroom, and picnic facilities. Frequency and duration of view from these positions varies seasonally with usage patterns, with peak activity occurring during the months of May through September.

The scenic attractiveness is common, and the scenic integrity is moderate to low.

3.10.2. Environmental Consequences

Under the No Action Alternative, TVA would not perform HMOD work on Units 1 through 4 at NJH. This would result in no discernable change in the existing landscape character. Tailwater elevations would continue to rise and fall at levels similar to those shown in Figure 1-2 and would vary seasonally and with periods of peak power demand. Construction activity would remain at levels typically observed by recreational reservoir users, motorists, and near shore residents. There would be no net change in the existing scenic value.

Under the Nickajack HMOD Alternative, TVA would perform work required to modernize generation Units 1 through 4. There would not be a discernable change in the scenic value from viewing positions previously described in the Affected Environment Section. The resulting changes in tailwater elevations associated with the proposed action would not be readily discernable to recreational lake users downstream of NJH; however, frequent visitors and recreational users familiar with water levels in close proximity to the tailwater area may notice slightly higher water levels. This minor change would not result in an adverse impact to the existing scenic value.

Potential impacts resulting from the proposed action would include changes in erosion patterns along the banks of the river, which could potentially cause temporary and local effects downstream of NJH during times of increases in discharges (e.g., during flood events and periods of high power demand). The greatest probability for increases in shoreline erosion and a discernable increase in turbidity in the waters downstream of NJH would occur where agricultural operations have reduced riparian areas toward the shoreline and erosion is presently visible. Any increases in exposed and undercut banks and turbidity following increases in flows or after heavy rains would be visible to those recreational reservoir users within the sections downstream of NJH. However, as Section

3.1.2 of this FEA states, the effects of the Nickajack HMOD Alternative on erosion would be minor and insignificant and, therefore, the visual impact would also be negligible.

During the construction period, material storage and laydown areas would be located at previously disturbed areas surrounding the powerhouse. Additionally, the slight increase in the number of personnel and equipment at the facility would result in minor visual discord, which would be temporary and confined to the HMOD period.

3.11. Air Quality

3.11.1. Affected Environment

National Ambient Air Quality Standards (NAAQS) exist for both the immediate local area and the regional area that could be affected by this project. NAAQS are designed to protect public health and welfare by providing concentration limits in the outside air for six pollutants: ozone, particulate matter, nitrogen oxides, carbon monoxide, sulfur dioxide, and lead. Any area where any air quality standard is violated may be designated as a nonattainment area for that pollutant, and emissions of that pollutant from new or expanding sources are carefully controlled. Nickajack Dam is located in Marion County, which is currently in attainment of the ozone NAAQS, but is adjacent to the Chattanooga, Tennessee-Georgia (TN-GA) ozone nonattainment area, which includes Hamilton and Meigs counties in Tennessee and Catoosa County, Georgia. The United States Environmental Protection Agency (USEPA) issued proposals in July 2007 to tighten the current primary ozone standard that will likely cause the Chattanooga metropolitan statistical area (MSA), which includes Marion County, to be designated nonattainment for ozone. In addition to tightening the primary standard, the USEPA has proposed a new secondary standard for ozone that will increase the likelihood of Marion County being designated nonattainment. The USEPA has proposed a new form of secondary standard designed specifically to protect sensitive plants from damage caused by repeated ozone exposure throughout the growing season. This cumulative standard would add daily ozone concentrations across a three-month period and could be more restrictive than the primary standard. Marion County is also currently in attainment with the fine particle matter $PM_{2.5}$ NAAQS but is also adjacent to the Chattanooga, TN-GA $PM_{2.5}$ NAAQS nonattainment area, which includes Hamilton County, Tennessee, and Walker and Catoosa counties in Georgia. USEPA tightened the primary fine particle standard in December 2006. The new standard may result in the Chattanooga MSA (and possibly Marion County) being designated nonattainment for $PM_{2.5}$. Recommendations for nonattainment areas are due from the states by December 2007 followed by official USEPA designations by December 2008.

In addition, prevention of significant deterioration (PSD) regulations, which restrict emissions to prevent any significant reduction in ambient air quality, provide protection for national parks and wilderness areas that are designated PSD Class I air quality areas. The closest Class I areas to Nickajack Dam are the Cohutta Wilderness, about 60 miles to the east-southeast; the Joyce Kilmer Slickrock Wilderness, about 80 miles to the northeast; and the Great Smoky Mountains National Park, about 90 miles to the northeast.

3.11.2. Environmental Consequences

The No Action Alternative would have only temporary, intermittent, and minor impacts on ambient air quality other than what would be expected during routine refurbishment and maintenance activities (e.g., combustion exhaust from fuel-burning engines such as those in cranes, compressors, and transportation vehicles that may be used, possible fugitive

dust, and particulates). Emissions of air pollutants from such activities would be very small and transitory, and no significant impacts on local or regional air quality would result.

Adoption of the Nickajack HMOD Alternative would similarly have only temporary, intermittent, and minor impacts on local and regional air quality during the course of the project activities. Air pollutant emissions may include combustion exhaust from fuel-burning engines such as those in cranes, compressors, and transportation vehicles that may be used, possible fugitive dust, and particulates. Such minor emissions would be further minimized by containment practices in keeping with state and federal regulations and safety procedures such as those required by the Occupational Safety and Health Administration**.** The minor and localized nature of any potential emissions makes any PSD considerations for Class I areas extremely remote and very unlikely. Therefore, impacts on local or regional air quality would likely be minor and insignificant.

3.12. Cultural Resources

3.12.1. Affected Environment

East Tennessee has been an area of human occupation for the last 12,000 years. This includes five broad cultural periods: Paleo-Indian (11,000-8000 B.C.), Archaic (8000-1600 B.C.), Woodland (1600 B.C.-A.D. 1000), Mississippian (A.D. 1000-1700), and Historic (A.D. 1700- to present). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on floodplains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. In East Tennessee, during the 17th and 18th centuries, Europeans and Native Americans began interacting through the fur trading industry. European-American settlement increased in the early 19th century as the Cherokee were forced to give up their land.

Marion County was established in 1817 out of Cherokee lands. During the Civil War, sentiment in the county was so divided that frequently members of the same family could be found in both the Confederate and Federal armies. The presence of the railroad and major turnpikes meant that troops from both sides often passed through the county. Industry and mining marked the county's post-war history. The development of hydroelectric power came with the completion of Hales Bar Dam in 1912. The lake created by TVA's Nickajack Dam covered the earlier Hales Bar Dam (Beene 1998).

As stated in Section 3.1.1, portions of the shoreline between Nickajack Dam and TRM 420.5 are extensively eroded. Archaeological surveys conducted at Burns Island for the Nickajack Shores project (described in Section 1.3) indicate the presence of archaeological resources in the Nickajack tailwater area, and shoreline stabilization activities are currently occurring on and adjacent to Burns Island to protect some of these resources.

For the Nickajack HMOD Alternative, the APE would be that stretch of river where the present hydro operation pool would be exceeded by the proposed HMOD pool elevation by 0.5 foot or greater, which could occur during periods of high power demand or flood events. Thus, the APE would consist of all shoreline between TRMs 419.7 (an additional 0.5 mile was included in the APE at the downstream point to capture margin of error in tailwater modeling) and 424.7 and SRMs 0.0-2.7. Therefore, this geographic setting would be a 100-foot-wide margin of land surrounding all shoreline within the APE.

A background search and review of Solis and Futato 1987 indicated 34 previously recorded archaeological sites (40MI2, 40MI36, 40MI39, 40MI47, 40MI55, 40MI65, 40MI89, 40MI90, 40MI93, 40MI108b, 40MI110, 40MI111, 40MI121, 40MI153, 40MI154, 40MI165-178, 40MI186-188, 40MI202, and Locus D) are present within a hundred feet of the shoreline of the APE. Of these previously recorded sites, nine are located along the shoreline of Burns Island. Alexander Archaeological Consultants (AAC) recently conducted a Phase I Archaeological Survey of Burns Island and Boyd's farm and a limited Phase II survey of Burns Island (Alexander and Trudeau 2005, Schneider and Trudeau 2005). In the report, AAC recommended that the sites on Burns Island be considered as separate loci and that the entire Island be considered potentially eligible for inclusion in the National Register of Historic Places (NRHP). These sites are important because they are eligible for listing in the NRHP, are of religious and cultural significance to Indian tribes that once occupied these lands, and are likely to yield archaeological information that would provide a better understanding of prehistoric occupation of this locality and region.

Therefore, TVA would conduct a Phase I survey to identify NRHP potentially eligible, eligible, or listed archaeological sites/districts within the APE. The level of survey would determine potential eligibility and assess site condition with regard to the effects of shoreline erosion for both newly recorded and previously recorded sites.

3.12.2. Environmental Consequences

Under the No Action Alternative, the proposed project would not take place. Therefore, no impacts to cultural resources would occur.

Under the Nickajack HMOD Alternative, TVA in consultation with the Tennessee SHPO determined that the proposed Nickajack HMOD undertaking would have a potential to affect NRHP potentially eligible, eligible, or listed archaeological sites/districts. Since the Phase I Archaeological Survey could not be completed at summer pool elevations, TVA executed an MOA with the Tennessee SHPO for identification and treatment of historic properties within the APE for the proposed undertaking and is awaiting the signature of the United Keetoowah Band of the Cherokee Indians as a consulting party. A copy of the MOA is provided in Appendix C. Fieldwork for the proposed Phase I survey is scheduled for winter 2008, when Guntersville pool elevations are less than 594 feet.

In assessing the potential for effects, TVA, in consultation with the Tennessee SHPO, would apply the Criteria of Adverse Effect, defined at 36 CFR Part 800.5(a)(1), to archaeological properties within the APE that are determined to be eligible for listing in the NRHP. TVA, in consultation with the Tennessee SHPO, would ensure that a treatment plan, if needed, is developed and executed for the treatment of those NRHP-eligible archaeological properties in the APE that could be adversely affected. The treatment plan would delineate a procedure for determining the most appropriate methods of avoiding, minimizing, or mitigating adverse effects on NRHP-eligible archaeological properties. Depending on the conditions of each specific archaeological property, such methods may include, but are not limited to, in-place preservation of the archaeological property, archaeological data recovery, or a combination of these methods. All treatment measures would be monitored for effectiveness in the manner specified in Stipulation 3.e. of the MOA (see Appendix C).

With the implementation of the MOA, the effects of the proposed action on cultural resources in the tailwater area of NJH would be small and insignificant.

3.13. Socioeconomics

3.13.1. Affected Environment

As previously stated, Nickajack Dam is located in Marion County, Tennessee. Nickajack Reservoir extends into Hamilton County (Chattanooga), Tennessee. Marion and Hamilton counties are part of the Chattanooga MSA, which also includes three counties in north Georgia and Sequatchie County, Tennessee, adjacent to Marion County on the northeast. The most recent population estimate by the U.S. Census Bureau for Marion County (2006) is 27,942, a small increase from the 2000 population of 27,776 (www.census.gov/popest/counties/). In addition to these counties, the labor market area for this project includes the remainder of the metropolitan area as well as other counties adjacent to Marion County in Tennessee and Alabama. This labor market area has a labor force of over 337,000, with an unemployment rate in 2006 of 4.6 percent.

3.13.2. Environmental Consequences

Under the No Action Alternative, maintenance and rehabilitation would continue on an as-needed basis. As a result, there would be occasional construction and/or maintenance activities that would result in minor increases in income and employment in the area for various periods of time. These would have only insignificant impacts on the local economy.

If the proposed Nickajack HMOD Alternative were chosen, numerous components of the units would be replaced or rehabilitated, as discussed in Section 2.1.2. These construction activities likely would occur sometime between the years 2009 and 2016. The workforce required would be small, with not more than about 50 to 75 workers at any given time. This activity would result in minor increases in income and employment in the area during each cycle. However, this would be a very small share of the labor force in the labor market area and, therefore, potential impacts to the area would be minor and insignificant.

3.14. Environmental Justice

3.14.1. Affected Environment

The population of Marion County, Tennessee, was 6.1 percent minority in 2000, according to the United States Census of Population. More recent estimates indicate that this share is essentially unchanged. This is well below both the state (20.8 percent) and the nation (30.9 percent). The share in the labor market area as a whole is somewhat larger, 15.2 percent in 2000, still below the state and national shares. On the south, the dam is located adjacent to Census Tract 503, Block Group 6, and Census Tract 502, Block Group 6 in Marion County. On the north, it is adjacent to Census Tract 502, Block Group 5, also in Marion County. Minority population in these three block groups in 2000 was 1.2, 6.5, and 7.1 percent, respectively, of the total. While two of these are somewhat higher than the overall county share, they are well below the labor market area, state, and national levels. There is no population in any of the individual blocks nearest to the dam.

The poverty rate in Marion County in 1999, according to the Census of Population, was 14.1 percent, slightly higher than the state average of 13.5 and the national average of 12.4. Census Bureau estimates for 2004 show an increase in the county rate to 15.0, the same as the state estimate. These estimates also indicate a small increase nationally to 12.7 percent. The poverty rates in 1999 for the block groups near the dam are 14.8 percent for Census Tract 503, Block Group 6; 11.6 for Census Tract 502, Block Group 6; and 5.3

percent for Census Tract 502, Block Group 5. Estimates for 2004 are not available for subcounty areas.

3.14.2. Environmental Consequences

Marion County has a relatively small minority population and has poverty levels slightly higher than the state. Block groups near Nickajack Dam also have relatively small minority populations, although the shares are slightly higher than the county average in parts of the area. The population of these block groups is relatively small and is generally not close to the dam site. Almost all construction activities would occur inside the plant, further removing it from the population in the surrounding area. No significant negative impacts to the environment are expected under either alternative due to the use of BMPs and the nature of the work. Therefore, no disproportionate negative impacts to minority or low-income populations are expected under either alternative. Environmental justice impacts, if any, would be minor and insignificant with either the No Action Alternative or the proposed Nickajack HMOD Alternative.

3.15. Waste Generation

3.15.1. Affected Environment

Areas potentially affected by generation of waste in either the No Action Alternative or the Nickajack HMOD Alternative would be limited to the plant building, transformer areas, and additional previously disturbed areas within the plant boundaries. Transformer oil, electrical system asbestos, small amounts of mercury in switches and flow meters, grease and lubricants, PCBs and heavy metals (lubricating greases/painted surfaces), nonhazardous solvents, and oil-contaminated solids are some of the typical wastes that would likely be encountered during the expected construction/rehabilitation activities associated with both alternatives.

3.15.2. Environmental Consequences

Both the No Action Alternative and the Nickajack HMOD Alternative would involve similar construction activities. Under either alternative the construction footprint would be confined to areas of the hydro plant itself, previously disturbed areas within the plant boundaries, and areas of the tailwater that are to have shoreline stabilization per agreement with the Tennessee SHPO and United States Fish and Wildlife Service. Temporary engineering controls, barriers/containment, and precautions would be employed to minimize waste generation and ensure wastes are contained to prevent introduction of waste into the environment. Spill kits, secondary containment, and storm drain blocking materials would be available under either alternative in the event of a spill.

As with present operations all wastes generated would be properly handled and disposed of per the facility waste management plan (WMP) in accordance with federal, state, and local regulations. Short-term, construction-associated waste volumes would not be significant. All removed/unused materials such as metals, containers, oil, etc., would be recycled/reused to the extent economically feasible. Solids that are released by deliberate cutting, sawing, etc. would be contained and placed with the other waste material that is disposed of or recycled. Estimates of such releases would be compiled for toxic release inventory (TRI) consideration. All weight quantities of metals/materials/equipment (by type) with designation as whether used/installed/removed/recycled/disposed of would be assessed for TRI/persistent biocumulative toxic chemicals reporting considerations. These

include (but are not limited to) copper; steel; pipe; conduit; paving materials, galvanized fencing; used oil; wire; cable; welding rods; fuels combusted on site; sandblast; equipment with PCBs, asbestos, mercury, lead, etc. BMPs would be exercised for all construction and shoreline stabilization activities associated with either alternative.

The present Hydro Environmental Project/Outage Management Plan (HEPOMP) would be followed to assure that TVA employees/contractors/partners comply with all applicable environmental requirements during the project work associated with either alternative. Among other topics, the HEPOMP covers the handling, storage, and minimization of hazardous waste, PCBs, asbestos, spill response, air quality (releases), solid waste, wastewater, lead abatement, chemical traffic control, and refueling activities.

The application of BMPs, coupled with the adherence to the facility WMP and the governance provided by the HEPOMP, assures that any potential waste generation impacts from either of the alternatives would be insignificant.

3.16. Cumulative Impacts

The proposed Nickajack HMOD Alternative is limited in scope and would have minimal physical impacts on the environment. The increase of the typical current flow rate from 42,000 cfs to a new MSL of 51,000 cfs would have no significant effects on the natural environment. No net increases in flow volume through NJH and Nickajack Dam would occur. HMOD could potentially have direct effects on cultural resources, but as no other activities are occurring in the vicinity, shoreline stabilization efforts are currently underway for Burns Island, and net erosion increases would be insignificant. Therefore, no cumulative effects on cultural resources are expected.

3.17. Summary of TVA Commitments and Proposed Mitigation Measures

The following commitments are identified in various media sections of this FEA as measures necessary to avoid or mitigate potential adverse effects related to adoption of either the No Action or HMOD alternatives. These measures constitute commitments that TVA would follow to better assure minimum and insignificant potential impacts on the archaeological and environmental resources of the NJH and tailwater.

1. **Waste Generation**. Application of BMPs for all construction and shoreline stabilization activities associated with either alternative. Adherence to the facility WMP and the guidance of the HEPOMP to assure that TVA employees, contractors, and partners comply with all applicable environmental requirements during the project work associated with either alternative.

2. **Cultural Resources**. Under the Nickajack HMOD Alternative, TVA would conduct a Phase I survey to identify NRHP potentially eligible, eligible, or listed archaeological sites/districts within the APE. The level of survey would determine potential eligibility and assess site condition with regard to the effects of shoreline erosion for both newly recorded and previously recorded sites. Since the Phase I Archaeological Survey could not be completed at summer pool elevations, TVA entered into an MOA with the Tennessee SHPO and other consulting parties for a phased approach for the identification, evaluation, and treatment of archaeological sites/districts eligible for and/or listed in the NRHP. Fieldwork for the proposed Phase I survey is scheduled for winter of 2008 when Guntersville pool elevations are less than 594 feet.

CHAPTER 4

4.0 LIST OF PREPARERS

Barry L. Barnard

Position:	Specialist, Environmental Permitting and Compliance Support, TVA Research & Technology Applications, Muscle Shoals, Alabama
Education:	B.S., Chemical Engineering
Experience:	35 years in Air Pollution Compliance Engineering, Permitting, Emissions Monitoring, and Impact Assessment
Involvement:	Air Quality

Angie S. Ballew

Position:	Waste Program Manager, TVA Environmental Stewardship and Policy, Chattanooga, Tennessee
Education:	B.A., Biology
Experience:	15 years in Hazardous and Solid Waste Compliance
Involvement:	Waste Generation

John (Bo) T. Baxter

Position:	Senior Aquatic Biologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	M.S. and B.S., Zoology
Experience:	17 years in Protected Aquatic Species Monitoring, Habitat Assessment, and Recovery; 7 years in Environmental Review
Involvement:	Aquatic Ecology/Threatened and Endangered Species

Jennifer M. Call

Position:	Meteorologist, TVA Research & Technology Applications, Muscle Shoals, Alabama
Education:	M.S. and B.S., Meteorology/Geosciences
Experience:	5 years in Meteorological Forecasting, Air Quality Monitoring, Data Analysis, and Air Quality Research
Involvement:	Air Resources

Patricia B. Cox

Position:	Senior Botanist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	Ph.D., Botany (Plant Taxonomy and Anatomy); M.S. and B.S., Biology
Experience:	30 years in Plant Taxonomy at the Academic Level; 3 years with TVA Heritage Project
Involvement:	Terrestrial Ecology, Invasive Plant Species, and Threatened and Endangered Species

Melvin B. Dean

Position:	Computer Technician-Geographic Information System, TVA Research & Technology Applications, Chattanooga, Tennessee
Education:	A.S., Civil Engineering Technology
Experience:	26 years in Mapping and Geographic Information System Work
Involvement:	Geographic Information System

James H. Eblen

Position:	Contract Economist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	Ph.D., Economics; B.S., Business Administration
Experience:	39 years in Economic Analysis and Research

Jenny K. Fiedler

Position:	Terrestrial Zoologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	M.S., Wildlife Science; B.S., Biology-Environmental Emphasis
Experience:	8 years in Field Biology; 3 years in NEPA Compliance
Involvement:	Terrestrial Ecology, Threatened and Endangered Species

James R. Hagerman

Position:	Environmental Engineer, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	M.S. and B.S., Agricultural Engineering; Registered Professional Engineer
Experience:	16 years in Nonpoint Source Pollution and Water Quality
Involvement:	Surface Water Resources, Erosion, and Sedimentation

Travis Hill Henry

Position:	Terrestrial Zoologist Specialist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	M.S., Zoology; B.S., Wildlife Biology
Experience:	17 years in Zoology, Endangered Species, and NEPA Compliance
Involvement:	Terrestrial Ecology, Threatened and Endangered Species

Ruth M. Horton

Position:	Senior NEPA Specialist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	B.S., History
Experience:	28 years in Public Policy and Planning, including 10 years in Environmental Impact Assessment
Involvement:	NEPA Compliance and Document Preparation

Clinton E. Jones

Position:	Aquatic Community Ecologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	B.S., Wildlife and Fisheries Science
Experience:	15 years in Environmental Consultation and Fisheries Management
Involvement:	Aquatic Ecology and Aquatic Threatened and Endangered Species

R. Keith Jones

Position:	Mechanical Engineer, TVA River Operations, Knoxville, Tennessee
Education:	B.S., Mechanical Engineering
Experience:	21 years in Hydro Operations, Monitoring, and Optimization
Involvement:	Power Simulation Studies

Colleen R. Montgomery

Position:	Civil Engineer, TVA River Operations, Knoxville, Tennessee
Education:	M.S., Environmental Engineering; B.S., Civil Engineering; Registered Professional Engineer in Tennessee
Experience:	15 years in Surface Water and Water Quality Modeling and Flood Risk Analysis
Involvement:	Flood Risk

Kim Pilarski-Brand

Position:	Senior Wetlands Biologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	M.S., Geography, Minor Ecology
Experience:	12 years in Wetlands Assessment and Delineation
Involvement:	Wetlands

Jon C. Riley

Position:	Landscape Architect, TVA Environmental Stewardship and Policy, Muscle Shoals, Alabama
Education:	Bachelor of Landscape Architecture, Associate Member American Society of Landscape Architects
Experience:	8 years in Site Planning, Design, and Visual Resource Management
Involvement:	Land Use and Visual Resources

Marianne M. Shuler

Position:	Archaeologist Technician, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	B.A., Religion/Middle Eastern Archaeology
Experience:	6 years in Middle Eastern Archaeology; 5 years in Southeastern United States Archaeology
Involvement:	Cultural Resources

Jan K. Thomas

Position:	Contract Natural Areas Specialist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	M.S., Human Ecology
Experience:	10 years in Health and Safety Research, Environmental Restoration, Technical Writing; 3 years in Natural Area Reviews
Involvement:	Managed Areas and Sensitive Ecological Sites

Tina M. Tomaszewski

Position:	Senior NEPA Specialist, TVA Environmental Stewardship and Policy, Chattanooga, Tennessee
Education:	M.S. and B.S., Chemical Engineering
Experience:	23 years in Reservoir Water Quality, Wastewater and Hazardous Waste Treatment, and Environmental Reviews
Involvement:	Surface Water Quality and Document Preparation

Matthew D. Williams

Position:	Environmental Engineer, TVA Research & Technology Applications, Knoxville, Tennessee
Education:	B.S., Civil Engineering; Professional Engineer
Experience:	5 years in Hydrologic/Environmental Investigation and Analysis for Environmental and Engineering Applications
Involvement:	Groundwater

W. Richard Yarnell

Position:	Archaeologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education:	B.S.
Experience:	36 years, Cultural Resources Management
Involvement:	Cultural Resources

Bruce L. Yeager

Position:	NEPA Program Manager, TVA NEPA Policy, Knoxville, Tennessee
Education:	M.S., Zoology (Ecology); B.S., Zoology (Aquatic Ecology)
Experience:	32 years in Environmental Compliance for Water, Air, and Land Use Planning; Environmental Business Services
Involvement:	Review for Compliance with Agency NEPA Policy and Procedures

CHAPTER 5

5.0 LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS TO WHOM COPIES ARE SENT

Federal Agencies

United States Army Corps of Engineers, Nashville District
United States Fish and Wildlife Service, Cookeville Office

State Agencies

Tennessee Department of Environment and Conservation
Tennessee State Historic Preservation Office
Tennessee Wildlife Resources Agency

Other Agency

United Keetoowah Band of the Cherokee Indians

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CHAPTER 6

6.0 LITERATURE CITED

Alexander, L. A., and M. F. Trudeau. 2005. *Phase I Cultural Resources Survey and Limited Testing of Burns Island, Marion County, Tennessee.* Report submitted to Tennessee Valley Authority. Knoxville, Tennessee, by Alexander Archaeological Consultants.

Beene, P. B. 1998. *The Tennessee Encyclopedia of History and Culture*, 1063-1064. Edited by Carroll Van West. Nashville, Tenn.: The Rutledge Hill Press.

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. *Classification of Wetland and Deepwater Habitats of the United States*. Washington, D.C.: United States Fish and Wildlife Publication FWS/OBS-79/31.

Dycus, D. L., and T. F. Baker. 2001. *Aquatic Ecological Health Determinations for TVA Reservoirs - 2000: An Informal Summary of 2000 Vital Signs Monitoring Results and Ecological Health Determination Methods*. Primary authors/editors D. L. Dycus and T. F. Baker. Chattanooga, Tenn.: Tennessee Valley Authority, Water Management.

Elder, J. A. 1958. *Soil Survey of Marion County, Tennessee*. United States Department of Agriculture, Soil Conservation Service, in Cooperation with Tennessee Agricultural Experiment Station and Tennessee Valley Authority.

Environmental Laboratory. 1987. *Corps of Engineers Wetland Delineation Manual*. Vicksburg, Miss.: United States Army Corps of Engineers Waterways Experiment Station, Technical Report Y-87-1.

Griffith, G.E., J. M. Omernik, J. A. Comstock, S. Lawrence, G. Martin, A. Goddard, V. J. Hulcher, and T. Foster. 2001. Ecoregions of Alabama and Georgia (color poster with map, descriptive text, summary tables, and photographs). Reston, Va.: United States Geological Survey (map scale 1:1,700,000).

James, W. 2002. *Nonnative, Noninvasive Species Suitable for Public Use Areas, Erosion Control/Stabilization and Wildlife Habitat Plantings*. Compiled by W. James, Lenoir City, Tennessee, TVA Watershed Team Office, as a result of Interdisciplinary Team for the Implementation of the Executive Order of Invasive Species, unpublished report.

Marshall, S. 2007. June 6, 2007, E-Mail From Scott Marshall (Scott.Marshall@state.tn.us) to Matthew Williams (mdwilliams@tva.gov). Subject: Sequatchie and South Pittsburg Quadrangle Wells.

NatureServe. 2007. "An Online Encyclopedia of Life." *NatureServe Explorer*, *Version 6.1.* Arlington, Va.: Nature Serve. Retrieved from <http://www.natureserve.org/explorer> (accessed June 11, 2007).

Newcome, R., Jr., and O. Smith Jr. 1958. *Ground Water Resources of the Cumberland Plateau in Tennessee.* Nashville, Tenn.: State of Tennessee Department of Conservation, Division of Water Resources.

Schneider, M., and M. F. Trudeau. 2005. *Archaeological Shoreline Assessment for Burns Island and Boyd's Farm Parcel, Marion County*, *Tennessee*. Report submitted to TVA, Knoxville, Tennessee, by Alexander Archaeological Consultants.

Solis, C., and E. Futato. 1987. *Cultural Resource Investigations in the Guntersville Reservoir Area, Marshall and Jackson Counties, Alabama, and Marion County, Tennessee.* University of Alabama, Report of Investigations 48.

Tennessee Valley Authority. 1963. *The Nickajack Project.* TVA, Division of Water Control Planning-Project Planning Branch, Report No. 44-100.

———. 1983. *Instruction IX Environmental Review*. Retrieved from <http://www.tva.gov/environment/reports/pdf/tvanepa_procedures.pdf> (n.d.)

———. 1995. *Energy Vision 2020 - Integrated Resource Management Plan and Final Programmatic Environmental Impact Statement*, July 1, 1995. Record of Decision, February 22, 1996.

———. 1997. *Recreation Development Alternatives for the Little Cedar Mountain Tracts, Nickajack Reservoir, Marion County, Tennessee, Final Environmental Assessment*, January 21, 1997.

———. 1999. *Shoreline Management Initiative (SMI): An Assessment of Residential Shoreline Development Impacts in the Tennessee Valley, Final Environmental Impact Statement*, June 1999.

———. 1999. *Lower Sequatchie River Management Unit Plan and Environmental Assessment*, September 17, 1999.

———. 2001a. *Guntersville Reservoir Land Management Plan, Jackson and Marshall Counties, Alabama, and Marion County, Tennessee, Final Environmental Impact Statement,* August 2, 2001.

———. 2001b. *Modernization of Turbines at Watts Bar Hydro Plant, Rhea County, Tennessee, Final Environmental Assessment and Finding of No Significant Impact,* December 12, 2001.

———. 2004a. *Reservoir Operations Study Final Programmatic Environmental Impact Statement*, February 2004. Record of Decision, May 2004. Prepared in cooperation with the U.S. Army Corps of Engineers and the U.S. Fish and Wildlife Service.

———. 2004b. *Nickajack Marina Land Use Approval for Proposed Commercial Upland Recreation Development and Section 26a Approval for Marina Expansion at Mile 431.1-Left Bank, Tennessee River, Final Environmental Assessment and Finding of No Significant Impact*, January 7, 2004.

———. 2005a. *Wilson Hydro Plant Modernization of Hydroturbines, Lauderdale and Colbert Counties, Alabama, Final Environmental Assessment and Finding of No Significant Impact,* January 28, 2005.

———. 2005b. *Proposed Development of Tract XNJR-3PT (Nickajack Shores), Nickajack Reservoir, Marion County, Tennessee, Final Supplemental Environmental Assessment*, September 20, 2005.

———. 2006. Vital Signs Monitoring Results and Ecological Health Data for TVA Reservoirs, unpublished data.

Tennessee Department of Environment and Conservation. 2007. *Known High-Quality (Tier 2 and Tier 3) Waters in Tennessee.* Retrieved from <http://www.tennessee.gov/environment/wpc/publications/hqwlist.mht> (accessed September 11, 2007).

———. 2006. *Final Version Year 2006 303(d) List*. Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Planning and Standards Section, August 2006.

———. 2004. *Rules of Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Amendments, Chapter 1200-4-4, Use Classifications for Surface Waters.* Revised January 2004.

Thomas, D. P., and T. L. Best. 2000. "Radiotelemetric Assessment of Movement Patterns of the Gray Bat (Myotis Grisescens) at Guntersville Reservoir, Alabama," *Occasional Papers of the North Carolina Museum of Natural Sciences and the North Carolina Biological Survey* 12:27-39.

United States Geological Survey. 1990. *Recharge Rates and Aquifer Hydraulic Characteristics for Selected Drainage Basins in Middle and East Tennessee.* Nashville, Tenn.: USGS, Water-Resources Investigations, Report No. 90-4015.

Weakley, A. S. 2007. *Flora of the Carolinas, Virginia, and Georgia, and Surrounding aaeas*. Chapel Hill, N.C.: University of North Carolina Herbarium. Retrieved from <http://www.herbarium.unc.edu/flora.htm> (accessed June 11, 2007).

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Appendix A – Agency Correspondence Concerning the Draft Environmental Assessment

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DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
Regulatory Branch
3701 Bell RD
Nashville, TN 37214

JAN - 9 2008

Doc. Type: EA Admin Record
Index Field: Agency Comments
Project Name: Nickajack Hydro HMOD
Project No.: 2006-57

January 3, 2008

Regulatory Branch

SUBJECT: File No. 200800013; Draft Environmental Assessment - Proposed Modernization of Hydroturbines at Nickajack Hydro Plant (NJH), in Marion County, Tennessee

Mr. Jon M. Loney
Senior Manager, NEPA Policy
Environmental Stewardship and Policy
Tennessee Valley Authority
400 Summit Hill Drive
Knoxville, Tennessee 37902-1499

Dear Mr. Loney:

This refers to your recent request for comments to the subject Draft Environmental Assessment (DEA). TVA would hydromodernize NJH's Units 1 through 4 between the years 2009 through 2016 to gain capacity and improve efficiency at the power plant. All work being considered would occur inside the existing structure. In the future, please reference File No. 200800013 when writing or calling us about this work.

Based on the information provided in the DEA, we have determined that your proposed activity is not subject to our regulatory authorities. Therefore, a DA permit is not required. In addition, we believe that the proposal would result in relatively minor environmental impacts.

Thank you for including us in your scoping process. When available, we would appreciate a copy of the final EA for our files. If you have any questions, please contact me at the above address or telephone (615) 369-7519.

Sincerely,

J. Ruben Hernandez

J. Ruben Hernandez
Project Manager
Operations Division

0801 00286

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

RECEIVED

January 8, 2008

JAN 1 0 2008

Doc. Type: EA- Admin Record
Index Field: Agency Comment
Project Name: Nickajack Hydro Amod
Project No.: 2006-59

Mr. Jon M. Loney
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1499

Attention: Bruce Yeager

Re: FWS #2008-FA-0216

Dear Mr. Loney:

Thank you for your letter and enclosure of November 30, 2007, regarding the Draft Environmental Assessment (EA) for the Proposed Modernization of Hydroturbines at Nickajack Hydro Plant in Marion County, Tennessee. The proposed action would increase tailwater elevations and velocities in the Tennessee River below Nickajack Dam (TRM 424.7) downstream to Burns Island (TRM 419.7). U.S. Fish and Wildlife Service (Service) personnel have reviewed the information submitted and offer the following comments for consideration.

The draft EA is adequate and supports the conclusion of "no effect" for the federally threatened snail darter (*Percina tanasi*) and the federally endangered royal marstonia (*Pyrgulopsis ogmorhaphe*) and gray bat (*Myotis grisescens*), with which we concur. In view of this, we believe that the requirements of section 7 of the Endangered Species Act of 1973, as amended, are fulfilled for these species. Obligations under section 7 of the Act must be reconsidered if (1) new information reveals impacts of the proposed action that may affect listed species or critical habitat in a manner not previously considered, (2) the proposed action is subsequently modified to include activities which were not considered during this consultation, or (3) new species are listed or critical habitat designated that might be affected by the proposed action.

A "not likely to adversely affect" finding appears warranted for the federally endangered pink mucket (*Lampsilis abrupta*) and Anthony's river snail (*Athearnia anthonyi*). Since the tailwater reach of the Tennessee River below Nickajack Dam is a State Mussel Sanctuary, the potential effects on existing aquatic habitats should be carefully monitored to validate your modeling predictions and to ensure that this habitat is adequately protected. We suggest that the draft EA be modified to include a comprehensive monitoring proposal that documents and evaluates changes in tailwater evaluations, velocities, and water quality after implementation of the preferred alternative. Provided the draft EA is modified accordingly, the Service can re-evaluate your findings for these aquatic species.

These constitute the comments of the U.S. Fish and Wildlife Service, provided in accordance with provisions of the Endangered Species Act (87 Stat. 884, as amended: 16 U.S.C. 1531 et seq.) and the National Environmental Policy Act (42 U.S.C. 4321-4347; 83 Stat. 852). Your interest and initiative to protect endangered and threatened species are greatly appreciated. If you have questions or if we can be of further assistance, please contact Steve Alexander of my staff at 931/528-6481, ext. 210, or via e-mail at *steven_alexander@fws.gov*.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

xc: Dave McKinney, TWRA, Nashville

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Tennessee Valley Authority, 400 West Summit Hill Drive, Knoxville, TN 37902-1499

January 30, 2008

Dr. Lee A. Barclay
Field Supervisor
U.S. Fish and Wildlife Service
446 Neal Street
Cookeville, TN 38501

Dear Dr. Barclay:

This letter responds to comments received from your office in a letter dated January 8, 2008, on the Draft Environmental Assessment (EA) for the Proposed Modernization of Hydroturbines at Nickajack Hydro Plant in Marion County, Tennessee.

In your letter you agreed that the draft EA supported TVA's "no effect" determination for the snail darter (*Percina tanasi*) federally listed as threatened, and the royal marstonia (*Pyrgulopsis ogmorhaphe*) and gray bat (*Myotis grisescens*) both listed as endangered. The letter questioned the suitability of a "no effect" determination for the pink mucket (*Lampsilis abrupta*) and Anthony's river snail (*Athearnia anthonyi*) both federally listed as endangered based on the potential for effects to instream habitat and water quality following turbine modernization. TVA staff biologists feel that our initial determinations are accurate and we are providing additional information to your office in support of our determination.

Your letter expressed concern over the magnitude of changes in tailwater elevations, and bottom velocities predicted by modeling, and suggested monitoring of these changes (and water quality) to verify whether the conditions predicted in the EA were accurate. The attached information explains our analysis of the modeling predictions for bottom velocities using velocity data collected January 23, 2008 from the Nickajack tailwater.

Because the maximum flows following modernization of the turbines at Nickajack fall within the range of historically measured flows, the tailwater elevations described in the EA are currently observed or exceeded approximately 20% of the time. These elevations are within the current range seen in the tailwater and do not represent a significant change in habitat conditions. The additional duration at these elevations would not cause or significantly contribute to shoreline erosion or other habitat effects in the Nickajack tailwater.

Dr. Lee A. Barclay
Page 2
January 30, 2008

Acoustic Doppler Current Profile information was gathered to validate the bottom velocities predicted by the model at a known flow rate (37,000 cfs) and to verify our conclusions regarding potential impacts to instream habitat. The actual measurements were well within the range predicted by the model. We feel that the model accurately predicts instream conditions under a variety of flow conditions. TVA staff concludes that the ~0.1 ft/s increase in bottom velocities predicted by the model under maximum generation flows (51,000 cfs) accurately reflects what would occur following modernization of these turbines. Flow changes of this magnitude would not result in the destabilization of bedload material, and would not cause impacts to the listed species or their habitat in Nickajack tailwater. The maximum generation flows that would be seen following modernization (51,000 cfs) are regularly exceeded under current operations when Nickajack Dam is both generating at full capacity and spilling to release excess water. Use of the modernized turbines would not result in changes to the existing flow regime that would adversely alter existing conditions downstream of Nickajack Dam.

Water quality is not an issue in Nickajack Reservoir or the Nickajack Dam tailwater due to the relatively small size of Nickajack Reservoir and a short retention time in the reservoir. The reservoir does not undergo a strong stratification like many other reservoirs, and none of the associated water quality problems (low dissolved oxygen, etc.) that result from reservoir stratification are observed in Nickajack Reservoir. These conditions would not change following modernization of the turbines at Nickajack Reservoir.

We appreciate your review of the document and have revised the EA based on your comments. We have also included this correspondence in support of our initial findings in the EA.

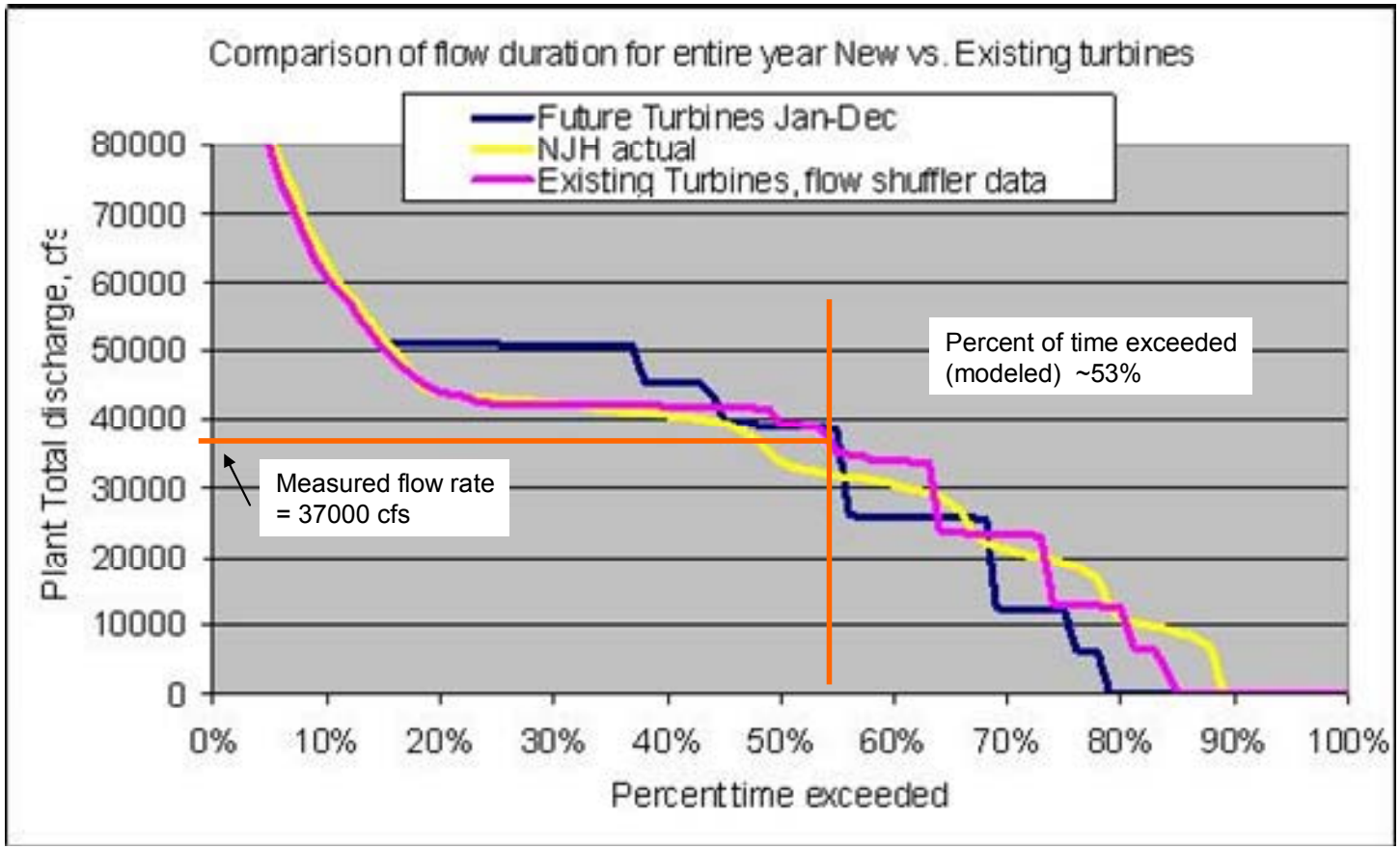
If you have any questions, please contact Bo Baxter at (865) 632-3360.

Sincerely,

Original signed by

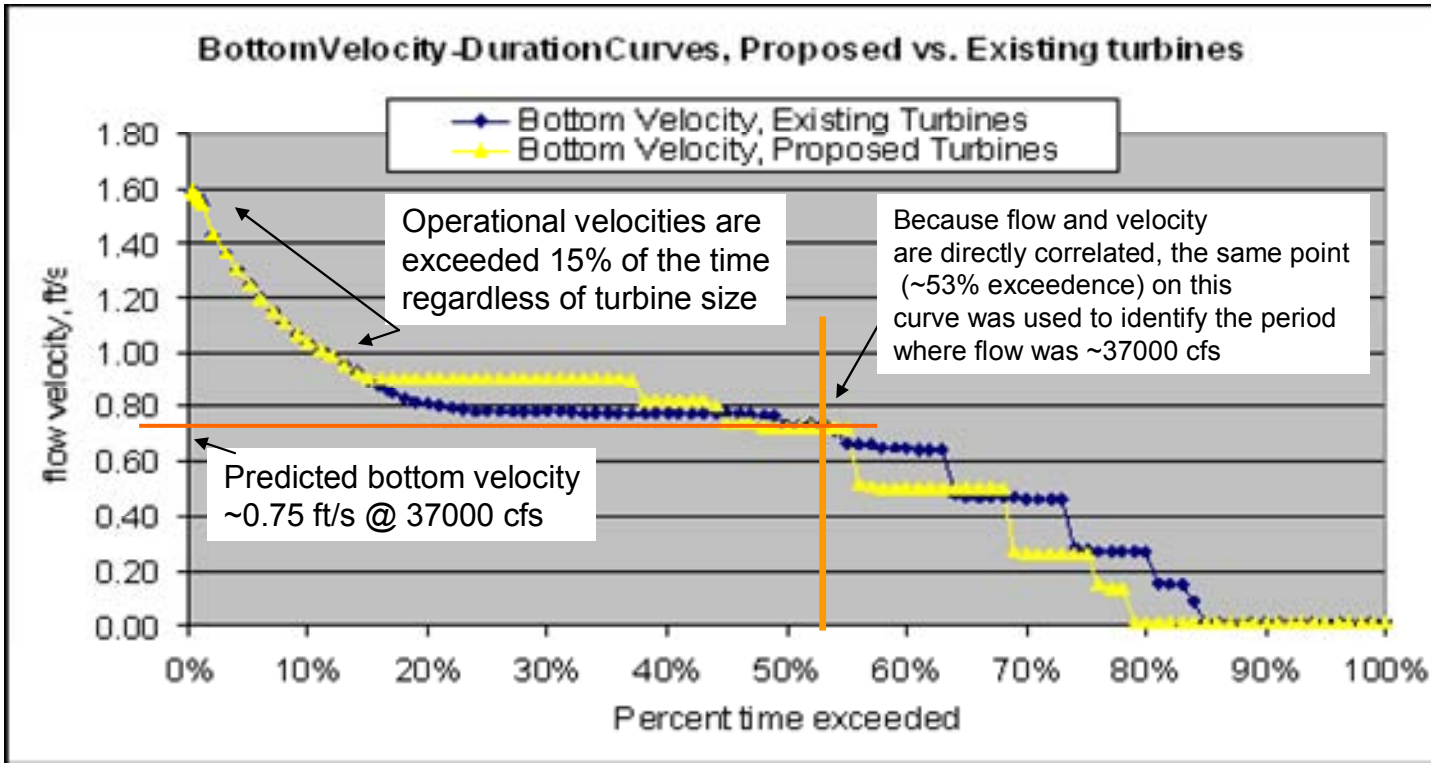
Peggy W. Shute, Manager
Heritage Resources

The modeled flow duration curve was used to predict the amount of time that specific velocities are exceeded. This data is compared to the actual conditions below. Because flow and velocity are directly correlated, the modeled flow duration curve was used to predict the amount of time that specific velocities are exceeded. In the graph below, modeled flow durations are compared to actual conditions. Velocity measurements were taken at 37,000 cfs on January 23, 2008. Therefore, measured flow rate of 37,000 cfs was used to determine the percent of time this velocity is exceeded (~53% of the time). In the graph on the next page, this value is used as the basis for determining the predicted bottom velocity at Burns Island (RM 420.5) at a flow rate of 37,000 cfs.

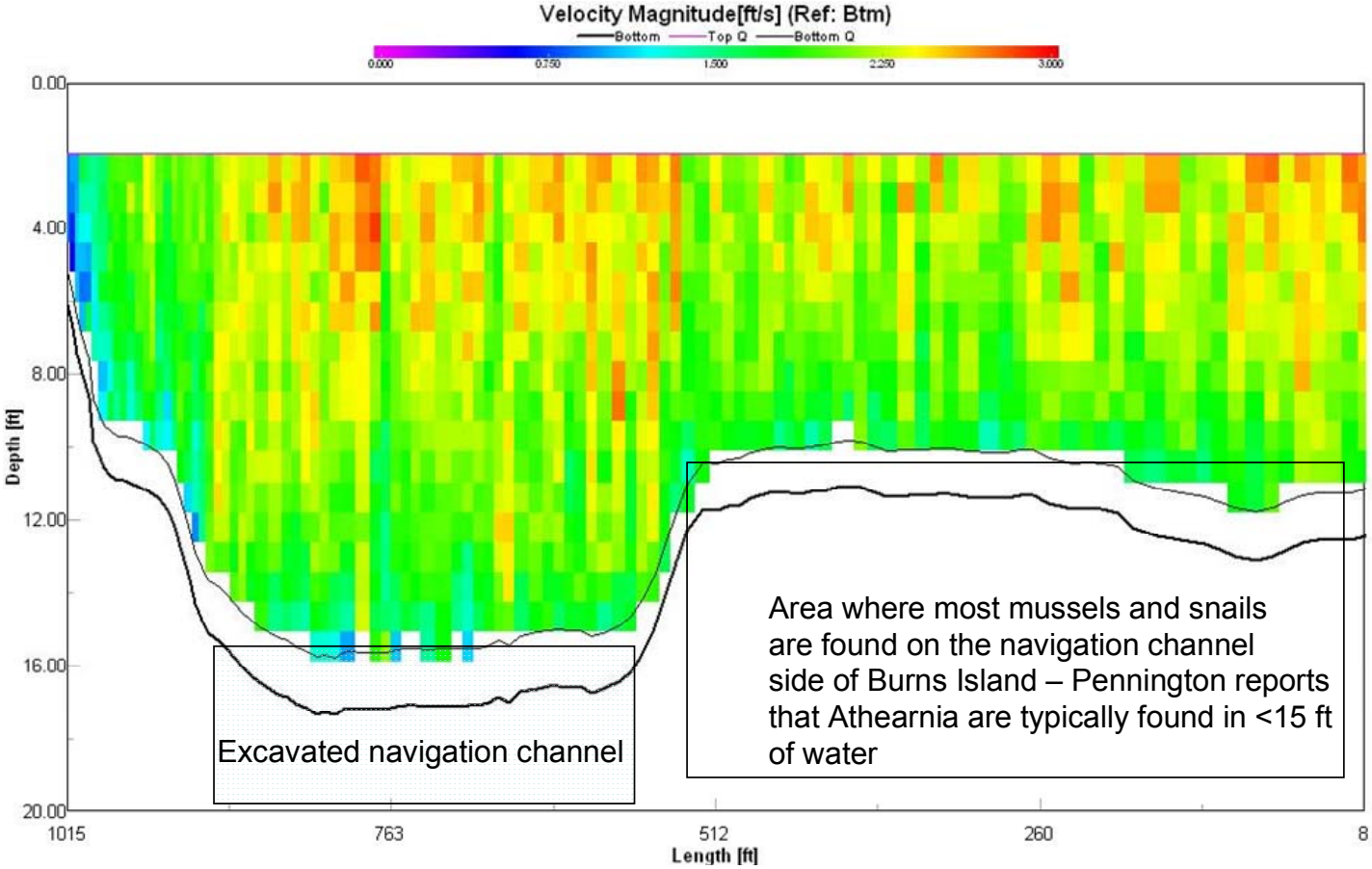


The velocity model shows the same shape as the flow model because flow and velocity are directly correlated. The exceedence point (~53%) identified in the flow model at 37,000 cfs was used to determine the predicted bottom velocity at a flow of 37,000 cfs.

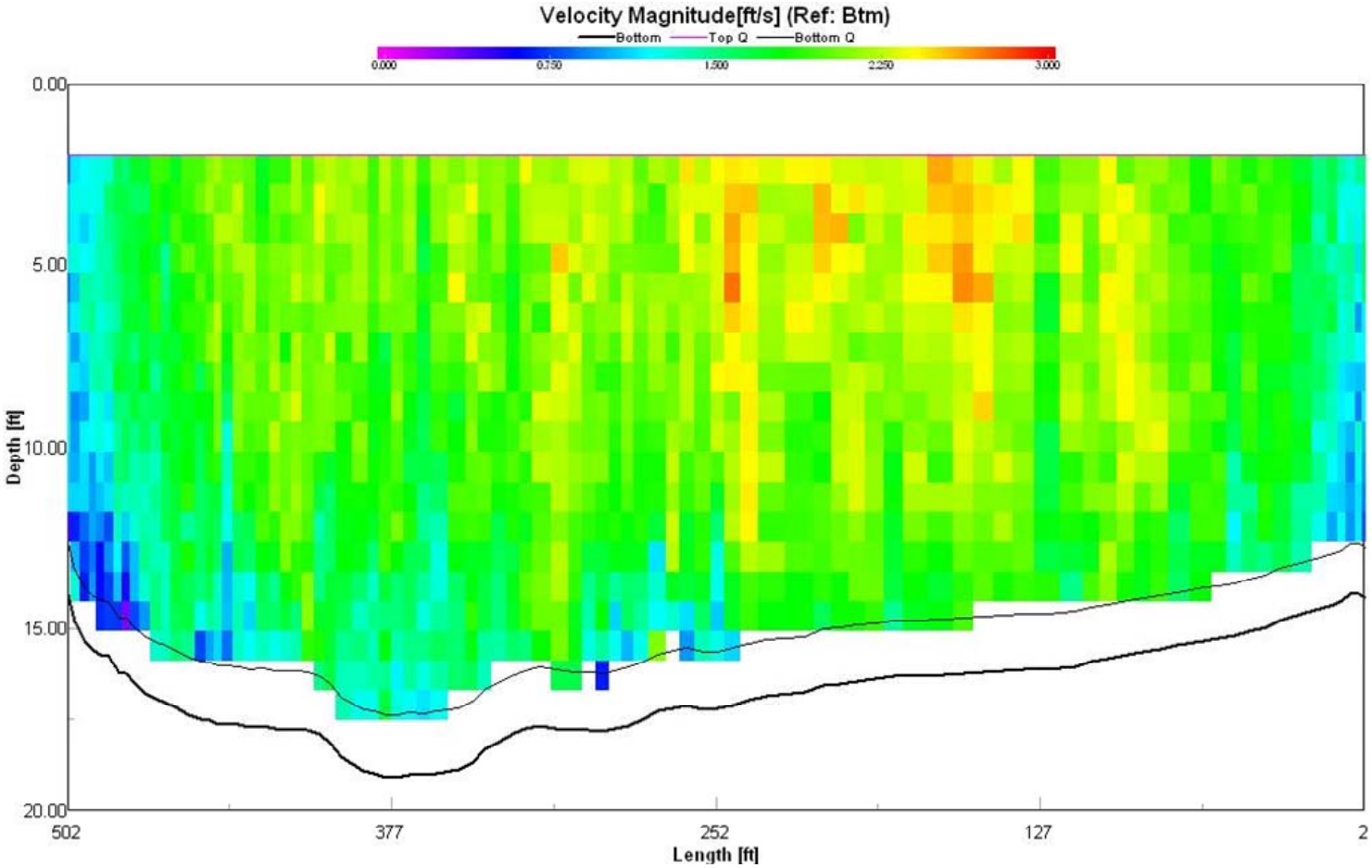
That predicted bottom velocity at RM 420.5 was about 0.75 ft/s. Please note that the predicted maximum velocity due to turbine release is about 0.90 ft/s, and this maximum discharge is exceeded approximately 15% of the time regardless of turbine size.



Acoustic Doppler Current Profile velocity measurements in a transect across the river in the right descending channel side of Burns Island (RM 420.5) (=navigation channel side) with flow of 37,000 cfs. The two lines at the bottom of the graph show the bottom profile (lower line) and the limit of the Doppler measurements. The bottom 1-2 feet are not measured due to the limitations of the equipment, but velocities continue to drop off in a fairly linear manner as you approach the bottom. The darker blue squares are at about 0.75 ft/s, so some areas are already measuring near the predicted bottom velocity. Velocities continue to decrease as you near the bottom, and bottom velocities would be correspondingly lower. The model predicted approximate bottom velocities of 0.75 ft/s in this area. This is right in line with the actual measurements. Actual velocity measurements were at or lower than predicted levels.



Acoustic Doppler Current Profile velocity measurements on the left descending channel side of Burns Island (RM 420.5) (=back channel) with flow of 37,000 cfs. As with the channel side, the model predicts approximate bottom velocities of 0.75 ft/s in this area. This is right in line with the actual measurements. In fact, actual measurements are below predicted levels in the slower back channel of the island due to channel morphology and gradient. Mussels and snails are also present in this area.



Conclusions of field verification of modeling results

- This model accurately predicts bottom velocities in Nickajack tailwater.
- Predicted velocities (0.75 ft/s at a flow rate of 37,000) were very close to actual measured velocities
- Maximum predicted velocities of ~0.9 ft/s at Burns Island at maximum turbine discharge represent an increase of only 0.1 ft/s over current conditions
- Downstream elevations have been truthed to the model as a required part of flood risk analysis. Predicted elevation changes in the Nickajack tailwater are accurate.

Implications for fish mussels and snails present in Nickajack tailwater

- The maximum bottom velocities predicted by the model do not exceed 1.0 ft/s. The predicted bottom velocity of 0.9 ft/s represents a 0.1 ft/s increase in bottom velocities over the 0.8 ft/s seen under current operations and is not a significant change. Field verification of the model indicates that these predictions are accurate.

- Bottom velocities of <1.0 ft/s would not to contribute to instream erosion or negative effects on instream habitat.

- The maximum bottom velocities generated by turbine discharge predicted by the model are regularly exceeded under current operations when river flows exceed turbine capacity, and spilling occurs. These conditions will be altered only slightly (~3% less frequent) with higher capacity turbines.

- Because Nickajack Reservoir is relatively shallow and small when compared to other mainstream reservoirs, it does not have a long retention time and does not stratify during summer months. Water quality problems (especially low DO) sometimes associated with TVA reservoirs are not observed at Nickajack. These conditions would not change as a result of the hydromodernization. The changes in velocity that would be seen would have no noticeable effect on current habitat conditions, and would not adversely effect aquatic species present in Nickajack tailwater.

Appendix B – Aquatic Animal Species Historically Reported Near Nickajack Dam

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Table B–1. Aquatic Species Historically Reported From the Tennessee River System, but Either no Longer Occurring in Areas Affected by Nickajack Operations or Present Only in the Paint Rock River System in Jackson County, Alabama

Common Name	Scientific Name	Federal Status	State Status/ Rank
Mussels			
Pheasantshell	*Actinonaias pectorosa*	-	NOST/S1 (AL)
Spectaclecase	*Cumberlandia monodonta*	CAND	NOST/S2S3 (TN)
Narrow catspaw	*Epioblasma lenior*	-	EXTI?/SX (AL)
Hickorynut	*Obovaria olivaria*	-	EXTI/SX (AL)
Orange-foot pimpleback	*Plethobasus cooperianus*	END	PROT/S1 (AL)
Sheepnose	*Plethobasus cyphyus*	CAND	PROT/S1 (AL)
Dromedary pearlymussel	*Dromus dromas*	END	END/S1 (TN)
Angled riffleshell	*Epioblasma biemarginata*	-	EXTI?/SX (AL)
Ring Pink	*Obovaria retusa*	END	PROT/S1 (AL)
Rough pigtoe	*Pleurobema plenum*	END	PROT/S1 (AL)
Cumberland monkeyface	*Quadrula intermedia*	END	PROT/S1 (AL)
Cumberland bean	*Villosa trabalis*	END	PROT/SX (AL)
Elktoe	*Alasmidonta marginata*	-	PROT/SX (AL)

- Indicates not applicable

Status/Rank Codes:

CAND = Candidate for federal listing
END = Endangered
NOST = No legal status, but tracked by the Tennessee or Alabama Natural Heritage programs
EXTI = Extirpated from the state
EXTI? = Potentially extirpated from the state

S1 = Extremely rare and critically imperiled in the state with 5 or fewer occurrences; or very few remaining individuals; or because of some special condition, where the species of some factor(s) make it vulnerable to extinction
S2 = Very rare and imperiled within the state, 6 to 20 occurrences
S3 = Rare or uncommon with 21 to 100 occurrences
SX = Extirpated from the state

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Appendix C – Memorandum of Agreement Between TVA and the Tennessee State Historic Preservation Officer

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MEMORANDUM OF AGREEMENT PURSUANT TO 36 CFR § 800 BETWEEN THE TENNESSEE VALLEY AUTHORITY AND THE TENNESSEE STATE HISTORIC PRESERVATION OFFICER

WHEREAS, the Tennessee Valley Authority (TVA) proposes to modernize the hydro-turbine units (HMOD) in Nickajack Hydro Plant (NJH) (Tennessee River Mile 424.7), Marion County, Tennessee; and,

WHEREAS, TVA proposes to modernize turbine units 1-4 (the Project) beginning in 2009 and ending in 2016, and,

WHEREAS, HMOD of units 1-4 may affect archaeological sites and/or districts eligible for listing in the National Register of Historic Places (NRHP); and,

WHEREAS, TVA has consulted with the Tennessee State Historic Preservation Officer (TN SHPO) in accordance with 36 CFR § 800, regulations implementing Section 106 of the *National Historic Preservation Act* (*NHPA*); and,

WHEREAS, TVA has consulted with the Eastern Band of Cherokee Indians, Cherokee Nation, United Keetoowah Band of Cherokee Indians, Muscogee (Creek) Nation of Oklahoma, Poarch Band of Creek Indians, Kialegee Tribal Town, Thlopthlocco Tribal Town, Alabama Quassarte Tribal Town, Alabama-Coushatta Tribe, the Seminole Tribe of Florida, and Chickasaw Nation regarding the potential for this undertaking to affect properties of religious, cultural, and traditional significance to those Indian tribes; and,

WHEREAS, the United Keetoowah Band of Cherokee Indians has requested an opportunity to concur in this Agreement; and,

WHEREAS, TVA, in consultation with TN SHPO, has determined that the area of potential effects (APE) for the Project will be the shoreline from Nickajack Dam at Tennessee River Mile (TRM) 424.7 downstream to TRM 419.7 on Guntersville Reservoir, including the shoreline of Burns Island and Sequatchie River from river mile 0.0 to river mile 2.7 (see Appendix A, Map); and,

WHEREAS, TVA, in consultation with TN SHPO and other consulting parties, has determined that the Project, taken by itself or cumulatively, may have an adverse effect on archaeological properties within the APE that are eligible for NRHP; and,

WHEREAS, APE is known to contain at least 35 archaeological properties plus the Burns Island Archaeological District and archaeological sites 40MI90 and 40MI167 located within APE have been determined eligible for listing on NRHP,

as described in Appendix A to this Agreement, Table and Map of Affected Archaeological properties; and,

WHEREAS, under 36 CFR § 800.5(a)(3) TVA must apply the criteria of adverse effect consistent with phased identification and evaluation efforts conducted pursuant to 36 CFR § 800.4 (b)(2); and,

WHEREAS, Pursuant to 36 CFR § 800.6, TVA, in consultation, will seek ways to avoid, minimize, or mitigate the adverse effects of the Project.

NOW THEREFORE, TVA and TN SHPO agree that the undertaking shall be implemented in accordance with the following stipulations to satisfy TVA's responsibilities under Section 106 of *NHPA*. The TVA Federal Preservation Officer, or the designee thereof, shall act for TVA in all matters concerning the administration of this Agreement.

Stipulations

TVA shall ensure that the following stipulations are implemented:

1. IDENTIFICATION

TVA, in consultation with TN SHPO, shall conduct investigations to identify archaeological properties within APE. The goal of these investigations will be to identify both known and unknown archaeological properties. A scope of work will be developed in consultation with the TN SHPO before the implementation of the survey. These investigations shall be carried out in a manner consistent with the Secretary of the Interior's (Secretary) Standards and Guidelines for Identification (48 FR 44720-23) and TN SHPO Standards and Guidelines for Archaeological Resource Management. TVA shall submit a draft report TN SHPO and all other consulting parties, who will have a thirty (30) day period to comment on each report.

2. EVALUATION

TVA, in consultation with TN SHPO, shall conduct investigations to evaluate NRHP eligibility of archaeological properties within APE. These evaluations shall be conducted in a manner consistent with the Secretary's Standards and Guidelines for Identification (48 FR 44720-23) and TN SHPO Standards and Guidelines for Archaeological Resource Management. When the investigations are completed, TVA shall submit a draft report to the TN SHPO and the United Keetowah Band of the Cherokee Indians, who will have a thirty (30) day period to comment on each report.

Archaeological properties evaluated in consultation with TN SHPO and found to meet NRHP criteria, shall be considered NRHP eligible. Should a dispute arise on the eligibility of an archaeological property, TVA shall consult with TN SHPO to resolve the objection. If TVA and TN SHPO do not agree, or if the Advisory Council on Historic Preservation (Council) or Secretary so request, TVA shall obtain a determination of eligibility from the Keeper of NRHP pursuant to 36 CFR § 63. If there is disagreement from an Indian tribe that attaches religious or cultural significance to a property, the tribe may ask the Council to request the TVA Federal Preservation Officer to obtain a determination of eligibility from the Keeper.

3. TREATMENT

TVA, in consultation with TN SHPO, shall apply the Criteria of Adverse Effect, defined at 36 CFR § 800.5(a)(1), to archaeological properties within the APE that are determined to be eligible for listing in NRHP. TVA, in consultation with TN SHPO, shall ensure that a Treatment Plan is developed and executed for the treatment of those NRHP-eligible archaeological properties in APE that will be adversely affected. The Treatment Plan will delineate a procedure for determining the most appropriate methods of avoiding, minimizing, or mitigating adverse effects on NRHP-eligible archaeological properties. Depending on the conditions of each specific archaeological property, such methods may include, but are not limited to: in-place preservation of the archaeological property, archaeological data recovery, or a combination of these methods. All treatment measures shall be monitored for effectiveness in the manner specified in Stipulation 3.e. of this Agreement.

Development and implementation of the Treatment Plan will be conducted as follows:

a. IN-PLACE PRESERVATION

TVA shall seek to preserve in-place those NRHP-eligible archaeological properties that would otherwise be subject to adverse effects from the Project, when in-place preservation is determined by TVA, in consultation with TN SHPO, to be economically and technically feasible. Methods of in-place preservation shall consist of hard armoring with rock, bio-engineering technology, or a combination of these methods as appropriate.

b. DECISION TO UNDERTAKE DATA RECOVERY

The following criteria will be applied by TVA, in consultation with TN SHPO, to determine if data recovery is the appropriate treatment method:

1. Adverse effects on the NRHP-eligible archaeological property are unavoidable.
2. In-place preservation of the NRHP-eligible archaeological property is not technically feasible;
3. In-place preservation is not economically feasible.
4. The NRHP-eligible archaeological property is significant and of value chiefly for the information on prehistory or history it is likely to yield through archaeological, historical, and scientific methods of information recovery, including archaeological excavation.
5. The NRHP-eligible archaeological property does not have long-term preservation value, such as traditional cultural and religious importance to an Indian tribe.
6. The NRHP-eligible archaeological property does not possess special significance to another ethnic group or community that historically ascribes cultural or symbolic value to the site and would object to the site's excavation and the removal of its contents.
7. The archaeological property is not appropriate for potential permanent in-situ display or public interpretation, although temporary public display and interpretation during the course of any excavations may be appropriate.
8. Human remains, associated or unassociated funerary objects, sacred objects, or items of cultural patrimony as those terms are defined by the *Native American Graves Protection and Repatriation Act* (25 U.S.C. 3001 et. seq.) (*NAGPRA*), are unlikely to occur in the area(s) where data recovery is being considered.

c. DEVELOPMENT OF A DATA RECOVERY PLAN

If data recovery is determined by TVA, in consultation with TN SHPO, as the preferred treatment method for an archaeological property, then TVA shall submit a Data Recovery Plan to TN SHPO for review and comment; and shall develop and execute the data recovery in consultation. Should TN SHPO object within 30 days to the Data Recovery Plan, TVA shall consult with TN SHPO to resolve the objection.

The Data Recovery Plan shall be consistent with the Secretary of the Interior's Standards and Guidelines for Archaeological Documentation (48 FR 44734-37) and shall consider and address the Council's publication, Section 106 Archaeology Guidance (2007). All data recovery will be carried out in a manner consistent with the Data Recovery Plan. The Data Recovery Plan shall specify, at a minimum:

1. The results of previous research relevant to the project;
2. Research problems or questions to be addressed with an explanation of their relevance and importance;

3. The field and laboratory analysis methods to be used, along with a justification of their cost-effectiveness and an explanation of how they apply to the property in question and how they will address the above research needs;
4. Explicit provisions for disseminating the research findings to professional peers in a timely manner;
5. Arrangements for presenting findings to the public and other interested parties that have vested interests in the results;
6. The curation of recovered materials and records resulting from the data recovery in accordance with 36 CFR § 79 (except in the case of objects that may need to be considered for repatriation pursuant to *NAGPRA*), including temporary and permanent repositories;
7. Procedures for evaluating and treating discoveries of unexpected remains or newly identified archaeological properties during the course of the project, including required consultation with other parties; and
8. A timeline for the field and laboratory analyses, completing a technical report on the investigation, disseminating the findings to professional peers, and presenting interpretive documents or other interpretive media to the public.

d. MANAGEMENT OF A DATA RECOVERY PLAN

TVA shall ensure that development and execution of the Data Recovery Plan meets the following standards:

1. The data recovery plan is developed and shall be implemented by or under the direct supervision of a person, or persons, meeting at a minimum the Secretary of the Interior's Professional Qualifications Standards (48 FR 44738- 44739);
2. Adequate time and money to carry out all aspects of the plan are provided, and that all parties consulted in the development of the plan are kept informed of the status of its implementation;
3. Draft archaeological reports resulting from the data recovery will be submitted to TN SHPO and other consulting parties for review and comment, and final reports are provided to TN SHPO and other consulting parties;
4. The final report conforms to professional standards, and to the Department of the Interior's Format Standards for Final Reports of Data Recovery Programs (42 FR 5377-79);
5. Provision for special oversight, including professional peer review in the event that unusual or complex issues arise during the process of development and/or execution of the Data Recovery Plan;
6. Consultation with TN SHPO and other consulting parties to ensure there are no unresolved issues concerning the recovery of

significant information with any Indian tribe that may attach religious or cultural significance to the affected archaeological property.

e. MONITORING

All treatment measures shall be monitored for effectiveness on a yearly basis (at minimum reservoir pool elevation, 593.5 feet above mean sea level), with a report of findings and recommendations submitted to TN SHPO and concurring parties for review and comment. In the event that any treatment method is found ineffective, TVA shall consult with TN SHPO and other concurring parties to develop an alternative appropriate treatment method.

Monitoring of archaeological properties will be carried out for the following situations:

1. Sites that have been treated, in order to evaluate the effectiveness of the treatment;
2. Sites that are discovered inadvertently, and therefore were not considered during the phased identification, evaluation and treatment process outlined in Stipulations 1-3 of this Agreement; and
3. Sites not identified for treatment, and unanticipated cumulative effects may have resulted in adverse effects, thus requiring inclusion in the Treatment Plan.

4. TREATMENT OF HUMAN REMAINS AND FUNERARY OBJECTS

All archaeological data recovery will be undertaken with the understanding, on the part of TVA and all consulting parties, that the NRHP-eligible archaeological property may contain previously unidentified human remains, associated or unassociated funerary objects, sacred objects, or items of cultural patrimony as those terms are defined by *NAGPRA*. In the event that such remains are discovered then those remains to the extent they were discovered on federal property will be treated pursuant to *NAGPRA*.

5. REPORTS

TVA shall ensure that all archaeological investigations undertaken for compliance with this Agreement are recorded in formal written reports that meet the Secretary's Standards and Guidelines for Identification (48 FR 44720-23) and the Tennessee Historical Commission Review and Compliance Section Reporting Standards, Archaeological and Architectural Identification Studies (Survey Reports). TN SHPO and other concurring parties shall be afforded thirty (30)

days to review and comment on any draft archaeological reports submitted under this Agreement.

6. PHASED COMPLIANCE

Pursuant to 36 CFR § 800.5(a)(3) TVA, in consultation, shall use a phased process in applying the criteria of adverse effect consistent with phased identification and evaluation efforts conducted pursuant to 36 CFR § 800.4 (b)(2); and seek ways to avoid, minimize, or mitigate the adverse effects of the proposed undertaking pursuant to 36 CFR § 800.6.

7. TIMETABLE FOR COMPLIANCE
   a. Consistent with Stipulation 6, TVA shall ensure that a phased process for the identification, evaluation and treatment of archaeological properties included, or eligible for inclusion in NRHP is developed and implemented in consultation in a timely manner.
   b. TVA will submit a draft treatment plan to concurring parties for review and comment by 2009, TVA will execute the treatment plan to avoid, minimize, or mitigate adverse effects to archaeological properties within APE that are included, or eligible for inclusion in NRHP.
   c. TN SHPO and other consulting parties shall have thirty (30) days to review and comment on all draft reports of investigation and proposed treatment plans.

8. ADMINISTRATIVE CONDITIONS
   a. If Stipulations 1-6, except 3.e, have not been implemented within five (5) years from the date of this Agreement's execution, this Agreement shall be considered null and void, unless the signatories have agreed in writing to an extension for carrying out its terms. If Stipulation 3.e has not been implemented within eleven (11) years from the date of this Agreement's execution, this Agreement shall be considered null and void, unless the signatories have agreed in writing to an extension for carrying out its terms. If the Agreement becomes null and void, then TVA and TN SHPO will resume consultation pursuant to 36 CFR § 800.
   b. Should TN SHPO or any concurring party object within thirty (30) days after receipt to any documents provided for review pursuant to this Agreement, TVA shall consult with the objecting party to resolve the objection.
   c. If either signatory to this Agreement determines that the terms of the Agreement cannot be carried out, the signatories shall consult to seek an amendment to the Agreement. If, after such consultation, the Agreement is not amended, then either signatory may terminate the Agreement. In that case, TVA shall either execute a new Agreement with the signatories

pursuant to 36 CFR § 800 or request the comments of the Council pursuant to 36 CFR § 800.7.

d. The signatories to this Agreement may agree to amend the terms of this Agreement. If the Agreement is amended, then such amendment shall take effect when both signatories have signed this Agreement, and the amendment shall be appended to the Agreement as an attachment.

EXECUTION of this Memorandum of Agreement by TVA and TN SHPO, the submission of documentation and filing of this Agreement with the Advisory Council, and implementation of its terms evidence that TVA has, in accordance with Section 106 of *NHPA,* taken into account the effects of this Undertaking on Historic Properties and afforded the Advisory Council an opportunity to comment.

SIGNATORIES

TENNESSEE VALLEY AUTHORITY

By: Bridgette K. Ellis Date: 10-17-07

Bridgette K. Ellis, Senior Vice President, Office of Environment & Research and Federal Preservation Officer

THE TENNESSEE STATE HISTORIC PRESERVATION OFFICER

By: E. Patrick McIntyre, Jr. Date: 11-15-07

E. Patrick McIntyre, Jr., Tennessee State Historic Preservation Officer

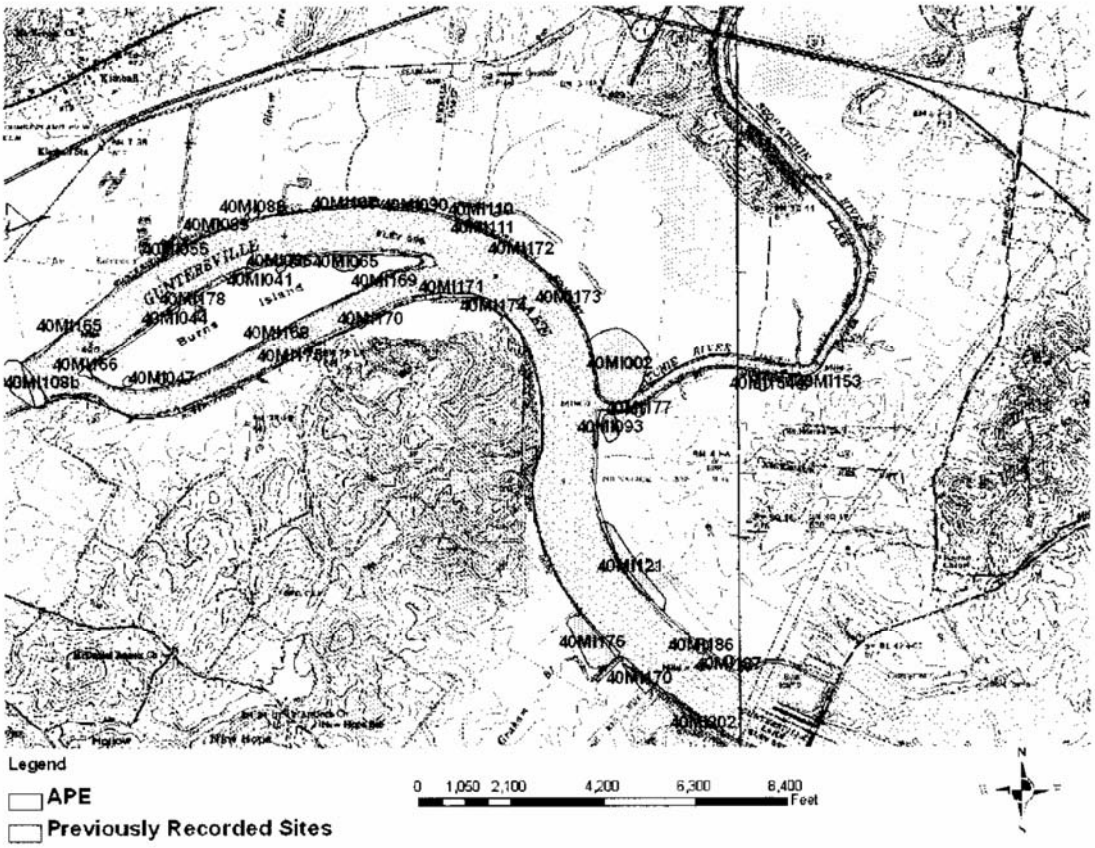
CONCURRENCE BY OTHERS:

THE UNITED KEETOOWAH BAND OF THE CHEROKEE INDIANS

By:_____ Date:_____

APPENDIX A

Table and Map of Affected Archaeological Properties



Previously Recorded Sites within the APE

Site	Components	NRHP Recommendation	Reference
40MI176	EW MW LW M	Unknown	Solis and Futato 1987
40MI93	Unknown	Unknown	Solis and Futato 1987
40MI177	LA	Unknown	Solis and Futato 1987
40MI2	LA EW MW LW M	Unknown	Solis and Futato 1987
40MI173	LW	Unknown	Solis and Futato 1987
40108b	H	Unknown	Solis and Futato 1987
40MI165	EW	Unknown	Solis and Futato 1987
40MI170	Unknown	Unknown	Solis and Futato 1987
40MI55	MA	Unknown	Solis and Futato 1987
40MI175	Unknown	Unknown	Solis and Futato 1987
40MI89	Unknown	Unknown	Solis and Futato 1987
40MI88	MW	Unknown	Solis and Futato 1987
40MI167	LA W M	Eligible	Schneider et al. 2005
40MI90	LA W M	Eligible	Schneider et al. 2005
40MI111	Unknown	Unknown	Solis and Futato 1987
40MI171	LW M	Unknown	Solis and Futato 1987
40MI172	W M	Unknown	Solis and Futato 1987
40MI174	Unknown	Unknown	Solis and Futato 1987
40MI121	A EW LW	Unknown	Solis and Futato 1987
40MI154	LA	Unknown	Solis and Futato 1987
40MI153	Unknown	Unknown	Solis and Futato 1987
40MI202	Unknown	Unknown	Solis and Futato 1987
40MI110	Unknown	Unknown	Solis and Futato 1987
40MI186	Unknown	Unknown	TDOA
40MI187	Unknown	Unknown	TDOA
40MI188	Unknown	Unknown	TDOA

Burns Island Sites within the APE

Burns Island Archaeological District			
Site	**Components**	**NRHP Recommendation**	**Reference**
40MI166 (Locus E)	W	Eligible	Alexander and Trudeau 2005
40MI47(Locus F)	LW M	Eligible	Alexander and Trudeau 2005
40MI178 (Locus C)	LA EW MW LW M	Eligible	Alexander and Trudeau 2005
40MI168 (Locus H)	LW	Eligible	Alexander and Trudeau 2005
40MI169 (Locus A)	W M	Eligible	Alexander and Trudeau 2005
40MI39 (Locus C)	LA EW MW LW M	Eligible	Alexander and Trudeau 2005
40MI36 (Locus C)	LA EW MW LW M	Eligible	Alexander and Trudeau 2005
40MI65 (Locus B)	EW MW LW M	Eligible	Alexander and Trudeau 2005
Locus D	M	Eligible	Alexander and Trudeau 2005