FINAL ENVIRONMENTAL ASSESSMENT

WILSON HYDRO PLANT
MODERNIZATION OF HYDROTURBINES

Lauderdale and Colbert Counties, Alabama

TENNESSEE VALLEY AUTHORITY

JANUARY 2005

For Further Information, Contact:

Charles P. Nicholson, NEPA Specialist
Tennessee Valley Authority
400 West Summit Hill Drive, WT 8C
Knoxville, Tennessee 37902-1499
cpnicholson@tva.gov
(865) 632-3582

Page intentionally blank

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

1. PURPOSE OF AND NEED FOR ACTION

TVA proposes to rehabilitate and modernize (hydromodernization [HMOD]) eleven generating units (#1-8 and #19-21) at Wilson Hydro Plant to maintain continued safe and reliable peak power generation, improve operational efficiency, provide additional megawatts (MW) of generating capacity, and increase TVA's net income from the power system. Units 9-18 were hydromodernized between 1994 and 2000.

Due to their age and condition, TVA must rehabilitate the remaining units (1-8 and 19-21) to maintain safe and reliable generating capacity. In addition, making improvements in the design of the turbine runners and other generation components would provide TVA the opportunity to increase the generating capacity and efficiency of these turbine units. Capacity gains and efficiency improvements at Wilson would help meet projected demands for peaking power in the Tennessee Valley in the near future.

This environmental assessment (EA) is being prepared in accordance with the National Environmental Policy Act (NEPA) and TVA's implementing procedures. This EA addresses the alternatives that have been considered and describes the potential environmental consequences associated with hydromodernization of the turbines at Wilson Hydro Plant. Modernization of TVA's hydropower facilities was evaluated in TVA's final environmental impact statement (EIS), *Energy Vision 2020* (1995). Modernization 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.

Background

Wilson Hydro Plant and Dam are located at Tennessee River Mile (TRM) 259.4 between Florence and Sheffield Alabama, in Lauderdale and Colbert Counties (Figure 1-1).

The 11 hydro units remaining to be hydromodernized at Wilson Hydro Plant were brought into commercial operation beginning in the mid-1920's (Units 1-8) and ending in 1962 (Units 19-21). Total discharge from all hydro units at Wilson prior to any HMOD work was rated at 100,000 cubic feet per second (cfs). The present existing discharge (partial HMOD) rating for all units at Wilson is 104,000 cfs. The rated discharge for all units of the completed HMOD would be 110,000 cfs. The pre-HMOD generating capacity was 629.8 MW; the present existing generating capacity (partial HMOD) is 670 MW and the proposed generating capacity (completed HMOD) would be 742 MW.

The hydropower units at Wilson 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. Operational objectives at Wilson Dam include: flood control, navigation, hydropower production, recreation, water quality, fishery and wildlife management, water supply and economic development. Reservoir levels are maintained at summer pool elevations from mid-April through the end of November.

Each day, a specified amount of water is moved through Wilson Dam to meet operational objectives. When flow requirements exceed the available turbine capacity, the excess water is passed over the spillways. Spilling at Wilson occurs an average of 35 days in a

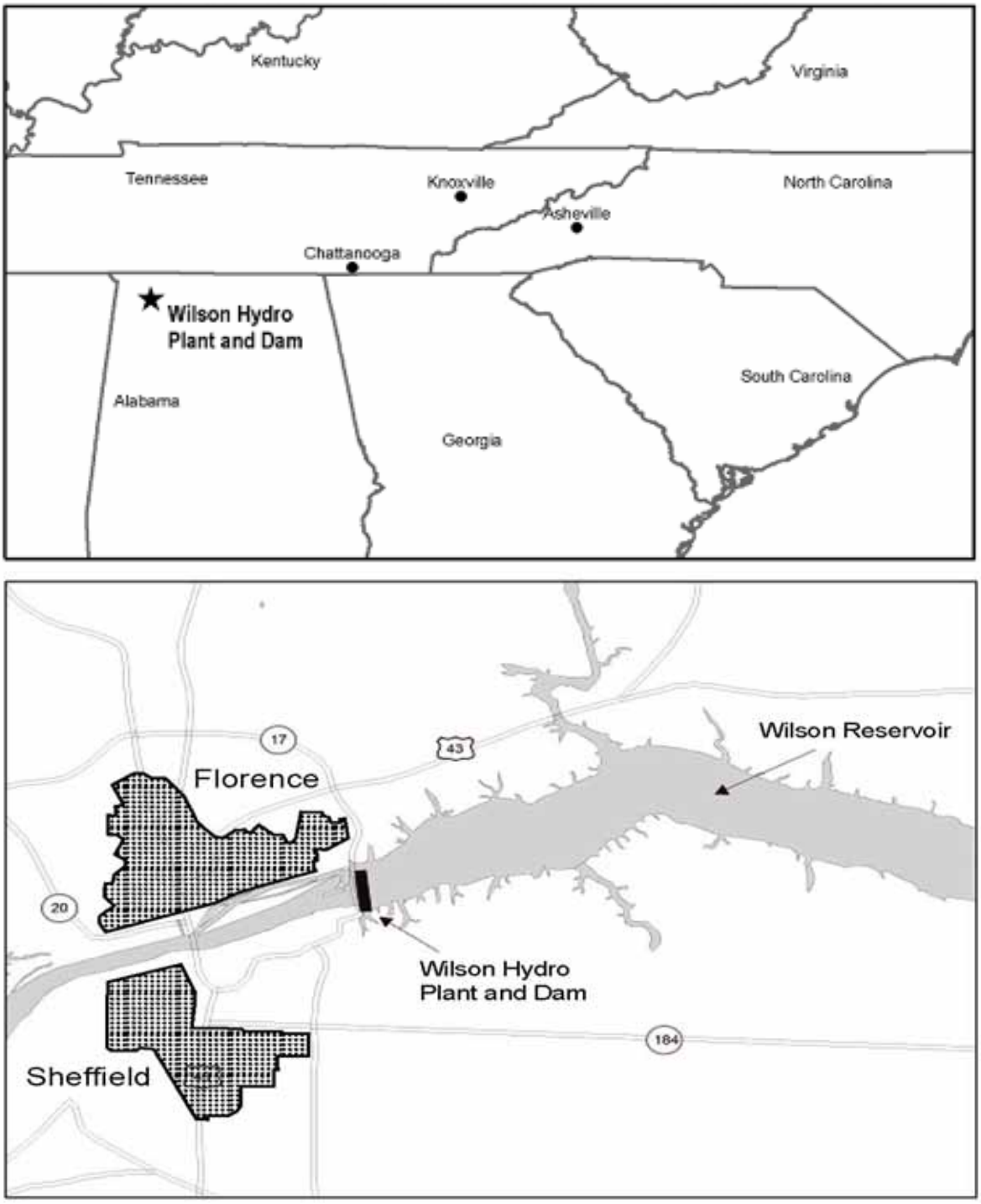

Figure 1-1. Wilson HMOD location maps.

typical year, primarily between December and March. Maximum daily discharge measured to date was 480,400 cfs (average) on March, 17, 1973. Under normal flood control and power generation operations, TVA discharge volumes maintain a minimum 11 ft. draft navigation channel below Wilson Dam in Pickwick Reservoir.

When not affected by the above requirements, the generating units at Wilson Hydro Plant are typically operated to meet daily peaks in power demand. During the winter, Wilson Hydro 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. There are no specifically mandated or required minimum flows through Wilson Dam/ tailwater area. The flow needs for reservoir surface elevation control and navigation channel depth including any water flow from power generation needs are the factors that determine the minimum flow through the dam and tailwater area. Changes in reservoir operating conditions resulting from the TVA River Operations Study Environmental Impact Statement (TVA 2004) preferred alternative (e.g., duration of full pool, winter drawdown levels, etc.) are expected to have no effect on any aspects of present hydropower operations or future hydropower (HMOD) operations at Wilson Hydro Plant.

CHAPTER 2

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

This Environmental Assessment considers two alternatives: The No Action alternative is the existing condition and the Action Alternative (Wilson HMOD) is hydromodernization of all the remaining units at the Wilson Hydro Plant.

2.1. The No Action Alternative

Under the No Action Alternative, TVA would continue to maintain and/or replace the existing generating components at Wilson Hydro Plant on an as-needed basis. Maintenance would include reworking, refurbishing, and/or replacing turbine, switchyard and generating components (not including the actual turbines) with no increase in the total plant turbine flow from the present (104,000 cfs) and with no increase in generating capacity from the current 670 MW. The overall operating efficiency of the remaining two groups of units (Units 1-8 and Units 19-21) would not change under the No Action Alternative. Additionally, under the No Action Alternative, no change in present environmental conditions and trends would be expected, because hydro-generation water flow capacity would not change. Any rehabilitation undertaken in the future would be the subject of subsequent environmental reviews.

2.2. The Action Alternative – Wilson HMOD Alternative

Under the Wilson HMOD Alternative (the Action Alternative), TVA would replace the turbines for Units 1-8 and 19-21 at Wilson Hydro Plant. This would be in addition to the reworking, refurbishing, and/or replacing of turbine, switchyard and generating components and modernization of the generators on these units (similar to activities under the No Action Alternative). This action would increase total generator rating from the current 670 MW to 742 MW. Maximum flow for the total hydroplant with the new turbines would change from the current 104,000 cfs to approximately 110,000 cfs. The HMOD work is currently scheduled to begin in 2003 and continue through 2013 or 2014. During this period, one unit would be modernized each spring and fall.

2.3. Construction, Operation, and Maintenance Activities

Essentially all replacement and/or rehabilitation activities for the No Action Alternative or the Wilson HMOD Alternative would occur inside the plant, transformer areas and some additional previously disturbed areas (for lay down) on the plant site. The existing overhead crane would be used to remove and replace the turbines for the Wilson HMOD Alternative. Additionally a 100-ton crane for the switchyard transformer replacement work and a 20-ton mobile crane for use in the powerhouse may be brought on site during the construction period for either alternative. Existing outside lay-down/storage areas at the plant site would be used to temporarily store the larger components. The maximum additional work force present on the site to complete either alternative would be approximately 50-75 persons. During each unit's outage period, the other remaining operational units at Wilson Hydro may be run for slightly longer durations to meet operational objectives.

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.

As part of both the Wilson HMOD Alternative and the No Action Alternative TVA has committed to a plan of shoreline stabilization with the Alabama State Historic Preservation Officer (SHPO) to protect specific archaeological sites in the Wilson Tailwater area from further erosion. TVA has agreed with a phased archaeological assessment and protection process to further identify, evaluate, and assess any potential adverse archaeological effects. All such archaeological sites identified as eligible for, or listed on the National Register of Historic Places (NRHP) that could be adversely affected by the proposed Wilson HMOD undertaking will be either protected against erosion with shoreline stabilization (Appendix 1) or have data recovered in accordance with the terms of a Memoranda of Agreement (MOA) with the SHPO and the terms of the U.S. Fish and Wildlife Service (USFWS) Biological Opinion (Appendix 2).

An examination of the power generation flow capacities for the Wheeler Hydro Plant (125,000 cfs) located 15 miles upstream from Wilson Hydro reveals that the substantially smaller generation flow capacity of Wilson, (currently 104,000 cfs with a possible increase to 110,000 cfs following the HMOD of all units), would remain the "limiting-point" in determining overall power generation flow through these two reservoir segments. The proposed increases in discharge flow for the Wilson HMOD Alternative would increase the tailwater elevations a small increment in areas downstream from the Wilson Hydro Plant, (Figure 2-1). Nominal increases in flow velocity would occur with the Wilson HMOD Alternative, generally about 0.1 ft/sec. Maximum increases would be less than 0.2 ft/sec compared to the present flow velocities. Comparing the Wilson-HMOD Alternative flow velocities with those of the pre-HMOD velocities, nominal increases of about 0.2 ft/sec would occur with maximum increases of less than 0.25 ft/sec (Figure 2-2).

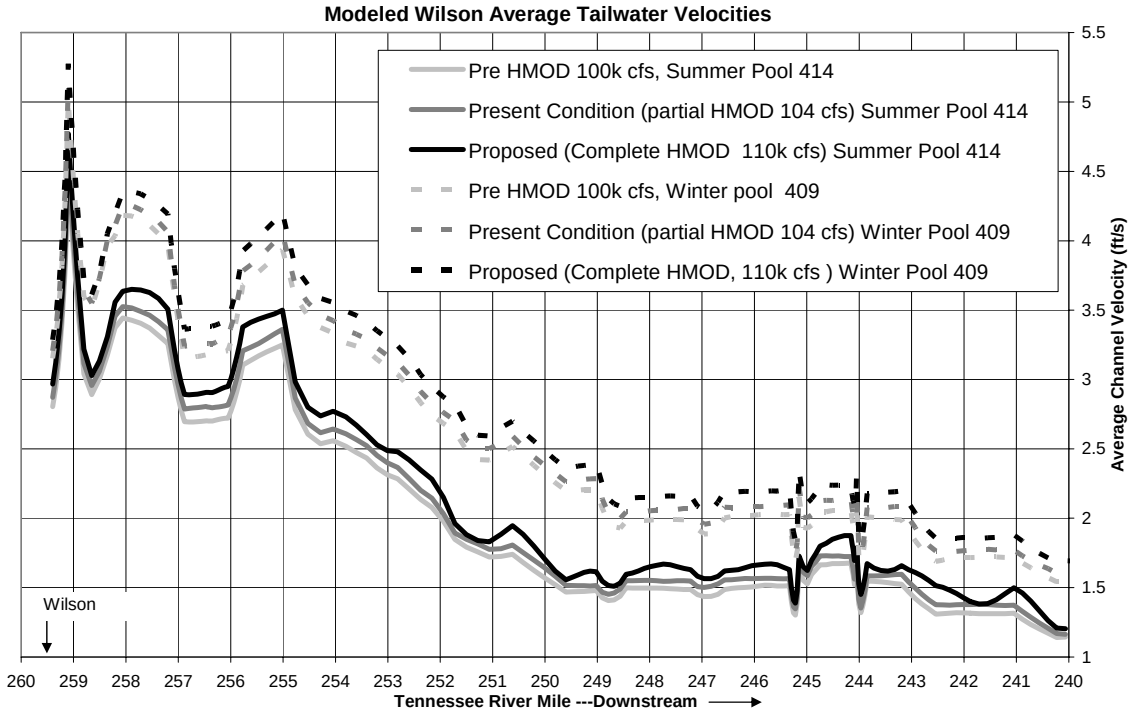

Figure 2-1. Modeled tailwater surface elevations by river mile downstream from Wilson Dam and Hydro Plant

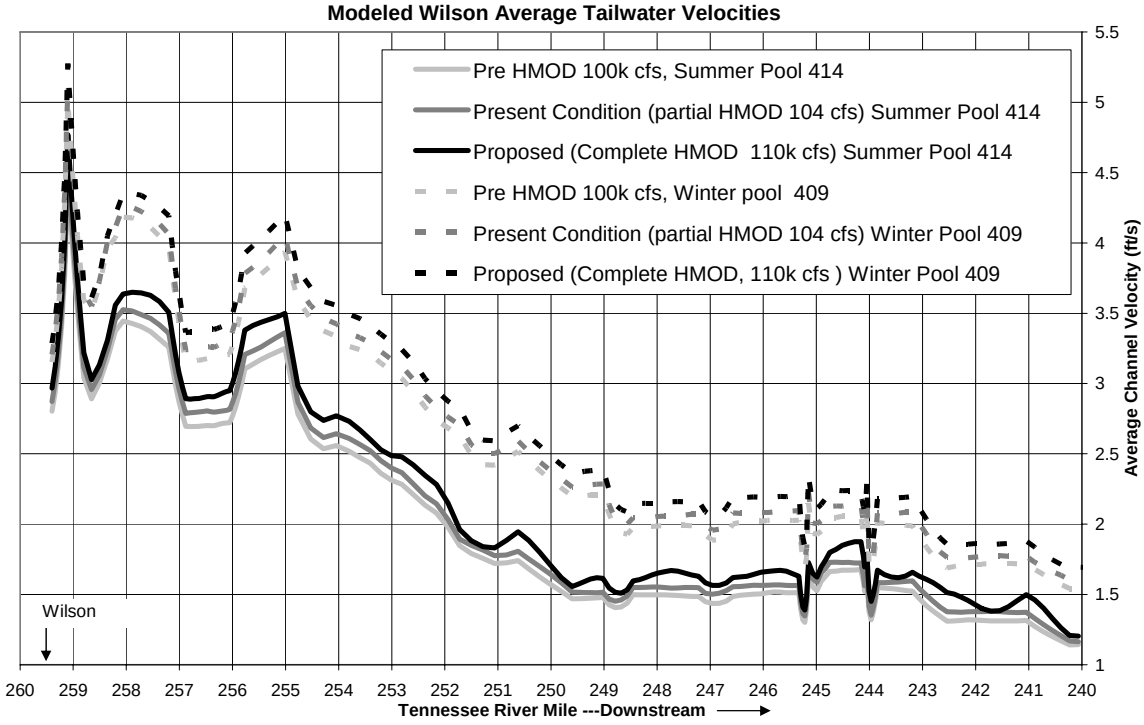

Figure 2-2. Modeled tailwater velocities by river mile downstream from Wilson Dam and Hydro Plant

CHAPTER 3

3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

During a preliminary review of the media categories potentially affected by the proposed Wilson HMOD Alternative activities, including the shoreline stabilization, some media were found to have little or no potential to be affected, and no further review of those media was required. Further review was recommended for the following media: Erosion, Waste Generation, Surface Water, Groundwater, Aquatic Life, Wetlands, Terrestrial Ecology-Plants, Terrestrial Ecology-Animals, Endangered and Threatened Species, Significant Managed Areas, Recreation, Visual, Air, Cultural Resources (Archeology and Historic Structures), Socioeconomics, and Environmental Justice.

3.1. Erosion

Affected Environment

The Wilson tailwater portion of the Tennessee River extends from Wilson Dam (TRM 259.4) downstream to about TRM 245, where flow variations from dam discharges are effectively damped by the Pickwick Reservoir pool. Along most of this section, the left bank (facing downstream) is predominantly steep rock bluff or rocky colluvium, with isolated flat areas of alluvial soil. Most of the right bank is relatively level, and the soils are mostly easily-eroded alluvial silt loams (predominantly Staser and Chennedy) of flood plains and terraces. The same alluvial soils are present on the complex of islands that is distributed through the main channel in much of this reach.

Most of the immediate shoreline in this area is undeveloped. The right descending bank and the islands are within the TVA reservation and the Seven Mile Island Wildlife Management Area. The left bank is mostly too steep or rocky for development. With the exception of a few isolated areas on the left bank, there is a wide area of woody vegetation lining the shoreline in all areas that are not too rocky to support this vegetation.

As with mainstem tailwaters in general, this area is subject to seasonal variation in surface elevation (5 foot winter drawdown); wave action from wind, recreational boats and commercial barge traffic; and increased 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 9 feet at the dam at winter pool and about 4 feet at summer pool). The changes in water surface elevation prevent the establishment of vegetation in the drawdown zone, consequently erosion reduction from any new vegetation growth is severely compromised. This leaves bare soil with low root density exposed to flowing water and wave action. Sediment settles in the upstream reservoirs, so there is no replacement of eroded material by natural sedimentation processes.

Much of the right bank and the many of the islands exhibit signs of active erosion. Exposed vertical banks are common, and an under-cut zone occurs at the base of the banks. Many of the islands have vertical banks or are mostly or entirely submerged at high water, subjecting these areas to erosion. Most of the left bank has little erosion because it is predominantly rocky or bluff.

Environmental Consequences

No Action Alternative*:* There would be no change in erosion trends in the Wilson tailwater because there would be no change in operation. Substantial erosion would continue. The proposed shoreline stabilization for protection of archaeological sites would incrementally reduce this continued erosion.

Wilson HMOD Alternative: The increase in maximum generation discharge (from 104,000 CFS to 110,000 cfs) increases all of the forces that affect erosion during generation in proportion to the increase in flow rate. Modeling shows that there would be a water surface elevation increase at the dam of about 0.42 foot at winter pool, and about 0.34 foot at summer pool. These increases taper to about 0.1 foot at TRM 245. Average water velocity increases typically range between 0.1 to 0.2 foot per second (fps), and the maximum increases are typically less than 0.25 fps. These differences are small, but may cause a small incremental increase in vegetation mortality from inundation of vegetation that was previously flooded only rarely. Low islands are particularly vulnerable to change in water depths because their surface is near the elevation of existing high flows, resulting in a larger area subject to an increase in vegetation mortality and an increase in erosive energy at the soil surface from more frequent and deeper flooding.

Substantial erosion problems already exist in this tailwater. Changes in generation capacity that increase peak flows would result in a slight/incremental increase for these erosion problems. It is unlikely that new areas would become affected because of these generation capacity changes, but erosion would accelerate marginally by a small increment where it is already occurring.

The shoreline stabilization which would be part of either alternative would incrementally reduce current erosion levels, and thus would not result in any significant negative impacts.

3.2. Waste Generation

Affected Environment

Areas potentially affected by either the No Action Alternative or the Wilson 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 flowmeters, grease and lubricants, PCBs and heavy metals (lubricating greases/painted surfaces), nonhazardous solvents, oil-contaminated solids are some of the typical wastes that would likely be encountered during the expected construction/rehabilitation activities associated with both alternatives.

Environment Consequences

Both the No Action Alternative and the Wilson 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 SHPO and USFWS. Temporary engineering controls, barriers/containment, and precautions shall 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. shall be contained and placed with the other waste material that is disposed of or recycled. Estimates of such releases shall be complied for TRI (Toxic Release Inventory) consideration. All weight quantities of metals/materials/equipment (by type) with designation as whether used/installed/removed/recycled/disposed of shall be assessed for TRI/PBT (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 onsite; sandblast; equipment with PCBs, asbestos, mercury, lead, etc. Best Management Practices (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 assure that any potential waste generation impacts from either of the alternatives would be insignificant.

3.3. Surface Water Quality

Affected Environment

Areas assessed for potential effects to surface water quality include the Wilson Reservoir forebay at Wilson Dam and the tailwater of Wilson Hydro Plant/Dam. Wilson Dam is located on the Tennessee River at river mile 259.4. The drainage area upstream of the dam is 30,750 square miles. Stream flow varies with rainfall and reservoir operations with an annual average of about 52,000 cubic feet per second (cfs). During the last 40 years, the mean annual flow at the dam has ranged from 24,100 cfs in the driest year to 77,500 cfs in the wettest year.

Wilson Reservoir is 15.5 miles long with a maximum depth of slightly over 100 feet at the forebay. It has a surface area of 15,500 acres and impounds 634,100 acre-feet at the normal maximum pool elevation of 507.5 feet (msl). At the average flow rate and water surface elevation, the reservoir has a mean depth of 40 feet and a hydraulic residence time of 6 days. The Alabama Department of Environmental Management classifies Wilson Reservoir for public water supply, swimming and other whole body water-contact sports, and fish and wildlife. The reservoir is not included on the state 303(d) list. Pickwick Reservoir downstream of Wilson Dam is classified for public water supply and fish and wildlife from Wilson Dam to the Sheffield water intake; for fish and wildlife from the Sheffield water intake to the lower end of Seven Mile Island; and for public water supply, fish and wildlife, and swimming and other whole body water-contact sports from the lower end of Seven Mile Island to the Alabama-Tennessee state line. There currently are no fish

consumption or swimming advisories on Wilson Reservoir. Fecal coliform bacteria levels in samples collected by TVA in 2000 at two sites on Wilson Reservoir were within state guidelines for water contact-recreation.

Nutrient enrichment and weak seasonal thermal stratification affects the quality of water in Wilson Reservoir during the summer and fall. Biochemical processes involved in the decomposition of organic matter below the thermocline (an intermediate layer in the water column having a maximum temperature gradient) reduce the dissolved oxygen (DO) concentration. In most years the DO in the lower levels of reservoir falls below 4 mg/L from late May until mid October. The DO concentration of reservoir releases is not severely depressed because of the mid-level water intakes that supply the turbines. Consequently, ninety percent of the dissolved oxygen measurements in the tailrace exceeds about 5 mg/L during the period of greatest stratification. From 1961-1996, there were four weekly observations (out of 1028 samples) with a DO less than 4 mg/L. The three lowest observations were 2.4 mg/L in 1965 and 3.9 mg/L in 1988 and 1993.

TVA monitoring of chlorophyll, dissolved oxygen, fish, benthos, and sediment indicate that the overall ecological condition of Wilson Reservoir varies. Wilson rated poor in 1991, 2000, and 2002, fair in 1992 and 1994, and good in 1993, 1996, and 1998. Flow is a key factor affecting the Wilson ratings with generally poorer conditions in dry years. Pickwick Reservoir rated good in 1991, 1992, 1994, and 1998, and fair (near the good category) in 1996, 2000, and 2002.

Environmental Consequences

No Action Alternative: Under the No Action Alternative, there would be no changes in flow patterns and thus no impact to surface water quality. Similarly there would be no significant impacts to water quality from the shoreline stabilization activities because the application of BMPs will insure minimal and short term /transient turbidity changes resulting from the shoreline activities.

Wilson HMOD Alternative: Following the proposed HMOD of Units 1-8 and Units 19-21, there would be an increase in the water flow rate during generation. The potential impact on downstream water elevations and velocities is examined for three flow conditions: A) 100,000 cfs—the original generation flow rate before the HMOD of any units; B) 104,000 cfs—the generation flow rate for the No Action Alternative (this includes the previously approved HMOD flows of Units 9-18; and C) 110,000 cfs—the potential generation flow rate with implementation of the proposed Wilson HMOD Alternative. The first flow condition is included for assessing the cumulative impact of the two phases of unit HMODs.

Figures 2-1 and 2-2 show the expected downstream water surface elevations and flow velocities for each flow condition, based on the results of a one-dimensional hydrodynamic model. The present existing condition (No Action Alternative) reflects small velocity increases of 2.3 to 3.7 percent compared to the pre-HMOD condition. The proposed Wilson HMOD Alternative would increase the velocities from 5.6 to 9.2 percent compared to the pre-HMOD condition. Similarly, the downstream water surface elevations in the winter vary from 416.5 feet immediately below the dam to 409.5 feet at river mile 240. The present existing condition (No Action Alternative) reflects a small surface elevation increase of 0.3 ft. compared to the per-HMOD condition and the proposed Wilson HMOD alternative reflects an increase of 0.7 ft. compared to the pre-HMOD condition.

The increased flow rate predicted with the Wilson HMOD alternative could have three potential effects on surface waters. First, increased flows will increase the potential for downstream erosion and corresponding increases in turbidity and sedimentation. These affects should be minor because the changes are quite small relative to the range of flow rate and surface elevation conditions routinely experienced downstream of the dam when spilling occurs. Second, the higher flows will increase the withdrawal zone of water from the reservoir. This could slightly alter the quality and temperature of water discharged from the lake during generation. Since the turbine intake is near the middle of the water depth, it is expected to draw additional water from above and below the intake, thus, balancing water quality variations (e.g., DO and temperature) resulting in little overall change. Third, the increased discharge rate will decrease the time of travel for water moving downstream. The reduced travel time means that downstream water temperatures could be somewhat cooler in the summer as there would be less time for solar heating. The shorter travel time and increased depth could also reduce reaeration of the water. These possible effects would be offset to some degree by the increased aeration and associated mixing resulting from the faster flowing water, and thus little overall impact is expected.

The quality of water within Wilson Reservoir and the downstream tailwater is not expected to be significantly impacted because the total amount of water released each day will not change with the unit upgrade. Consequently, the increase in flow rate will not change average daily pool elevations or the detention time of water within the reservoir. Variations in flow rate and surface elevation within the day would occur over a slightly shorter period of time. Additionally, BMPs will be used for shoreline stabilization for the protection of archaeological sites to help control erosion, turbidity, and sedimentation.

In addition to the above discussed potential long-term effects of the proposed project, there are also potential effects during the construction or outage period. Construction materials would be brought to the site and various construction wastes generated. No new wastewater streams would be created. BMPs consistent with the plant's environmental permits would be used throughout project construction to avoid oil spills and pollutant discharge into either the Wilson Reservoir forebay or Wilson Dam Tailwater. All potential water pollutants would be contained and disposed in accordance with applicable local, state, and federal laws and regulations (see additional information in the previous Waste Generation section).

In summary it is expected that the proposed Wilson HMOD alternative would have only minor and insignificant effects upon the surface waters of Wilson Reservoir forebay and Wilson Dam tailwater.

3.4. Groundwater

Affected Environment

The only groundwater resources potentially affected are those in the immediate areas bordering the upper reaches of the Wilson tailwater. This area is underlain by aquifers in the Appalachian Plateaus and Interior Low Plateaus Physiographic Provinces and consists of permeable stratigraphic units within flat-lying, sedimentary rocks of Paleozoic age. The Appalachian Plateaus are flat areas of undissected plateau that lie at high altitudes and are capped by resistant sandstone. The major aquifers in both physiographic provinces are in limestone units of Mississippian age that are exposed in wide valley floors in the Interior

Low Plateaus Province and are covered in the Appalachian Plateau areas by clastic rocks of Pennsylvanian age.

The quality of the water in the Appalachian Plateaus and Interior Low Plateaus aquifers is widely variable, from suitable domestic drinking water to very objectionable concentrations of iron, dissolved solids and or hydrogen sulfide ("rotten egg" odor). Generally most of the groundwater water is suitable for most uses.

Environmental Consequences

No Action Alternative: If the No Action Alternative is chosen the Wilson tailwater would not experience increased generation flows. It is expected that shoreline stabilization activities will have no effect on groundwater. Thus there would be no impact to the groundwater resources of the tailwater areas.

Wilson HMOD Alternative: Adoption of the Wilson HMOD Alternative would result in minor increases in tailwater elevation (less than 0.5 ft). This may cause minor temporary short term increases in local groundwater elevations near the river edge. Seasonal floods typically alter the tailwater surface elevations to a much greater extent than the potential minor and short term daily increases likely to occur under the proposed Wilson HMOD Alternative. Impacts from this potential increase in groundwater elevation, should it occur, would be insignificant. It is expected that shoreline stabilization activities will have no effect on groundwater. Thus if the proposed Wilson HMOD alternative were adopted there would be only minor and insignificant impacts on the groundwater resources of the tailwater areas.

3.5. Aquatic Life

Affected Environment

Aquatic communities in the Wilson Reservoir forebay and in the Tennessee River downstream of the dam (Wilson tailwater) encompass the areas that could be impacted by the proposed Wilson HMOD alternative.

Wilson Reservoir Fisheries - The fish community of Wilson Reservoir forebay, most recently sampled in the fall of 2002, exhibited an overall Reservoir Fisheries Assemblage Index (RFAI) rating of "Good" compared to the fisheries of other TVA mainstream reservoir forebays (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 Wilson tailwater (the inflow to Pickwick Reservoir), most recently sampled by TVA in the fall of 2000, exhibited an overall RFAI rating of "Good" compared to other TVA mainstream reservoir tailwaters. Wilson tailwater is an important spawning area for migratory spawning species such as sauger, white bass, yellow bass, paddlefish, and also various buffalo and redhorse species.

Wilson tailwater supports a viable and popular sport fishery. In creel surveys conducted in Wilson tailwater in winter and early spring of 1993-1995, anglers targeted primarily sauger, temperate basses (striped bass, white bass, and yellow bass), and black basses (largemouth and smallmouth bass) (Maceina et. al. 1996). The tailwater is nationally

recognized for providing superior quality smallmouth bass angling (Maceina and Slipke 1997).

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. Riverine habitat is now found only in tailwaters, but overbank habitat is available in some impounded reaches of the reservoir.

A number of freshwater mussel surveys have been conducted in the Wilson Dam tailwater during the last 25 years. These surveys indicate that a relatively diverse assemblage of mussel species persists in this part of the river, numbering at least 34 species. The most abundant species in this area typically are the ebonyshell (*Fusconaia ebena*), elephantear (*Elliptio crassidens*), pimpleback (*Quadrula pustulosa*) and purple wartyback (*Cyclonaias tuberculata*). The ebonyshell, pimpleback, and other species which are more abundant further downstream support a modest commercial shell harvest in Pickwick Reservoir. The tailwater reach from Wilson Dam downstream to the upper end of Seven Mile Island (TRM 259.4-253.9), is a state-designated mussel sanctuary, where it is unlawful to take, catch, or kill native mussels.

Environmental Consequences

No Action Alternative: Under the No Action Alternative, there would be no impact to the Wilson forebay or Wilson tailwater aquatic life including fisheries and mussels.

Wilson HMOD Alternative: Only minor and insignificant effects on the reservoir forebay fishery would be expected. Under this alternative, intake hydrogeneration volume would increase approximately 10 percent from pre-HMOD volume (four percent more than the present intake volume). This would slightly increase intake flow velocities near the penstock openings, which could lead to a minor increase in fish entrainment during periods of highest hydrogenation flow. This small overall effect would result in insignificant impacts to the fisheries of the Wilson Reservoir forebay.

Adoption of the Wilson HMOD Alternative would increase tailwater flow velocities slightly and thus could have some effect on habitat for tailwater fisheries. In addition to the Wilson HMOD volumetric increases, water velocities are dependent on tailwater surface elevation (i.e., Pickwick Reservoir pool). In the near-dam area (TRM 258), average velocities modeled for the surface and bottom at HMOD flows would increase only slightly from pre-HMOD velocities at Pickwick winter pool and summer pool elevations (typically, less than 0.2 fps increase in average velocity and less than 0.1 fps bottom velocity). These (initally) small velocity increases resulting from the proposed Wilson 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 Wilson Dam, and potential effects on these species over the entire tailwater are also expected to be insignificant.

The proposed Wilson HMOD Alternative would result in only minor and insignificant effects on resident mussel resources in the Wilson tailwater. The potential increase in average water velocities (Figure 2-2) would result in minimal (less than 0.1 fps at TRM 258) to undetectable changes in downstream bottom velocities at TRM 240. Modeling of bottom

velocities from TRM 256 to TRM 240 indicated no observable changes from the proposed HMOD flow increases for either summer or winter pool conditions. Thus, if the bottom habitat would not be changed, there would be no reason to expect any change to the resident mussel stocks of the Wilson tailwater and only insignificant impacts.

Shoreline stabilization planned for protection of cultural resources in the tailwater would result in insignificant impacts under either alternative for nearshore habitats with implementation of routine BMPs to minimize turbidity during riprap placement. The potential for adverse impacts is minimized since bank recontouring (and attendant removal of woody vegetation) would not be allowed (per SHPO agreement) prior to riprap placement. Measures outlined in the USFWS Biological Opinion (described in more detail below in the Endangered and Threatened Species section) would also minimize impacts to fisheries and the mussel community.

3.6. Wetlands

Affected Environment

Due to the topography and channel morphology of the Wilson Dam tailwater area, the potential areas for wetlands include floodplains, sloughs, islands, and tributary floodplain areas. An office-level review of National Wetland Inventory (NWI) data was conducted to determine the potential occurrence of wetlands within ten miles of Wilson Dam (approximately TRM 259 to 249). The ten mile 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 area close to the dam, before any increased flows would be attenuated. An additional seven miles (TRM 249 to 242) was reviewed to assess potential impacts to wetlands resulting from planned shoreline stabilization to protect archaeological resources between Wilson Dam and TRM 242 (Table 3-1).

The NWI data indicates extensive wetland areas on islands, on the right-descending (RD) floodplain, and in association with tributary streams between Wilson Dam and Tennessee River Mile 242. According to the NWI data, almost all of the land area on islands, including those in the Seven-Mile Island complex, consists of wetlands. The primary wetland types indicated are seasonally flooded palustrine forested and scrub-shrub wetlands on islands, floodplains, and tributary riparian zones, and lacustrine flats in seasonally exposed reservoir drawdown zones. No ground surveys were conducted to verify the present status of these areas, or to determine if any meet USACE wetland criteria (Environmental Laboratory, 1987) and therefore would be jurisdictional wetlands subject to regulation under the federal Clean Water Act.

Table 3-1. Location of wetlands identified on National Wetland Inventory maps of the Wilson Dam tailwater between Wilson Dam and TRM 242

Location	Comments
TRM 259LD*	Jackson Island
TRM 258.8RD**	In floodplain
TRM 257-258LD	Patton Island
TRM 269.8RD	In riparian zone of unnamed tributary

Location	Comments
TRM 259.6RD	In riparian zone of unnamed tributary
TRM 259.4LD	Associated with Little Cypress Creek
TRM 254.4RD	In riparian zone of unnamed tributary
TRM 253-254.4LD	In floodplain
TRM249LD	Buck Island
TRM249-253	Coffee Slough
TRM242-253.2 mid-reservoir and RD floodplain	Seven Mile Island Wildlife Management Area

*LD Left descending (bank)
**RD Right descending (bank)

Environmental Consequences

Under the No Action Alternative, present trends in wetland development and degradation would not be affected.

Adoption of the Wilson HMOD Alternative is expected to have only minor and insignificant (if any) impacts on the wetlands in the Wilson Dam tailwater area between Wilson Dam and TRM 242. The proposed changes in water volume, velocity, downstream surface elevation, and flood duration that would occur under this alternative appear to be within the normal annual and seasonal variability for these parameters. In addition, they are within the range of hydrologic variability of the wetlands that have developed in these areas. Expansion of wetlands in some areas is a possibility, particularly along tributary bottomlands. Small increases in water levels could expand the zone of soil saturation in some riparian and shoreline areas. These expanded wetland boundaries would be likely to persist, however, only as long as increased water levels continued to occur for sufficient periods during the growing season on a consistent annual basis. The proposed shoreline stabilization work at various locations between Wilson Dam and Tennessee River Mile 242 is also expected to have insignificant or no effects on wetlands.

Under either alternative, the conditions present at the stabilization sites, which include steeply eroded banks, persistent wave action, and high flow events, the probability of wetland occurrence either at the shoreline or at the top of the banks in these areas is extremely remote. Any wetlands that may occur on the landward side of the bank would not be impacted by the stabilization work since most of the work would be done from barges on the water and would consist of placement of riprap on the shoreline with no bank disturbance. If stabilization activities requiring bank disturbance or work from the landward side of the bank are proposed for any of the stabilization sites, TVA wetland biologists would conduct an on-site wetland determination and consulted on impact avoidance and minimization. Appropriate federal and state permits would be obtained as necessary.

3.7. Terrestrial Ecology – Plants

Affected Environment

Wilson Hydro Plant and Dam are located in a region that contains a variety of native forest types ranging from rich forests of mixed hardwoods, to oak, oak-hickory, and oak-hickory-pine forests. The area of the plant site is mostly non-vegetated, being buildings, concrete

and asphalt. Some area of mowed lawn is present. Areas immediately adjacent to the facility are a mixture of hardwood forests; grasslands associated with lawns, roadsides, and transmission line corridors; and non-vegetated areas associated with roads, parking areas, and buildings. Invasive plant species, including privet, oriental bittersweet, Japanese honeysuckle, and kudzu, are a conspicuous part of the local flora.

Environmental Consequences

Both the No Action Alternative and Wilson HMOD Alternative would involve similar construction activities, and shoreline stabilization activities and further all construction activities associated with both alternatives would be confined to areas that have historically been graveled, paved, or covered with concrete during construction or for other purposes. No uncommon plant communities or otherwise sensitive habitats are known or expected to occur on areas to be affected by the either the No Action Alternative or the Wilson HMOD Alternative. Therefore, any impacts to the vegetation of the region resulting from either of these alternatives are expected to be minor and insignificant

Potential impacts from the introduction or spread of invasive plants would be minimized by the adoption of the following measures during any revegetation activities:

- Avoiding species found on the Invasive Plant Species of High Priority to TVA and the Tennessee Exotic Pest Plant Council (TN-EPPC) lists in any re-vegetation plan.

- Utilizing seed mixes for re-vegetation and erosion control comprised of native species or non-invasive, non-native species.

3.8. Terrestrial Ecology – Animals

Affected Environment

Areas encompassing the Tennessee River and its tributaries downstream from Wilson Dam are predominantly occupied by terrestrial animals that are regionally common. Species such as muskrat, mink, double-crested cormorants, black-crowned night-herons, great blue herons and a variety of gulls and waterfowl are abundant downstream of Wilson Dam. A great blue heron colony has become established just downstream of the dam in recent years. Riparian habitat and forested bluffs along the river corridor provide habitat for species such as raccoon, southern short-tailed shrew, slimy salamander, ring-necked snake and numerous songbirds.

Muscle Shoals Reservation is recognized as a stopover for migratory birds. Large numbers of neotropical migrants and other birds use this site as a stopover area during migration. These birds actively feed along the shoreline in the tailwater areas.

Environmental Consequences

No discernible changes to the terrestrial ecology of the area are anticipated under either the No Action or Wilson HMOD Alternatives, and thus no impacts to terrestrial animal communities are expected. Potential changes in flow rates from the Wilson HMOD Alternative would not result in any significant impacts to terrestrial animals, wading birds, waterfowl, migratory birds, or their habitats. Neither alternative would be expected to contribute to the spread of exotic and invasive terrestrial animals. Mitigation measures

required under either alternative to control erosion at archaeological sites along the Seven Mile Island district and the tailwater reaches below Wilson Dam may be beneficial to wildlife species that forage along the reservoir. Thus adoption of either the No Action or the proposed Wilson HMOD alternative would have only minor (if any) and insignificant effects on terrestrial animal and bird communities.

3.9. Endangered and Threatened Species

Affected Environment

Plants: Review of the TVA Regional Natural Heritage database reveals that there are no federal and two Alabama state-listed plant species reported from within a five mile radius of the Wilson Hydro Plant (Table 3-2). In addition, two federal-listed plant species and two species that are candidates for federal-listing have been reported from greater than five miles from Wilson Hydro Plant, but within the two counties (Colbert and Lauderdale) in which the Hydro Plant and Dam occur.

Table 3-2. Federally and state-listed plant species reported from within five miles of the proposed project area, and additional federal-listed plant species reported from Colbert and Lauderdale Counties, Alabama.

Common Name	Scientific Name	Federal Status	State Status
Dutchman's breeches	*Dicentra cucullaria*		NOST
False rue anemone	*Enemion bitternatum a*		NOST
Harper's umbrella plant	*Erigonum longifolium* var. *harperi*	PS	NOST
Alabama glade cress	*Leavenworthia alabamica*		NOST
Georgia rock cress*	*Arabis georgiana*	C	NOST
White trout lily	*Erythronium albidum*		NOST

Federal status codes: PS = Proposed for Federal Status; C = candidate for listing.
State status codes: NOST =Listed as a rare plant in Alabama but no state status assigned by Alabama Division of Natural Heritage.

Terrestrial Animals: A review of the TVA Regional Natural Heritage Project database indicates that two federally listed terrestrial animal species have been reported from Lauderdale and Colbert Counties and three state-listed terrestrial animals have been reported within a 3-mile radius of Wilson Dam (Table 3-3). Several caves are known to occur along the Tennessee River downstream of the dam.

Table 3-3. Federally listed terrestrial animals in Lauderdale and Colbert Counties, and protected terrestrial animals within three miles of Wilson Dam.

Common Name	Scientific Name	Federal Status	AL State Status
Gray bat	*Myotis grisescens*	E	P
Bald eagle	*Haliaeetus leucocephalus*	T	P
Alligator snapping turtle	*Macroclemys temminckii*		P

Osprey	*Pandion haliaetus*	P
Eastern big eared bat	*Corynorhinus rafinesquii*	P

Abbreviations: E – endangered, P – protected, T – threatened

The Tennessee River and its tributaries provide foraging habitat for many of the species listed above. A gray bat maternity colony is located several miles downstream of Wilson Dam. These bats forage along the Tennessee River and its tributaries in the vicinity of the project area.

Osprey nest on a powerline structure on Patton Island, approximately 1.5 miles downstream of Wilson Dam. These birds, as well as bald eagles, commonly feed on fish released through Wilson Dam.

There are no recent reports of alligator snapping turtles within the immediate vicinity of Wilson Dam. However, suitable habitat exists and it is likely that the species continues to occur in the vicinity.

Aquatic Animals**:** Data stored in the TVA Regional Natural Heritage Project database and results from recent surveys conducted in this area (e.g., Garner and McGregor 2001) indicate that a number of federal- and state-listed species could occur in the Tennessee River within the first 15 miles downstream from Wilson Dam. Several other federal-listed or federal candidate aquatic species are known from Colbert and/or Lauderdale Counties (Table 3-4).

Table 3-4. Federal- and state-listed aquatic animal species known from within fifteen miles downstream from Wilson Dam (TRM 259) and additional federal-listed aquatic species reported from Colbert and Lauderdale Counties, Alabama.

Common Name	Scientific Name	Federal Status	State Status	Present in Project Area
Crustacean				
Alabama cave shrimp	*Palaemonias alabamae*	E	T	No
Native Mussels				
Birdwing pearlymussel	*Lemiox rimosus*	E	P	Yes (R)
Cumberlandian combshell	*Epioblasma brevidens*	E	P	No
Cracking pearlymussel	*Hemistena lata*	E	P	Maybe
Dromedary pearlymussel	*Dromus dromas*	E	P	Yes (R)
Fanshell	*Cyprogenia stegaria*	E	P	Maybe
Orange-footed pearlymussel	*Plethobasus cooperianus*	E	P	Yes
Oyster mussel	*Epioblasma capsaeformis*	E	P	Yes (R)
Pink mucket	*Lampsilis abrupta*	E	P	Yes
Pyramid pigtoe	*Pleurobema rubrum*	-	P	Yes

Common Name	Scientific Name	Federal Status	State Status	Present in Project Area
Ring pink	*Obovaria retusa*	E	P	Yes
Rough pigtoe pearlymussel	*Pleurobema plenum*	E	P	Yes
Sheepnose	*Plethobasus cyphyus*	-	P	Yes
Slabside pearlymussel	*Lexingtonia dolabelloides*	C	P	No
Spectaclecase	*Cumberlandia monodonta*	-	P	Yes
Turgid blossom pearlymussel	*Epioblasma turgidula*	E	P	No
White wartyback pearly mussel	*Plethobasus cicatricosus*	E	P	Yes
Snail				
Anthony's riversnail	*Athearnia anthonyi*	E	-	Yes (R)
Fishes				
Alabama cavefish	*Speoplatyrhinus poulsoni*	E	P	No
Slackwater darter	*Etheostoma boschungi*	T	P	No
Spotfin chub	*Cyprinella (=Hybopsis) monacha*	T	P	No

Abbreviations: C – identified candidate, E – endangered, P – protected, R – reintroduced nonessential experimental population, T – threatened

As indicated in Table 3-4, seven of these 21 protected species are not considered likely to occur in the Wilson Dam tailwater. Four of these species (Cumberlandian combshell, slabside pearlymussel, slackwater darter, and spotfin chub) are known from small streams in one or both of these counties; however, they are not known from the mainstem Tennessee River. Two of the other species in this group (Alabama cave shrimp and Alabama cavefish) are only know from underground aquifers. The remaining species in this group (turgid blossom pearlymussel) is one of several federal-listed freshwater mussels previously known from this part of the Tennessee River that have not been observed alive in over 50 years.

Four other species included in Table 3-4 are identified as being present as reintroduced non-essential experimental populations (birdwing pearlymussel, dromedary pearlymussel, oyster mussel, and Anthony's riversnail). All four of these species were known to occur in this part of the Tennessee River at some time in the past; however, no living individuals had been observed in over 50 years. In 2003 and 2004, representatives of these four species were reintroduced into the Wilson Dam tailwater under a Nonessential Experimental Population authorization from the U.S. Fish and Wildlife Service (J. Garner, Alabama Wildlife and Freshwater Fisheries Division 2004). It may take several years to determine if any of these reintroductions result in reproducing populations of these endangered species. The area designated for these reintroductions extends 12 miles downstream from Wilson Dam.

The ten remaining species included in Table 3-4 are identified as either present or possibly present ("maybe") in the Wilson Dam tailwater. The following paragraphs summarize what

is known about each of these species. No critical habitat has been designated or proposed in the project area for any of these species.

The orange-footed pearly mussel is a large-river species which was listed as endangered in 1976 (USFWS 1984b). This species is known only from the lower Ohio, Cumberland, and Tennessee Rivers. In the Tennessee system, the orange-footed pearly mussel has been found as far upstream as Fort Loudoun Dam (TRM 595). Several members of this species were found during an extensive mussel relocation project just downstream from Pickwick Landing Dam (Jenkinson 1995). A specimen documented in a 1996 photograph is the only recent specimen of this species known from the Wilson Dam tailwater (TVA unpublished data).

The pink mucket was listed as endangered in 1976 (USFWS 1985). This mussel is known to exist in larger rivers at scattered locations ranging from the Kanawha River, West Virginia, west to the Gasconade River, Missouri, south to the Black River, Arkansas, and east to the Tennessee River basin. The most upstream site in the Tennessee River watershed where this species has been found is the Clinch River, Claiborne County, Tennessee. Specimens of the pink mucket have been found at several locations in the Wilson Dam tailwater during the last 25 years. The abundance of the pink mucket in this area is relatively typical for the species. Wherever it occurs, this species usually accounts for between 0.3 and 0.7 percent of the mussel community (Jenkinson and Hickman 1983).

The ring pink, listed as endangered in 1989 (USFWS 1991), barely persists in the Tennessee and Cumberland Rivers. It is also extremely rare in the Green River, Kentucky, and the Kanawha River, West Virginia. One member of this species was found in Wilson tailwater in 1992 (Richardson, personal communication, *in* Garner and McGregor 2001).

The white wartyback pearly mussel was listed as an endangered species in 1976 (USFWS 1984a). This nearly-extinct large river species was only known to survive in the Tennessee River downstream from Pickwick Landing Dam (TRM 206) until five live animals and one empty shell were found in the Wilson tailwater between 1997 and 1999 (Garner and McGregor 2001).

The rough pigtoe also was listed as an endangered species in 1976 (USFWS 1984c). Individuals of this species are often confused with other closely-related species in the *Pleurobema cordatum* complex. The known distribution includes the Green and Barren Rivers, Kentucky, the Cumberland River in Tennessee, and scattered locations on the Tennessee River upstream to the Clinch River in southwest Virginia. One rough pigtoe was found near TRM 253 in 1996 (Yokley 1996) and another was found in the Wilson tailwater in 1999 (Garner and McGregor 2001).

Two other endangered mussels, the fanshell and the cracking pearlymussel, may still be present in the Wilson Dam tailwater. The fanshell, listed as endangered in 1990 (USFWS 1991a), is extremely rare in the Tennessee and Cumberland Rivers but is more abundant in the Green and Licking Rivers, Kentucky, and in the Clinch River, Tennessee and Virginia. The cracking pearlymussel, listed as an endangered species in 1989 (USFWS 1991b) is only known to survive in the Powell and Clinch Rivers, Tennessee and Virginia, and in the Elk River, Tennessee. A few individuals may persist in the Green River, Kentucky, and in the Tennessee River downstream from Pickwick Landing Dam. There are no recent records of either of these species in the Wilson Dam tailwater; however, an empty shell of

the cracking pearlymussel found in the downstream part of the Elk River in 1999 (Garner and McGregor 2001) suggests that at least one of them also could occur there.

The last three species in this group are protected in Alabama but, as of yet, are not federally listed as an endangered or threatened species. All three of these species (pyramid pigtoe, sheepnose, and spectaclecase) still occur in a number of large-river locations; however, each of them is less abundant in Alabama than it was in the past. A few individuals of each of these species have been encountered in the Wilson Dam tailwater within the last 10 years and they are likely to continue to be present (Garner and McGregor 2001).

So far as is known, each of these listed mussels has similar habitat, feeding, and reproductive requirements. Adult members of these species live imbedded in cobble or gravel river bottoms where water currents prevent excessive silt accumulations. Native mussels feed by filtering small food particles (detritus, algae, etc.) out of the water. Reproduction involves a stage when the larvae (glochidia) must become temporary parasites on certain fish species in order to complete their development. The required "fish hosts" are unknown for most of these species; however, the pink mucket is reported to parasitize sauger (*Stizostedion canadense*) and freshwater drum (*Aplodinotus grunniens*) (USFWS 1985). Members of these mussel species may live for 40 years or more.

Environmental Consequences

Plants: Both the No Action Alternative and Wilson HMOD Alternative would involve similar construction and shoreline stabilization activities. All construction associated with these alternatives would be confined to areas that have historically been graveled, paved, or covered with concrete during construction or for subsequent purposes. Any vegetation remaining in these areas is not likely to include rare plant communities or otherwise sensitive habitats. No occurrences of, nor suitable habitats for, rare or protected plant species are known or expected to occur on or immediately adjacent to those areas to be affected by the either the No Action Alternative or the Wilson HMOD Alternative construction (including shoreline stabilization activities associated with both alternatives). Therefore, no impacts to protected plant species are expected under either of these alternatives.

Terrestrial Animals: Under the No Action Alternative, the listed terrestrial animals in the area are expected to continue present levels of foraging and/or nesting behavior. Shoreline stabilization proposed to control erosion at archaeological sites along the Seven Mile Islands and the tailwater reaches below Wilson Dam may improve water quality and thus be beneficial to rare wildlife species that forage along the reservoir. Thus no negative impacts are expected to listed terrestrial animals.

Adoption of the Wilson HMOD Alternative would result in minimal changes in water flow rates. Those changes are not expected to alter habitats used by any listed terrestrial animals. Mitigation measures proposed to control erosion at archaeological sites along the Seven Mile Island district and the tailwater reaches below Wilson Dam may improve water quality and thus be beneficial to rare wildlife species that forage along the reservoir. Caves along the tailwater downstream from the dam and the animals inhabiting them are not expected to be affected by the minor flow changes potentially resulting from this alternative. Thus, adoption of the Wilson HMOD Alternative would not affect listed terrestrial animals or their habitat.

Aquatic Animals: Turbine repair and rehabilitation activities under the No Action Alternative would not have any effect on listed aquatic species. The changes within the Hydro Plant would not result in any modification in the flow regime or bottom habitats in the river.

Under the Wilson HMOD Alternative, activities associated with plant modernization and resultant changes in downstream flow patterns also would not result in any effect on listed aquatic species. As described above in the Aquatic Life Section, the modernization of the turbines would result in very small increases in bottom velocities downstream from Wilson 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 mussels or their fish hosts downstream from Wilson Dam. Similarly, as described above in the Surface Water Quality Section, little change in either dissolved oxygen or temperature is anticipated in the tailwater.

Stabilization of shoreline areas in the Wilson Dam tailwater adjacent to archaeological sites could result in adverse effects on listed aquatic species if those projects resulted in destruction or disturbance of occupied mussel habitat. Typical procedures for this stabilization work are described in Appendix 1. With implementation of these procedures, the long-term effects on listed species should be beneficial because of the reduced shoreline erosion.

In accordance with Section 7 of the Endangered Species Act (ESA), TVA entered into formal consultation with the USFWS in May 2004 on the potential effects to endangered and threatened species that would result from adoption of the Wilson HMOD Alternative and the shoreline stabilization that would occur under either alternative. The USFWS issued a programmatic biological opinion (BO) to TVA on December 2, 2004 (see Appendix 2).

The BO addressed the potential effects of the proposed actions on the five endangered mussels persisting in the Wilson tailwater: orangefoot pimpleback, pink mucket pearlymussel, ring pink, rough pigtoe pearlymussel, and white wartyback pearlymussel (see Table 3-4). The two endangered mussels identified as maybe occurring in the Wilson tailwater, cracking pearlymussel and fanshell, were also included in the BO. Per Section 10(j) of the ESA, the three mussels and one snail recently reintroduced as nonessential experimental populations were not specifically addressed in the BO, although the USFWS concluded that the measures to be implemented to conserve the seven mussels specifically addressed would also benefit the reintroduced species.

In the BO, the USFWS concurred with TVA's conclusion that the proposed HMOD activities would not directly impact listed mussels. It also concurred with TVA's conclusion that the proposed stabilization work had the potential to adversely affect listed mussels. The adverse effects could occur in an area of about 80 acres (66 feet wide [the width of two work barges used for bank stabilization] along the 10 miles of shoreline where stabilization could be done), where disturbance of the river bottom substrate could occur. As part of the BO, the USFWS issued an incidental take statement for up to 20 pink mucket pearly mussels, 2 orangefoot pimplebacks, 2 rough pigtoe pearly mussels, 2 white wartyback pearly mussels, 2 fanshells, 2 cracking pearly mussels, and 2 ring pink mussels.

The USFWS concluded that TVA's proposed actions are not likely to jeopardize the continued existence of these 7 mussel species. This conclusion is based on the implementation of reasonable and prudent measures and associated terms and conditions. The reasonable and prudent measures are:

1. When avoidance of mussel beds is not possible, actions to minimize the impact to mussels would be implemented. When TVA personnel determine a known mussel bed would be impacted by shoreline stabilization efforts, TVA would implement a salvage/relocation effort for all federally listed mussels. Mussels would be relocated to a suitable habitat.

2. Minimize the siltation of aquatic habitats. Measures will be employed to prevent sedimentation of the river to the maximum extent possible. When barges and tugboats are utilized, reduce the extent of prop wash stirring up the bottom substrates and habitats that may contain listed mussel species.

3. Measures will be employed to minimize the potential for degradation of water quality.

4. Minimization of riverbank and river island vegetation removal.

5. Use of BMPs during all phases of riverbank and island shoreline stabilization efforts.

Terms and conditions to carry out the reasonable and prudent measures are:

1. Implement appropriate preventive measures to minimize the potential for hazardous materials (e.g., hydraulic fluid, oils, lubricants, fuel) from leaking onto the ground or into the water. Have in-place a Hazardous Material/Fluid Spill Prevention Plan to address accidental spills/leaks.

2. In instances when riprap would need to be placed below low winter pool elevation to properly protect the bank, TVA malacologists would conduct a site tour of these locations to determine potential impacts of this action on mussel species. If visual observations can not conclude the absence of listed mussel species in or near the footprint of the riprap placement, a mussel presence/absence survey would be necessary. These surveys would need to be conducted by divers and biologists familiar with the listed species discussed in the BO. The survey protocol guidelines are listed in Appendix B of the BO.

3. TVA and USFWS biologists would mutually agree on at least two mussel relocation sites prior to implementation of the proposed project. These sites would have an established mussel population and would exhibit the habitat features needed to sustain the 7 listed mussel species that would be relocated to these areas.

4. When stabilization activities are deemed necessary, or are to occur, between TRM 249.0 and TRM 250.0, the USFWS would need to be contacted in advance of any work for assistance in properly positioning the barge and tug boat to prevent disturbance of the NEP (or "pilot") populations located in this reach (i.e., Buck Island Chute area).

5. TVA is required to report to the USFWS project-specific information of their proposed actions and site-specific areas to be affected by their actions (i.e., provide location of project site, extent of impact area, and anticipated impacts of stabilization activities on listed mussels). This report would be appended to the programmatic BO utilizing the format found in Appendix C of the BO.

In order to have some measure of the effectiveness of the reasonable and prudent measures, as well as a better understanding of local biological trends, TVA will continue its ongoing water quality and biological community monitoring efforts and will also, as time and budgets allow, assist other biological survey efforts in the Wilson tailwaters.

3.10. Managed Areas and Ecologically Significant Sites

Affected Environment

A review of the TVA Natural Heritage database indicates that the proposed project is within three miles of four Managed Areas and two Ecologically Significant Sites.

The project site is immediately adjacent to the Wilson Dam Tailwater Restricted Mussel Harvest Area. Alabama Department of Conservation and Natural Resources regulations protect rare mussel species from Wilson Dam downstream to the upper end of Seven Mile Island.

Veterans Park is adjacent to the project site, on the north side of Wilson Dam. Operated by the city of Florence, the park has hiking trails, playgrounds, picnic areas, boat access and a developed campground.

Old First Quarters (Potential) National Natural Landmark is a 50-acre site that includes the aforementioned area. This National Park Service program recognizes areas of national ecological significance. This tract, while meeting the criteria for listing, has not to date been registered as a National Natural Landmark.

Old First Quarters TVA Small Wild Area (SWA) is located two miles downstream of Wilson Dam, on the left descending bank. This 24-acre area on Muscle Shoals Reservoir Reservation is managed by TVA to preserve natural and cultural resources. Old First Quarters SWA includes a trail system featuring structures built in the 1930s by the Civilian Conservation Corps.

There are approximately 7.5 miles of hiking trails on the Muscle Shoals Reservation. The 2.7-mile Rockpile National Recreation Trail, designated by the National Park Service, begins just below Wilson Dam. The TVA recently received a grant from federal highway funds, administered by the Alabama Department of Transportation, for an additional 2.75 miles of trail to be built in the Old First Quarters area.

Managed Areas and Ecologically Significant Sites are reviewed for impacts within a three-mile radius of a proposed project site. As provided above, the Wilson Dam HMOD review includes managed areas and ecologically significant sites within three miles of Wilson Dam, from TRM 259 to 256. However, mitigation sites for cultural resources, i.e., shoreline stabilization to protect archaeological sites in the Seven Mile Island Archaeological District, include the area between Wilson Dam and TRM 242. Three managed areas and three ecologically significant sites exist adjacent to this part of the river.

McFarland Park is located on Pickwick Reservoir at approximately TRM 255 and provides various recreational activities.

The Seven Mile Island State Wildlife Management Area is managed by the Alabama Department of Conservation and Natural Resources, Division of Fish and Game. It comprises 4,685 acres along the north bank of Pickwick Reservoir, including about 400 acres within Seven Mile Island extending from TRM 246.7 to 253.2. It is managed primarily for waterfowl hunting, although other recreational activities such as hiking and camping are permitted.

The Key Cave Aquifer Hazard Zone extends approximately from TRM 247 to 255. This area includes Key Cave, which is 1.14 air miles northeast of TRM 248. The wooded bluff where cave entrances are located is protected by TVA. Back lying land is owned and managed by the USFWS. Most of the remainder of the aquifer recharge area is in privately-owned pasture or row crops. The cave area is an Alabama Cavefish Designated Critical Habitat. The entrance to Key Cave is on TVA land on the Coffee Bluff TVA Habitat Protection Area (HPA). The Coffee Bluff TVA HPA also includes Colliers Cave and six other caves. Key Cave National Wildlife Refuge, administered by Wheeler National Wildlife Refuge, is a 1,060-acre refuge maintained primarily to protect endangered species and their critical habitat while also providing opportunities for compatible outdoor recreation, environmental education, and interpretation.

Environmental Consequences

Adoption of either the Wilson HMOD Alternative or the No Action alternative would involve a construction phase during which slight increases in traffic and noise levels would affect visitor activities in Veterans Park, the Old First Quarters TVA Small Wild Area, and on the Muscle Shoals Reservation trail complex. These impacts would occur over several years and, based on the anticipated level of construction activity, as well as the lack of observed impacts from the previously completed HMOD work at Wilson, are not expected to be adverse. Shoreline stabilization would be required at various archeological sites in the tailwater area within the Seven Mile Island Archaeological District (i.e., the river channel areas below Wilson Dam (TRM 259 – 242). Several severely eroded banks are within Managed Areas/Ecologically Significant Sites and stabilization efforts would be beneficial. The use of BMPs and measures described in Appendix 1 during stabilization activities will help safeguard against impact to protected mussel areas and critical cave habitats. During the construction phase, BMPs would be implemented to ensure that no debris or spill from the project site enters the waterway, preventing impacts to the protected mussel areas adjacent to and downstream from Wilson Dam (see Aquatic Life section).

As described above in the Erosion Section, changes in the tailwater surface elevation and the velocity of flows under the Wilson HMOD Alternative would likely result in some increase in the rate of shoreline erosion that is already occurring in the tailwater. This increase would be partially offset by the shoreline stabilization activities and significant impacts to Managed Areas and/or Ecologically Significant Sites below Wilson Dam are not anticipated.

3.11. Recreation

Affected Environment

Recreation areas in the immediate vicinity of Wilson Hydro Plant and dam include Veterans Park on the north side of the dam and the Muscle Shoals Reservation predominantly on the south side of the dam. Public recreation facilities on the Muscle Shoals Reservation include several miles of trails (see the Managed Areas and Ecologically Significant Sites section, above) and the Rockpile Boat Ramp at TRM 258.8L. Other recreation areas further downstream include Florence Harbor/McFarland Park, with three boat ramps, at TRM 256.2R; Sheffield Riverfront Park, with two boat ramps, at TRM 253.7L; Spring Creek Boat Ramp at TRM 252.1L,; Pride Boat Ramp at TRM 246.9L, and Cane Creek Boat Ramp at TRM 244.0L.

The Wilson tailwater is a nationally recognized sport fishing area. It is also heavily used in summer for recreational boating and personal watercrafts, especially downstream of Florence Harbor. The canal area is heavily used for water skiing.

Bank fishing and informal recreation activity occurs throughout the project area. Seven Mile Island is a popular informal recreation area. Activities include boating swimming and camping. There are several informal river access areas on the Lauderdale County side of the river below McFarland Park. The Seven Mile Island Wildlife Management Area, operated by the State of Alabama includes several thousand acres of hunting and wildlife observation areas.

Environmental Consequences

Under both the No Action Alternative and the Wilson HMOD (action) Alternative there would be a nominal increase in truck traffic for equipment delivery. The routine work would not require any additional truck traffic and a maximum of 50 -75 additional workers would be coming to the plant during the construction period. The majority of the work would be in inside the plant so noise is not likely to be an issue. Both alternatives will require some shoreline stabilization in the Seven Mile island district similar to stabilization work that has been on going on in this area in recent years. There would be only insignificant (minimal to zero) impacts to recreation activities from the above noted activities

No Action Alternative: Under this alternative, there would be no changes in existing tailwater elevations below Wilson Hydro Plant and thus no impact to public recreation resources, facilities and activities.

Wilson HMOD Alternative: If the Wilson HMOD Alternative is adopted the increases in tailwater elevations and velocities below the hydro plant would have minor and insignificant effects on the boat ramps and other recreational facilities, especially in view of the present range of elevations and velocities regularly experienced in this area. The effect of this alternative on the winter pool elevations would be slightly beneficial due to conditions at some boat ramps that become unusable at low pool levels. Overall effects on recreational facilities and recreation use in the Wilson tailwater from the Wilson HMOD Alternative would be insignificant.

3.12. Visual Resources

Affected Environment

The powerhouse and switchyard areas at Wilson Dam are industrial areas. Routine operation and maintenance activities, and the resulting vehicular traffic, including

occasional large trucks, and movement of heavy equipment are existing parts of the affected visual environment.

The affected visual environment upstream of the Wilson Dam is scenic terrain on the Tennessee River. These areas are seen mostly in the foreground (up to ¼ mile from the observer) by recreation users along the river. Some views of the river are enjoyed by passing motorists along adjacent roadways and at numerous bridge crossings. Scenic attractiveness and integrity is high.

The affected visual environment downstream of Wilson Dam consists of mixed woodland and developed areas. The visual character varies along the shoreline of the tailwater area depending on generation activity (water elevation and flow volume). With little or no generation, some areas are seen as low water streams with exposed banks, rocks, and shallow pools. With increased generation, the area is seen as a much wider, fuller river.

Generation activities have less effect on views available farther downstream from the dam. The water course provides visual coherence in the landscape, while the natural and cultural elements along it provide variety and scenic attractiveness. Together they form a generally harmonious landscape.

Generally, throughout the tailwater area, shoreline that has not previously been stabilized by mechanical methods has experienced erosion and bank failure to some degree. Though most riparian buffer zones throughout the proposed project area are considered good, shoreline erosion is evident from viewing distances available to recreational users. Exposed soil banks vary in height, with some areas showing severe erosion and exposed banks in excess of five feet. Turbidity in the waters along eroding shoreline is perceivable from the foreground

The tailwater area is most readily visible from the foreground viewing distance where landscape elements can be seen in detail and distinguished by their form, texture, line, and color. Visitors to public use areas and recreational users along the river have more direct views of the tailwater area. Motorists traveling on roads along the shores and bridges that cross the river have views from a somewhat greater distance into the middleground (1/4 mile to four miles from the observer). Foreground views can sometimes be obscured by foggy mists that result from contrasting air and water temperatures. Views available from more remote locations and greater distances also may have poor definition during the summer months due to hazy conditions created by the warm, moist climatic conditions.

Environmental Consequences

Under the No Action Alternative: There would not be an increase in flow under this alternative; therefore, there would be no discernable change in the scenic value. Construction activity and shoreline stabilization activity would remain at levels typically observed by recreational lake users, passing motorists, and near shore residents, also resulting in no discernable change in the existing scenic value. Thus only insignificant (if any) impacts would occur.

Wilson HMOD Alternative: Under this alternative, minor impacts to visual resources would result from the proposed replacement of turbine runners and modernizing the existing generators on all units. There would be little perceived change to the harmony, coherence, or scenic integrity of the landscape. The small increase in tailwater elevations associated

with high flow operations would occur more frequently. The tailwater area experiencing the greatest change in elevation as a result of the proposed project would lie closest to the powerhouse discharge area. The differences in elevation would be much less discernable at locations farther downstream.

The minor changes in the existing scenic value would not be measurably/readily apparent to passing motorists, casual observers, or visitors to TVA facilities. Frequent visitors and recreational users familiar with water levels at boat ramps, and other sites may notice slightly higher water elevations for extended periods of time. Those people that reside or use land along the tailwater shoreline may also notice slightly higher levels, but there would be little change in the scenic integrity. Downstream of the powerhouse, higher water elevations may be noticed for a longer period of time, where a slight reduction in scenic integrity would likely occur.

Impacts visible from the foreground viewing distance resulting from shoreline stabilization activities would be minimal under either alternative. Stabilization methods, as proposed, would result in a discernable change from the existing shoreline character. Stabilization with graded stone, having already occurred along several sections of the reservoir, would generally be preferable to existing intermittent views of shoreline that has begun to be undercut from erosion and is experiencing bank failure. In addition to improving the integrity of reservoir shoreline and riparian buffer zones, stabilization would reduce perceivable impacts associated with rain events and the resulting turbid waters that surround the eroding banks. Pool elevation increases would be minor due to modernization (increased flow) of the turbines; therefore, any erosion occurring prior to the completion of shoreline stabilization activities would be incremental and minimal.

Under either alternative, material storage and staging areas during construction would be located at existing locations outside the powerhouse. Views of shoreline stabilization activities would be readily discernable to recreational lake users, near shore residents, and motorists passing on nearby roadways. There would be a slight increase in the number of personnel and associated construction equipment at the Wilson Hydro facility which would result in minor visual discord visible to motorists and recreational lake users. This increase would each spring and fall for several years and would take place in an existing industrial setting adjacent to a heavily traveled highway. Therefore, impacts to visual resources resulting from this project would be insignificant.

3.13. Air Quality

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: particulate matter, sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide, and lead. Any area where any air quality standard is violated is designated as a non-attainment area for that pollutant, and emissions of that pollutant from new or expanding sources are carefully controlled. Wilson Dam is not in or near any non-attainment areas**.**

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 area to Wilson Dam is the Sipsey River Wilderness, about 48 kilometers (30 miles) to the south-southeast.

Environmental Consequences

No Action Alternative: This alternative would have only temporary, intermittent, 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 trucks that may be use, 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.

Wilson HMOD Alternative: Adoption of the Wilson HMOD Alternative would similarly have only temporary, intermittent, and minor impacts on local and regional air quality during the course of the project refurbishment activities, and turbine replacement activities. Air pollutant emissions may include combustion exhaust from fuel-burning engines such as those in cranes, compressors, and trucks 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 OSHA**.** 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.

3.14. Cultural Resources – Archaeology

Affected Environment

Humans have occupied northern Alabama for at least 13,000 years. In this area, developments in prehistoric archaeology roughly correspond to five time periods: Paleo-Indian, Archaic, Gulf Formational, Woodland, and Mississippian (Walthall 1980; McNutt and Weaver 1985). Prehistoric land use and settlement patterns vary during each period. Nevertheless, short- and long-term habitation sites are generally located on flood plains and alluvial terraces, while specialized campsites tend to be located on older alluvial terraces and in the uplands.

Nearly 850 archaeological sites have been recorded within the Wilson Dam Tailwater/Pickwick Reservoir Pool area (WDT/PRP) (Meyer 1995, TRC 2003). Three historic properties within the APE are currently listed in the National Register of Historic Places (NRHP): Wilson Dam (also designated a National Historic Landmark [NHL]), the Seven Mile Island Archaeological District (“the District”) and the Florence Wagon Works Site. Currently, the District contains 123 archaeological sites, all of which are listed on the NRHP by virtue of their inclusion in the District.

The project has no potential to affect either Wilson Dam or the Florence Wagon Works Site. TVA has defined the Area of Potential Effect (APE) for archaeological resources as all shoreline within the WDT/PRP between TRM 259.5 (Wilson Dam) and 245.0. TVA’s erosion assessment reconnaissance identified conditions that are adversely affecting eligible and listed archaeological sites, including sites in the district. A recent archaeological reconnaissance of all shoreline within the WDT/PRP (TRC 2003) concluded that the cumulative effects of completing Wilson HMOD would exacerbate those effects.

Archaeological surveys (Meyer 1995, TRC 2003, Waselkov and Morgan 1983, Webb and DeJarnette 1942) have identified 241 archaeological sites within the APE, including the 123 sites in the Seven Mile Island Archaeological District. The most recent investigation in the APE (TRC 2003) was carried out in order to comply with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, prior to completion of the Wilson HMOD project. This investigation consisted of an identification survey of all shoreline within the APE and evaluation testing (limited excavation) of selected sites that are currently subject to shoreline erosion. Two major goals of this investigation are to determine NRHP eligibility for previously recorded and newly recorded sites, and to assess the effects of shoreline erosion on the scientific value of recorded sites.

Environmental Consequences

Based on previous survey data, and in consultation with the Alabama State Historic Preservation Officer (SHPO) and other consulting parties, TVA has determined that the proposed action has the potential for adverse effects to archaeological properties that are listed, or eligible for listing, on the NRHP (i.e., significant sites). Accordingly, TVA has executed a Memorandum of Agreement (MOA) with the SHPO. The MOA stipulates a continuing program of phased identification, evaluation, and assessment of adverse effects on significant sites and the development of a plan to treat adverse effects. Treatments would consist of shoreline stabilization or archaeological data recovery excavations (Appendix 1). Treatment decisions would be based on logistics, costs, and other factors such as religious and cultural significance to Indian tribes, as well as terms of the USFWS biological opinion on potential effects to endangered and threatened species. Execution of the MOA documents that TVA has fully considered the effects of Wilson HMOD on historic properties, pursuant to Section 106 of the NHPA and its implementing regulations at 36CFR800.

3.15. Cultural Resources – Historic Structures

Affected Environment

TVA Cultural Resources staff has defined the study area for this project as the Wilson Dam and Power House. Wilson Dam and Power House, with construction beginning in 1918 and dam closure in 1924, is a listed National Historic Landmark (NHL) and is a contributing element of a thematic resource consisting of the TVA dam and reservoir system. Because of their age and potential contribution to the historic integrity of the dam and power house, some of the plant components that would be replaced or rehabilitated may be historically significant.

Environmental Consequences

No external changes to Wilson Dam and Power House would occur with the No Action Alternative or with the proposed Wilson HMOD Alternative. No historic interior features would be altered, including ceilings, walls, and equipment panels. The “in-plant” components that would be replaced or rehabilitated if current operations are continued (No Action Alternative) or if the proposed Wilson HMOD Alternative is adopted would be inventoried and examined by an industrial archaeologist to determine which, if any, have a significant contribution to the National Register eligibility of the facility. All significant elements would be preserved or documented in consultation with the Alabama SHPO. Under these conditions, neither the No Action Alternative nor the proposed Wilson HMOD

Alternative would adversely affect any of the characteristics of Wilson Dam and Power House that qualify it for National Landmark eligibility. Thus, only insignificant impacts would occur

3.16. Socioeconomics

Affected Environment

Wilson Dam is located in Colbert and Lauderdale Counties, Alabama. Most of Wilson Reservoir is located in these same two counties; however, a small portion of the reservoir occurs in Lawrence County. The combined population of Colbert and Lauderdale Counties, which form the Florence Metropolitan Area, is about 143,000. The population of Lawrence County is almost 35,000. In addition to these three counties, the labor market area potentially affected by these proposed actions includes Morgan and Madison Counties, where Decatur and Huntsville are located, as well as Limestone County and several other smaller counties. The labor force in the Florence MA is over 66,000, with an unemployment rate in 2001 of 8.2 percent. The entire labor market area for this project has a labor force of more than 425,000 persons, with a 2001 unemployment rate of 5.6 percent.

Environmental Consequences

No Action Alternative: Under this alternative, maintenance and equipment upgrades including refurbishments and/or replacement of turbine and generation components, 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 have insignificant impacts on the local economy.

Wilson HMOD Alternative: If the Wilson HMOD Alternative is adopted TVA would replace the eleven turbine runners that have not yet been uprated, in addition to refurbishments and /or replacement of turbine and generation components on these units. The construction activities likely would occur between 2008 and 2014, and would involve a peak workforce of approximately 50 to 75 workers at various times during construction. This activity would result in minor increases in income and employment in the area during each cycle. However, the maximum employment would represent only about 0.1 percent of the labor force of Colbert and Lauderdale Counties, and as such the potential impacts to the area would be minor and insignificant.

3.17. Environmental Justice

Affected Environment

The population of the Florence Metropolitan Area is 14.9 percent minority, well below the minority percentage in both the state of Alabama (29.7 percent), and the nation (30.9 percent). The minority population is about evenly divided between Colbert and Lauderdale Counties. The labor market area has a slightly higher minority population share, 18.9 percent, with the majority living in the metropolitan areas of Huntsville, Decatur, and Florence. On the south, Wilson Dam is located adjacent to Census Tract 207.01, Block Group 1, in Colbert County. On the north, it is adjacent to Census Tract 101, Block Group 1; Tract 107, Block Group 3; and Tract 108, Block Group 4, all in Lauderdale County. The minority population in these block groups is, respectively, 6.5 percent, 35.0 percent, 30.0

percent, and 11.4 percent of the total population. These are generally similar to or lower than the state and national averages, but two of the block groups are well above the metropolitan area and labor market area averages. Most of the population in all these block groups is somewhat removed from the site of the dam.

According to the 2000 Census of Population, poverty rates in Colbert and Lauderdale Counties are 14 percent and 14.4 percent, respectively. These are slightly higher than the national average (12.4 percent), but slightly lower than the state average (16.1 percent). The rate for the labor market area as a whole is 13.1 percent, slightly lower than Colbert and Lauderdale Counties. Poverty rates in the block groups near the dam are generally higher than in Colbert and Lauderdale Counties. In Colbert County, Block Group 1, Census Tract 207.01, the poverty rate is 18.0 percent. In Lauderdale County, rates are much higher in the two Block Groups on Pickwick Lake, west of the dam (CT 101, BG 1, and CT 107, BG 3 are 31.7 and 31.1 percent, respectively). However, Block Group 4 in Census Tract 108, which is east of the dam, has a very low poverty rate of only 3.4 percent.

Environmental Consequences

The counties adjacent to the dam have relatively low poverty rates and small minority populations. However, some of the block groups near the dam have relatively high minority populations and poverty levels. The populations in these block groups are small and are generally not close to the dam site. Almost all construction activities would occur inside the plant under either alternative, 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 populations are expected under either alternative. As such the Environmental Justice impacts (if any) will be minor and insignificant with either the No Action Alternative or the Proposed Wilson HMOD alternative.

3.18. Cumulative Impacts

The proposed Wilson HMOD Alternative is limited in scope and would have minimal physical impacts on the environment. The minimal flow rate increase from the Wilson Hydro Plant associated with the selection of the Wilson HMOD Alternative would have no significant adverse effects on the environment. No net increases in flow volume through the Wilson Hydro Plant and Dam would occur, i.e., system-wide water availability limitations dictate the total daily flow volume. Changes in reservoir operating conditions resulting from the TVA River Operations Study EIS preferred alternative (e.g., duration of full pool, winter drawdown levels, etc.) are expected to have no effect on any aspects of present hydropower operations or future hydropower (HMOD) operations at Wilson Hydro Plant. Therefore, TVA has determined that the cumulative impacts of the Wilson HMOD Alternative would be insignificant.

3.19. Measures to Mitigate Potential Adverse Impacts

The following commitments are identified in various media sections of this EA as measures necessary to avoid or mitigate potential adverse effects related to adoption of one or both of the alternatives. These measures constitute commitments that TVA would follow to better assure minimum and insignificant potential impacts on the archeological and environmental resources of the Wilson Hydro Plant and tailwater.

1. All historically significant components that would be replaced or modified would be documented by an industrial archaeologist with concurrence of the AL SHPO. Unique or rare components that are not earmarked as replacement/spare parts would be preserved.

2. The phased archaeological assessment and protection process (agreed to by the SHPO), including an MOA and future shoreline stabilization efforts to protect the archeological sites potentially affected by the Wilson HMOD will continue until fully implemented per the details of the Archaeological Survey Report and site prioritization and required (via MOA) future consultation with the SHPO.

3. Avoid the use of species found on the Invasive Plant Species of High Priority to TVA and the Tennessee Exotic Pest Plant Council (TN-EPPC) lists in any revegetation work.

4. Utilize seed mixes for re-vegetation and erosion control comprised of native species or non-invasive, non-native species during any revegetation work.

5. Stabilization activities requiring bank disturbance or work from the landward side of the bank for any of the stabilization sites will require that TVA wetland biologists conduct an on-site wetland determination and be consulted on impact avoidance and minimization. Appropriate federal and state permits will be obtained as necessary.

Reasonable and prudent measures required by the USFWS are:

6. When avoidance of mussel beds is not possible, actions to minimize the impact to mussels would be implemented. When TVA personnel determine a known mussel bed would be impacted by shoreline stabilization efforts, TVA would implement a salvage/relocation effort for all federally listed mussels. Mussels would be relocated to a suitable habitat.

7. Minimize the siltation of aquatic habitats. Measures will be employed to prevent sedimentation of the river to the maximum extent possible. When barges and tugboats are utilized, reduce the extent of prop wash stirring up the bottom substrates and habitats that may contain listed mussel species.

8. Measures will be employed to minimize the potential for degradation of water quality.

9. Minimization of riverbank and river island vegetation removal.

10. Use of BMPs during all phases of riverbank and island shoreline stabilization efforts.

Terms and conditions to carry out the reasonable and prudent measures are:

11. Implement appropriate preventive measures to minimize the potential for hazardous materials (e.g., hydraulic fluid, oils, lubricants, fuel) from leaking onto the ground or into the water. Have in-place a Hazardous Material/Fluid Spill Prevention Plan to address accidental spills/leaks.

12. In instances when riprap would need to be placed below low wither pool elevation to properly protect the bank, TVA malacologists would conduct a site tour of these locations to determine potential impacts of this action on mussel species. If visual observations can not conclude the absence of listed mussel species in or near the footprint of the riprap placement, a mussel presence/absence survey would be necessary. These surveys would need to be conducted by divers and biologists familiar with the listed species discussed in the BO. The survey protocol guidelines are listed in Appendix B of the BO.

13. TVA and USFWS biologists would mutually agree on at least two mussel relocation sites prior to implementation of the proposed project. These sites would have an established mussel population and would exhibit the habitat features needed to sustain the 7 listed mussel species that would be relocated to these areas.

14. When stabilization activities are deemed necessary, or are to occur, between TRM 249.0 and TRM 250.0, the USFWS would need to be contacted in advance of any work for assistance in properly positioning the barge and tug boat to prevent disturbance of the nonessential (or “pilot”) populations located in this reach (i.e., Buck Island Chute area).

15. TVA is required to report to the USFWS project-specific information of their proposed actions and site-specific areas to be affected by their actions (i.e., provide location of project site, extent of impact area, and anticipated impacts of stabilization activities on listed mussels). This report would be appended to the programmatic BO utilizing the format found in Appendix C of the BO.

In order to have some measure of the effectiveness of the reasonable and prudent measures, as well as a better understanding of local biological trends:

16. TVA will continue its ongoing water quality and biological community monitoring efforts and will also, as time and budgets allow, assist other biological survey efforts in the Wilson tailwaters.

CHAPTER 4

4. SUPPORTING INFORMATION

4.1. List of Preparers

Contribution	Preparer
Project Description	Gregory Keith
Hydraulic Modeling Support	William Proctor
Erosion	Jim Hagerman
Waste Generation	Lee Graser
Surface Water	John Higgins
Groundwater	Jack Milligan
Aquatic Life	John Jenkinson, Stephanie Chance, George Peck
Wetlands	Kim Pilarski, Barbara Rosensteel, Jane Awl
Terrestrial Ecology - Plants	Leo Collins, Nancy Fraley, Britta Dimick
Terrestrial Ecology - Animals	Hill Henry
Endangered and Threatened Species	John Jenkinson, Stephanie Chance, Hill Henry, Leo Collins, Britta Dimick
Managed Areas	Kenny Gardner, Nancy Fraley
Recreation	Richard Pflueger
Visual	Chett Peebles, Jon Riley
Air Quality	Norris Nielsen
Cultural Resources (Archeological)	Richard Yarnell, Steven Cole, Danny Olinger
Cultural Resources (Historic Structures)	Charles Tichy
Environmental Justice	James Eblen
Socioeconomics	James Eblen
EA Project Coordination	Lee Graser, Charles Nicholson

4.2. Literature Cited

Cowardin, L. M., V. Carter, F. C. Golet, and E. T. LaRoe. 1979. Classification of wetland and deepwater habitats of the United States. U.S. Fish and Wildlife publication FWS/OBS-79/31, Washington, D.C.

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. Water Management, Tennessee Valley Authority, Chattanooga, Tennessee.

Garner, J. T, and S. W. McGregor. 2001. Current status of freshwater mussels (Unionidae, Margaritiferidae) in the Muscle Shoals area of the Tennessee River in Alabama (Muscle Shoals revisited again). American Malacological Bulletin, 16(1/2):155-170.

Gooch, C. H., W. J. Pardue, and D. C. Wade. 1979. Recent Mollusk Investigations on the Tennessee River, 1978. draft report, Division of Environmental Planning,

Tennessee Valley Authority, Muscle Shoals, Alabama, and Chattanooga, Tennessee, 126 pages.

Jenkinson, J. J. 1993. Native mussel survey along McFarland Park, Tennessee River Miles 255-256R, Florence, Alabama. Tennessee Valley Authority, Chattanooga, Tennessee, 14 pages.

Jenkinson, J. J. and G. D. Hickman. 1983. Biological Assessment of Proposed U.S. Army corps of Engineers Navigation Dredging and Disposal on Freshwater Mussels at Sites Downstream from Cordell Hull Dam, Cumberland River Miles 303.8-309.2. Office of Natural Resources and Economic Development, Tennessee Valley Authority, Norris, Tennessee, 17 pages.

Jenkinson, J. J. 1995. Pickwick Channel Widening Project, Mussel Relocation Activity: Status Report. Unpublished report, Tennessee Valley Authority, 2 pages.

Maceina, M. J., P. W. Bettoli, S. D. Finely, and V. J. DiCenzo. 1996. Recruitment, movement, and exploitation of sauger in the Alabama portion of the Tennessee River. Job Performance Final Report Project F-40. Alabama Dept. of Conservation d Natural Resources. Montgomery, Alabama. 58pp.

Maceina, M. J., and J. W. Slipke. 1997. Assessment of the smallmouth bass fishery on Pickwick Reservoir. Job Performance Interim Final Report Project F-40. Alabama Dept. of Conservation and Natural Resources. Montgomery, Alabama. 31pp.

McNutt, C. H. and G. G. Weaver. 1985*. An Above-Pool Survey of Cultural Resources within the Little Bear Creek Reservoir Area, Franklin County, Alabama*. Memphis State University, Anthropological Research Center, Occasional Papers No. 13, and Tennessee Valley Authority Publications in Anthropology No. 45.

Meyer, C. C. 1995. *Cultural Resources in the Pickwick Reservoir*. Prepared for the Tennessee Valley Authority, Norris, TN by The University of Alabama, Alabama Museum of Natural History, Division of Archaeology, Moundville, AL

Tennessee Valley Authority. 2004. Reservoir Operations Study – Final Programmatic Environmental Impact Statement. Tennessee Valley Authority, Knoxville, Tennessee.

TRC 2003. Phase I *Archaeological Survey and Site Assessment for the Wilson Dam Hydromodernization Project at Pickwick Lake in Colbert and Lauderdale Counties, Alabama*. Submitted to The Tennessee Valley Authority, Norris, TN by TRC, Atlanta, Georgia.

U.S. Fish and Wildlife Service. 1984a. Recovery Plan for the White Warty-back Pearly Mussel. U.S. Fish and Wildlife Service, Atlanta, Georgia, 43 pages.

U.S. Fish and Wildlife Service. 1984b. Recovery Plan for the Orange-footed Pearly Mussel *Plethobasus cooperianus* (Lea, 1834). U.S. Fish and Wildlife Service, Atlanta, Georgia, 44 pages.

U.S. Fish and Wildlife Service. 1984c. Recovery Plan for the Rough Pigtoe Pearly Mussel, *Pleurobema plenum* (Lea, 1840). U.S. Fish and Wildlife Service, Atlanta, Georgia, 51 pages.

U.S. Fish and Wildlife Service. 1985. Recovery Plan for the Pink Mucket Pearly Mussel. U.S. Fish and Wildlife Service, Atlanta, Georgia, 47 pages.

U.S. Fish and Wildlife Service. 1991a. Fanshell (*Cyprogenia stegaria* (=*C. irrorata*)) Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia, 37 pages.

U.S. Fish and Wildlife Service. 1991b. Ring Pink Mussel Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia, 24 pages.

U.S. Fish and Wildlife Service. 1991c. Cracking Pearlymussel (*Hemistena* (=*Lastena*) *lata*) Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia, 25 pages.

Waselkov, G. A. and R. T. Morgan 1983. The Archaeology of Seven Mile Island: A Cultural Resources Survey of the National Register District. Report submitted to the Tennessee Valley Authority, Norris, TN by Auburn University, Department of Sociology and Anthropology, Auburn, AL.

Walthall, J. A. 1980. *Prehistoric Indians of the Southeast: Archaeology of Alabama and the Middle South*. University of Alabama Press, Tuscaloosa.

Webb, W. S. and D. L. DeJarnette 1942. *An Archaeological Survey of Pickwick Basin in the Adjacent Portions of the States of Alabama, Mississippi and Tennessee*. Bureau of American Ethnology, Bulletin 129. Washington, D. C.

Yokley, P. 1993. Freshwater Mussel Survey at TRM 254.7. Contract Report provided to the City of Florence, Alabama, and the U.S. Army Corps of Engineers, 44 numbered and unnumbered pages.

Yokley, P. 1996. Freshwater Mussel Survey of the Tennessee River at TRM. 254.2 and Immediately Below and an Additional Survey Across Cypress Creek Below Highway 20 Bridge. Contract Report provided to the City of Florence, Alabama, 5 pages.

APPENDIX 1 - SHORELINE STABILIZATION ALONG ARCHAEOLOGICAL SITES LOCATED DOWNSTREAM FROM TENNESSEE VALLEY AUTHORITY DAMS

Purposes

This document has two purposes: to describe how the Tennessee Valley Authority (TVA) stabilizes shorelines for the protection and preservation of significant archaeological resources, and to describe the ways TVA and its contractors avoid or minimize adverse effects on other resources when the shorelines adjacent to archaeological sites must be stabilized.

Background

Many sites along the shoreline of the Tennessee River and its larger tributaries contain important archaeological resources. These sites contain an archaeological record spanning more than 11,000 years and are a priceless resource for helping to understand North American prehistory and the heritage of Native Americans. Some of these sites have been excavated and studied scientifically; however, many others have not. The archaeological sites that still exist should be preserved for future generations, in part out of respect for the people who created or are buried in them. The federal National Historic Preservation Act (NHPA) and the Archaeological Resources Protection Act (ARPA) also mandate protection of these sites.

The force of moving water in rivers typically erodes away some parts of the banks and deposits that material elsewhere. The construction of dams and reservoirs on the Tennessee River and many of its tributaries has modified this natural process, reducing shoreline erosion in some areas and accelerating it in others. Impoundment typically slows or prevents the erosion of former stream banks that are covered by standing water and increases erosion in some areas formerly protected by upland vegetation. Releases from dams can create unnatural flow patterns, including frequent changes from low- to high-flow events. Downstream from some TVA dams, shoreline sites are experiencing accelerated erosion, in places resulting in the loss of 0.5 to 1.5 feet of bank width per year. Where archaeological sites occur in these rapidly eroding areas, the history they contain can be lost or exposed to theft by looters. TVA continues to implement a long-term program to stabilize, protect, and preserve significant archaeological sites, some of which are located downstream from various dams. These measures also are conducted pursuant to NHPA and ARPA.

The tailwater sections of the Tennessee River and many of its tributaries downstream from dams are important for a variety of reasons other than the presence of archaeological resources. Many tailwaters contain some of the best surviving large river habitats in the region, supporting populations of fish that are sought by both recreational and commercial fishermen. In addition, some tailwaters support populations of native freshwater mussels, a few of which are protected as federal endangered species. Other tailwaters, where discharges from the dams remain fairly cold all year, now support trout populations and recreational fisheries that could not occur in those areas if the dams were not present. All of the dams on the Tennessee River and its largest tributaries are operated as parts of an

integrated system to minimize flooding effects, provide for navigation, and support the production of power.

Basic Decisions

TVA is continually adding to an extensive inventory of archaeological sites located on TVA-managed federal property and/or along the Tennessee River and its larger tributaries. TVA also routinely evaluates the status of reservoir and tailwater shorelines with regard to the locations of ongoing or accelerating shoreline erosion. Results from these two programs are combined to prioritize shoreline sites with the most critical need to be stabilized. Typically, closely associated groups of seriously eroding archaeological sites receive the highest priority for stabilization. Isolated and less-rapidly eroding archaeological sites also are given priority over sites without known archaeological resources.

Once the need to stabilize an archaeological site has been identified, the next step is to determine how the stabilization should be done. Table 1 identifies a variety of bank stabilization techniques and presents a summary of their approaches, typical applications, and relative costs. The three main stabilization techniques are live planting, bioengineering, and hard armoring. Live planting and bioengineering involve using plants or plant products to slow erosion on part or all of a site. These techniques typically are less expensive and can be conducted using hand tools or light power equipment. The two hard armoring techniques involve covering the bank with properly sized quarried rock placed either individually (riprap) or within shaped wire baskets (gabions). Both hard armoring techniques are more expensive than live planting or bioengineering and require the use of heavy power equipment.

The selection of an appropriate stabilization technique depends on the specific objective(s) of the treatment and the physical characteristics of the site. Typically, the major objective of stabilization work at an archaeological site is to protect the integrity of as much of the deposit as possible. Techniques that would require extensive excavation to install the stabilizing material would be considerably less desirable than techniques that would cause little or no disturbance of the site.

The most important physical features at an archaeological site that affect the choice of a stabilization technique are the erosive force of the water expected in the area and the frequency of flow changes.

Archaeological sites located within the first few miles downstream from large dams typically are exposed to daily flow fluctuations and extremely large maximum discharges during spilling events. Shoreline stabilization techniques used in these areas must be able to remain in place during large discharge events and must be capable of handling short-term flow changes and water level variations.

Table 1: Techniques Used for Stabilizing Banks of Streams and Reservoirs

				Stabilization Purposes			
Treatment	Description	Costs	Equipment Required	Toe protect-tion	Upper bank protection	Runoff control	Comments
Live Planting Vegetation	Trees, shrubs and other vegetation used to stabilize bank	Low	Hand tools or light power machinery	X	X	X	May require protection from flowing water during root establishment
Live stakes	Branches of rootable plants inserted into the bank	Low	Hand tools	o	X	o	A flexible technique with many applications
Branch packing	Live branch cuttings incorporated into compacted soil	Moderate	Hand tools	o	X	X	Used to fill depressions in soil
Live fascines	Bundles of live branch cuttings that are buried into the bank and staked in place	Moderate	Hand tools	o	X	X	Used with other bioengineering techniques and vegetative plantings; enhances colonization of native vegetation
Bioengineering Vegetated geogrids	Alternating layers of live branch cuttings and compacted soil layers wrapped in geotextile fabric	High	Hand tools	X	X	X	Can be used on steeper and higher slopes and on outside bends where erosion is a problem
Brush mattress	Live branch cuttings covering entire stream bank and secured in place	Moderate to high	Hand tools		X	X	Provides immediate, complete cover and long-term stabilization
Tree revetments	Rows of cut trees (usually cedar trees) anchored to the toe of the bank	Low	Hand tools or light power machinery	X			Often used as toe protection with other bioengineering techniques

				Stabilization Purposes			
Treatment	Description	Costs	Equipment Required	Toe protect-tion	Upper bank protection	Runoff control	Comments
Coconut fiber roll	Flexible “logs” made from coconut hull fibers, staked at the toe of the bank	Moderate	Hand tools	X			Used in conjunction with native plants to trap sediment and encourage plant growth
Hard Armoring Rock riprap	Large stones placed along the slope of a bank	Moderate to high	Light to heavy power machinery	X	X	X	Requires good design and construction; can be a safety hazard
Gabions	Wire baskets filled with rocks	High to very high	Light to heavy power machinery	X	X	X	Can reduce or eliminate the need for bank sloping by creating a vertical wall

In spite of the high cost, TVA has determined that placement of rock riprap is the appropriate shoreline stabilization technique for use at most archeological sites located in tailwater areas. Rock riprap can be placed along the shoreline with little or no disturbance of the surviving deposits, can be used to cover the area quickly in a way that is difficult for potential looters to remove, can withstand the strong erosion forces caused by moving water, and can remain in place for long periods of time. In general, live planting and bioengineering stabilization techniques do not provide quick or un-removable coverage for a site and do not provide long-term protection in high erosion areas or where water elevations vary over short time periods. Installation of gabions and some bioengineering techniques require excavation and shaping of the banks that can result in destruction of part of the archaeological resource. TVA typically uses rock riprap to stabilize tailwater shorelines adjacent to archaeological sites unless some other consideration indicates that an alternative technique must be used.

Protection Considerations

TVA conducts stabilization projects at eroding and other archaeological sites in consultation with the State Historic Preservation Officers and affiliated federally recognized Indian tribes. Once TVA has determined that an archaeological site (or a group of adjacent sites) located along a tailwater needs to be protected by bank stabilization, the proposed project is described and circulated internally for an environmental review. The proposed (typically rock riprap) stabilization project at one or more identified locations is reviewed with regard to potential effects on water quality, aquatic life, wetlands, terrestrial life, endangered species, land use, navigation, recreation, and other resource areas. Each part of this review results in a determination that the project would not have any adverse effect on the

specific resource area or identifies the potential adverse effects that could occur and the ways those effects could be avoided or mitigated. Often the avoidance or mitigation measures can be incorporated into the project description. Occasionally, potential adverse effects to important resource areas require changes in the stabilization technique to be used, the timing of the work, and/or specific procedures to be used in the field. When required or recommended, results of the internal TVA review are coordinated with appropriate federal and state agencies. The review is finalized to document that TVA has met all pertinent laws and regulations, including the overall environmental review requirements identified in the National Environmental Policy Act. If any commitments are involved, completion of the work is tracked to ensure that those commitments are met.

Typical Field Procedures

The following paragraphs describe the field procedures TVA staff and contractors typically follow during bank stabilization projects involving archaeological sites in tailwater areas. These procedures include a variety of measures that have been adopted specifically to minimize potential adverse effects on terrestrial and aquatic resources, in addition to preserving the integrity of the archaeological sites.

- Whenever possible, all rock riprap placement work is conducted from barges when the water level is at full (summer) pool elevation. In addition, shallow draft barges (typically 3 to 4 feet) are used for this work, moved to and from the site(s) by a shallow draft tug with a prop extending no more than 4 feet below the water surface. If the water depth at full pool level is less than 6 feet in the work area, rock riprap placement is conducted from a smaller, self-propelled barge that can adjust the trim of the prop to operate in shallow water.

- Site preparation involves the selective removal of vegetation from the surface of the eroding bank and the storage of this material on top of the bank or on the barge. Trees in the area to be covered by rock riprap are cut at soil level, leaving the stump and root mass intact. Typically, existing bank contours are not modified, there is no shaping of the bank surface, and an earthen keyway is not excavated at the toe of the rock riprap slope. Non-woven filter fabric is hand secured over the bank surface prior to the placement of any rock riprap when necessary to protect protruding human remains, to protect other unique archaeological features, or to minimize future soil loss.

- For a typical project, two barges and a tug are involved in the placement of rock riprap on the bank. Both barges are placed parallel to the bank, with the near-shore barge pushed to grounding. [Each barge is approximately 32 feet wide, and the typical tug is at least 38 feet long, so the prop on the tugboat is more than 100 feet offshore.] Quarried stone of the appropriate sizes are stockpiled on the barge closer to the tug and a track-hoe operates on the near-shore barge. The track-hoe is used to pick up rock from the loaded barge and place it along the shoreline. The rock is placed (not dropped) on the bank, to further avoid damaging archaeological resources.

- The desired slope of the finished rock riprap surface is at least as shallow as 1.5 feet of width for every 1 foot of height (1.5:1 slope). Depending on location, the desired slope typically can be achieved by locating the toe of the rock riprap above the low-water (winter) pool level. At some locations, the only way to achieve a slope

as shallow as 1.5:1 is to place some rock below the low-water pool level. Typically, that necessity is identified in the project description when it is circulated for internal review.

- Once the desired height and slope of the rock riprap armoring has been placed all along the length the track-hoe can reach from the barge, the entire floating unit is relocated upstream or downstream to the next section to be treated. The placement process continues until the entire site has been covered. Between 300 and 500 tons of rock riprap can be placed during an average workday.

- Once the barge work is completed, any removed woody vegetation is placed on one of the barges and the floating unit is moved away from the site. Hand work is often needed to make the finished surface more uniform, to fill any small voids, and to insure that the armoring meets the desired elevation and slope criteria. Vegetation planting also may be conducted to tie in the riprap slope to the remainder of the shoreline.

- Stabilized sites typically are checked after the first high flow event and during the next low-water period to ensure that the entire site was armored and the rock riprap was installed properly.

TVA is aware that rock riprap can be placed on eroding shoreline sites from the land; however, previous experience indicates that technique almost always involves more potential for adverse effects than placement from barges. Stabilizing riverbanks from the land often requires the construction of heavy equipment access roads and the clearing of additional woody vegetation along the shoreline. Use of heavy equipment on the ground can adversely affect archaeological resources due to soil compaction and disturbance of surface and near-surface deposits. When rock riprap is to be placed from above an undercut bank, the necessary safety restrictions can result in less precision in riprap placement, sediment discharges into the water, and less than optimum protection of the archaeological resources. TVA proposes to use land application of rock riprap along archaeological sites only where barge placement is precluded for some reason and the possible loss of a major site to erosion would outweigh the potential adverse effects associated with conducting the work from the land.

APPENDIX 2 – U.S. FISH AND WILDLIFE SERVICE BIOLOGICAL OPINION ON PROPOSED WILSON HYDRO PLANT MODERNIZATION OF HYDROTURBINES