CHAPTER 4 - ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This chapter presents the potential environmental consequences that could occur to several resource areas following adoption of each of the four flood remediation alternatives. The general concepts and components of each alternative are presented in Sections 2.4, 2.5, 2.6, and 2.7. The sections in this chapter address the same resource areas as those described in Chapter 3 (Affected Environment) and are presented in the same order. Within each section, any general discussion is followed by an evaluation of the effects of each alternative and a brief comparison among them. All of this information is summarized in Section 2.9 and in Table 4.

4.2 CLIMATE, GEOLOGY, AND SOILS

Climate and Geology

The local climate and natural geology in the area around Nolichucky Reservoir would not be affected by adoption of any of the flood remediation alternatives. Existing and long-term climatic conditions and natural geologic trends would continue to affect the Nolichucky River watershed regardless of which alternative was adopted.

Soils

Alternative A: No Action

The existing conditions and long-term trends affecting the characteristics and distribution of soil types around Nolichucky Reservoir and downstream from Nolichucky Dam would not change if the No Action Alternative were adopted. The periodic flooding, natural addition of sediment from upstream, and annual runoff from the land around the reservoir would maintain the present conditions and weathering rates of the soils in the area. There would be no discernible change in the impacts of flooding on prime farmland soils, because Nolichucky Reservoir already is essentially full of sediment (see Section 4.4).

Alternatives B: Acquire Landrights

Changes in the ownership or easement rights over some or all of the land within the 500-year floodplain around Nolichucky Reservoir, by itself, would not affect the long-term trends in characteristics and distribution of the soil types in the area. As under Alternative A, the periodic flooding, addition of sediment from upstream, and annual runoff from the land around the reservoir would maintain the present rate of weathering of the soils. Use restrictions associated with federal ownership or control over all of the floodplain in this area might provide more long-term protection for the soils around the reservoir.

Alternative C: Lower Nolichucky Dam

Lowering part of the dam and relocating and stabilizing some of the accumulated sediment in the reservoir pool would involve disturbing the present soils in several areas and modifying where flooding and sedimentation would occur. Essentially, part of the river would be returned to its preimpoundment channel, and flood levels would be lowered all along the length of the present reservoir pool. Prime farmland soils within higher elevation parts of the present floodplain would be less likely to be eroded during flood events if this alternative were adopted.

Lowering the dam would create a smaller reservoir pool, thus exposing bare soil on the banks of the river. As this material was removed or stabilized, the erosion control procedures described in Sections 2.6 and 4.4 would minimize the potential loss of soils. In addition, displaced concrete from the dam would be used to armor adjacent side slopes of the river valley.

Storage of dredged sediment on TVA or private land could potentially be on soil classified as prime farmland. Analyses of the sediment indicate that the concentration of PCBs, pesticides, and volatile and semivolatile organics are below detectable limits (Section 3.4). Concentrations of the metals measured were within the expected range for the geologic region. In general, application of riverbed sediment tends to increase the fertility of the soil. Long-term storage sites would be contoured to match the surrounding area and planted with vegetation. Disposal of the sediment could have a positive impact by increasing the soil fertility at the storage sites. The changes in the dam and reservoir pool could increase sedimentation effects on soils in the floodplains downstream from Nolichucky Dam. Both during the construction period and for a time after the construction work was completed, the increased erosion potential in the reservoir pool could carry additional sediment downstream over the dam. Minor additional accumulations of sediment could occur on land covered by floodwater. As the erosion control measures became established and more effective, the amount of sediment carried over the lowered dam would decrease. Eventually, the riverbed in the present reservoir pool area would stabilize, and more typical sedimentation rates would occur downstream.

Overall, adoption of Alternative C could have positive impacts on soils. Proper disposal of dredged sediment would be beneficial to soils in areas of present low fertility. Also, the lowered flood elevations would expose less prime farmland soils to flooding.

Alternative D: Remove Nolichucky Dam

Complete removal of the dam would have similar effects on soils as lowering the dam, only the extent would be greater. More sediment would be removed, more acreage would be required for disposal sites, more land would be exposed when the pool level was lowered, and more sediment could be carried downstream toward Douglas Reservoir. Removal of the dam and powerhouse would have minimal impacts on soils.

As with Alternative C, disposal of the sediment could improve low soil fertility at some disposal sites. All these sites would be stabilized and contoured to establish a natural landscape planted with native or agricultural vegetation. Timely revegetation of the stream banks, accompanied by erosion control measures (described in Section 4.4), would decrease the impacts on soil in the exposed slopes of the river. In addition, some of the concrete debris would be used to armor the side slopes of the riverbank.

Even with implementation of erosion control methods, final removal of the dam could increase sediment deposits on downstream floodplain soils; however, the inclusion of appropriate erosion and sedimentation control measures would reduce those impacts to insignificant levels. Once the river resumed its preimpoundment flow and flood levels, the sediment load would decrease to more typical amounts, and the long-term impacts of this alternative on downstream soils would be insignificant.

Comparison

None of the alternatives would affect the climate or natural geologic conditions in the project area or in the remainder of the Nolichucky River basin. Adoption of Alternative A or B would not change the long-term characteristics and distribution of the soils around and downstream from Nolichucky Reservoir. Adoption of Alternative C or D could result in disturbing the present soils in some or many areas in and around Nolichucky Reservoir and reducing the area around the reservoir where soils would be affected by flooding and sedimentation. Adoption of Alternative C or D could have positive impacts where dredged sediment would be placed over low fertility soils. Downstream from Nolichucky Dam, adoption of Alternative C or D could result in some additional sediment deposition on floodplain soils; however, with the inclusion of appropriate erosion and sedimentation control measures, impacts to downstream soils would be insignificant. The long-term impacts of Alternative C or D on soils also would be insignificant, because sediment loading would decrease as the river returns to preimpoundment flow and sediment transport conditions.

4.3 GROUNDWATER

As described in Section 3.3, the presence of the Nolichucky Reservoir pool has raised the groundwater level in the adjacent land. Near Nolichucky Dam, the reservoir probably loses water to the ground, but this water returns to the river just downstream from the dam. In addition, more water can be stored in the floodplains around the reservoir (i.e., bank storage) during flood conditions. This groundwater returns to the reservoir and river over time after flood conditions subside.

Alternative A: No Action

If Alternative A were adopted, there would not be any change in the existing groundwater conditions around Nolichucky Reservoir or along the downstream reach of the river. No significant impacts to groundwater resources or their present use would occur under this alternative. Any additional removal of sediment from the reservoir would have negligible effects on reservoir water levels or groundwater in the area.

Alternative B: Acquire Landrights

A change in ownership of the land or flowage easement rights within the 500-year floodplain would not, by itself, cause any changes in the groundwater resources or their use. Public ownership or some level of public control over the land adjacent to the reservoir might serve to buffer any potential adverse local effects on groundwater resources from adjacent development activities.

Alternative C: Lower Nolichucky Dam

Lowering the pool level in Nolichucky Reservoir by 40 feet would result in corresponding reductions in groundwater levels and bank storage capacity around the reservoir. The groundwater levels could be expected to decrease by as much as 40 feet near the dam, decreasing to less than 1 foot at the upstream limit of the present reservoir pool. Reductions in the groundwater table and water levels in wells would be most pronounced near the downstream part of the reservoir, with considerably less effect at distances both away from the reservoir and upstream along the length of the river.

The change in the reservoir pool level would not have any adverse effect on groundwater quality; however, dredging sediment from Nolichucky Reservoir and depositing that material on other sites could produce short-term adverse impacts to groundwater quality adjacent to these work sites. These possible impacts to groundwater quality would occur only in wells close to the dredging and disposal sites where the soils were thin or absent and where the wells were directly connected to any affected aquifers.

As indicated in Section 3.3, about 100 structures that might be supplied with water from groundwater wells are located within approximately 0.5 mile of Nolichucky Reservoir. At wells located inland and along upstream parts of the reservoir, the small anticipated decreases in the groundwater level might result in slightly higher pumping lifts and pumping costs; however, those changes would not affect well performance. Changes in the groundwater level at wells located close to the downstream part of the reservoir might result in modest increases in pumping lifts and the associated costs and could affect well performance.

If this alternative were adopted, TVA would work with local agencies to identify existing wells that could be adversely affected by the lower groundwater level and/or adverse impacts on groundwater quality. Depending on the situation at each active well site, owners would be assisted in maintaining their water supply by modifying the existing well to ensure its continued use; installing a new, deeper well; or in obtaining a connection to the existing public water distribution system in the area. The inclusion of these corrective actions would help ensure that adoption of this alternative would have only local, temporary, and insignificant effects on groundwater resources and their use.

Alternative D: Remove Nolichucky Dam

The potential for adverse impacts on groundwater resources under this alternative would be similar to those described under Alternative C: lowering of the local groundwater level and possible temporary impacts on groundwater quality. Lowering the present reservoir water level by a total of about 70 feet, however, would increase the potential that wells adjacent to the reservoir could be affected. The potential effects on the water level and water quality in active wells would be addressed using the same measures discussed under Alternative C: modifying the existing wells to ensure their continued use; installing new, deeper wells; or obtaining connections to the existing public water distribution system. The inclusion of these corrective actions would help ensure that adoption of this alternative would have only local, temporary, and insignificant effects on groundwater resources and their use.

Comparison

Adoption of Alternative A or B would not have any adverse effects on groundwater or its present uses around Nolichucky Reservoir. Adoption of Alternative C or D could result in lowering the groundwater level by as much as 40 or 70 feet, respectively, immediately adjacent to the downstream part of the reservoir and considerably less than that depth with increasing distance upstream from the dam site. The greater reduction in the groundwater level associated with Alternative D would have more potential for adverse effects on active wells than Alternative C. Under both dam modification alternatives, the potential adverse effects on active wells in the affected area would be addressed in ways to ensure that there would be only insignificant effects on groundwater quality and use.

4.4 SURFACE WATER AND SEDIMENTATION

Sediment in the Nolichucky River can by classified into two size categories: small particles that are moved as suspended sediment and larger particles that are moved as bed load (Section 3.4). Because it can be moved so easily, the amount of suspended sediment in a river can respond relatively quickly to changes at the source or along the river corridor. The available data indicate that suspended sediment concentrations have declined in recent years both upstream and downstream from Nolichucky Dam. Mining-related sources in the upstream part of the watershed probably have been controlled to the point that agriculture and other nonpoint sources now contribute at least as much suspended sediment to the river.

Bed load material, however, is moved downstream only during high-flow events. Even though the upstream mine sources of additional sediment in the Nolichucky River watershed have been reduced, substantial bed load material is still stored in the river channel and along the floodplain. If present conditions in the upstream part of the watershed remain unchanged, the supply of sediment coming into Nolichucky Reservoir should continue to decline. It could, however, take a very long time before the bed load volume declines to a level similar to what is being transported into other TVA reservoirs in the region.

Approximately 19,000 acre-feet of sediment have accumulated in Nolichucky Reservoir, and the surface sediments in the reservoir now consist mostly of sand-size particles. As the reservoir pool has filled, its ability to trap sediment has declined dramatically, and it has become easier for high flows to carry sand over the top of the dam. The river channel downstream from the dam does not contain as much bed load sediment as occurs upstream, because larger particles are carried over the dam only when flow is high enough to move this material through the downstream reach.

Laboratory analysis indicates the sediment deposited in Nolichucky Reservoir does not contain problem amounts of metals or other pollutants.

Alternative A: No Action

If this alternative were adopted, present water quality conditions and sediment transport trends would continue in Nolichucky Reservoir and in the Nolichucky River. Some of the sediment being carried down the river from upstream sources would continue to be deposited in the reservoir pool, while most of that material (including nearly all of the suspended sediment) would continue to be transported over the dam. This alternative would maintain active floodplains along the length of the reservoir that would continue to trap some sediment particles. Although the efficiency of this sediment trapping function would continue to decline as the storage capacity of the floodplains was filled, the reservoir area would have some value as a sediment trap almost indefinitely.

The supply of sand and smaller sediment particles from upstream likely would decrease gradually over the next several decades, to a level that is more typical for the geologic setting; however, large amounts of bed load sediment stored in the bed and banks of the river upstream from the reservoir pool would be available during high-flow events. The rate at which material would be deposited in the reservoir also would decrease, because of both the decreasing sediment supply and the decreasing size of the reservoir pool. Even if the human-created sources of sediment were completely depleted, the part of the river within the present reservoir would have a lower gradient, and more of the moving sediment would be deposited on the floodplain around the reservoir pool than would be deposited there if the reservoir did not exist.

During flood events, suspended sediment and, depending on the extent of the flood, varying amounts of bed load material would be carried over Nolichucky Dam. Some of the suspended sediment and bed load material would be deposited on the floodplains along the downstream part of the river, and the remaining suspended sediment particles would be carried on downstream into Douglas Reservoir. Small amounts of sand and other fine bed load material would be deposited in pools and other low-flow areas in the river; however, the force of the water would continue to move some of this material on downstream and out of the Nolichucky River.

As indicated in Section 3.4, excluding the estimated volume of the active river channel, Nolichucky Reservoir is essentially full of sediment below the present pool level (elevation 1,240.9); however, approximately 3,600 acre-feet of volume remains below elevation 1,251.0. If deposition continues at the present rate (approximately 28 acre-feet per year), all of this remaining volume would be filled within about 130 years, although decreases in the sediment supply and the declining trapping efficiency of the reservoir might double that time estimate. During the next few decades, however, it is very likely that the low areas between the valley walls and the natural levees along the channel would fill in considerably, so much so that there would no longer be standing water in them.

Over a series of decades or centuries, the material forming the developing riverbed within the reservoir would gradually become coarser as the upstream sand supply becomes exhausted. Eventually, the riverbed would develop gravel armor over the sand and, as this occurred; increasing amounts of gravel bed load would be carried over the dam during flood events. Until then, there would be little deposition of larger bed load particles in the river downstream from the dam.

If, in the future, commercial activity resulted in the removal of sand and sediment from the reservoir, the extent and depth of open water may increase. Some of this increase in open water would likely occur where the dredging was taking place, while the rest would occur in adjacent areas where deposits of fine sand and sediment would slump and move to fill in the dredging sites. The extent and depth of open water areas in the reservoir would depend on precisely where sediment would be removed, how long the removal would continue, and how adjacent sediment deposits would readjust during and after the sediment removal. TVA would continue to review requests for commercial sand removal operations on a case-by-case basis and approve these as appropriate. Over the long term, however, these sand removal operations only partially address the sediment accumulation in the reservoir and its contributing problems, including flooding. Based on the present removal rate, there appears to be roughly an equivalent annual accumulation of sediment.

Alternative B: Acquire Landrights

If this alternative were adopted, the impacts on water quality and sedimentation would be essentially the same as those described under Alternative A. Nolichucky Reservoir would continue to fill with sediment coming down the river and most of that material would continue to be carried over the dam to be deposited on the downstream floodplains or in Douglas Reservoir. Public ownership of more land around the reservoir may serve as a buffer to reduce or minimize any adverse local erosion and pollution effects on water quality in the reservoir, but this would be unlikely to have a significant effect on water quality or sedimentation in the river downstream from Nolichucky Dam.

Alternative C: Lower Nolichucky Dam

This alternative would involve dredging and stabilizing as much as 12,000 acre-feet of sediment now located in Nolichucky Reservoir, lowering the spillway in Nolichucky Dam by approximately 40 feet, and establishing a new river channel in the remaining sediment within a lower and much smaller reservoir pool. While this major sediment relocation and dam modification work would have the potential to cause severe adverse effects on water quality in the Nolichucky River both in and downstream from Nolichucky Reservoir, the project would be designed and conducted to avoid or reduce these effects to minimal levels.

Much of this project would consist of dredging sediment out of the reservoir. Dredging sediment would involve disturbing the reservoir bottom, moving sediment to disposal sites away from the reservoir, dealing with the water that would run off the relocated sediment, and stabilizing the disposal sites once each area was filled. As indicated in Section 2.7, a variety of best management practices would be used in all phases of this work to minimize adverse effects on water quality. The vast majority of the sediment in the reservoir would be removed using suction dredges. These dredges, which use pumps to continuously suck water and sediment out of the reservoir bottom, generate very little turbidity at the removal site. At the disposal site, the sediment would be separated from the water coming out of the pipeline in a series of settling ponds. The water would be treated as appropriate to meet applicable turbidity and other water quality requirements before it was discharged from the work sites. Sediment deposits that were to remain in place, either along the margins of the river or in upland spoil sites, would be stabilized and planted with appropriate vegetation, in part to minimize erosion. Drainageways adjacent to all sediment disposal sites would be augmented with appropriate erosion control structures (such as silt fences, hay bales, etc.) to reduce the potential for erosion and sedimentation effects further.

The use of various erosion control and sediment management measures would generally reduce the effects of the dredging work on surface water quality to barely perceptible levels. Some temporary increases in turbidity could occur, however, because of the large volumes of sediment and water that would be moved and the long time during which the process would occur. Occasionally during low flows, the increase in turbidity might be large enough to be noticeable or measurable. Turbidity increases probably would not be noticeable during moderate or high flows, because the river routinely carries so much suspended sediment under these conditions.

As indicated in Section 2.7, during an early part of this project, most of the sediment would be removed from the first mile of the main river channel just upstream from Nolichucky Dam. Throughout the construction period, this large area of deep water would serve to trap bed load material that otherwise might be swept over the dam. The size of this area and its location would be designed to maximize its potential to serve as a sediment trap. Periodic dredging in this area throughout the construction period would maintain its capability to trap bed load material and minimize the movement of larger sediment particles past the dam.

Along the upper half of the existing reservoir, sediment would be moved to assist the river in reclaiming its original channel. When the water level in the reservoir was lowered, the river flow would erode down through the remaining sediment deposits in this area and expose or establish a channel essentially in the former riverbed. Within the pool of the lowered reservoir, dredging or erosion by the river would establish a new channel through the remaining sediment. Sediment from this in-channel erosion would be carried downstream and essentially all of it, along with some of the material coming from further upstream, would be deposited in the excavated sediment trap. Because of the existence of this trap and the periodic dredging that would occur there, the total amount of bed load sediment passing over the dam probably would be lower during the construction period than occurs now. Bed load material that remained in this trap would help form the bottom of the smaller reservoir and would not be transported over the dam.

Initially, no vegetation would be present on the banks along the restored part of the river or around the lowered reservoir. Appropriate measures would be taken to minimize erosion on these disturbed areas, to stabilize them, and to establish vegetation soon after they were stabilized. Erosion-control measures to be used during this part of the project would likely include building appropriate grade-control structures and lateral dikes, using erosion-control fabric, placing riprap, and installing native material revetments. Revegetation measures on the banks and disturbed upland areas would likely include using bioengineering techniques, various types of specific seeding measures, and tree planting. Although these measures would be designed to minimize sediment loss, some erosion probably would occur during the first few years, because vegetation would not provide full erosion protection for 5 to 10 years after it was planted. Some additional erosion of the banks and shaped slopes also could occur during intense rainfall, high-flow events, or when the river adjusted its channel within the new floodplain. During the construction period and for a time after the spillway was lowered, the sediment trap would capture most of the eroded material. Most impacts downstream from the dam would be limited to increased suspended sediment and the associated turbidity. After the initial adjustment period, there would be some risk that large floods could cause significant erosion of the sediment deposits. This risk would become progressively lower as woody vegetation reached maturity.

Once the construction period was over and the former sediment trap became filled, the small size of the lowered reservoir (about 160 acres) would allow more efficient transport of upstream sediment past the dam. The settling and filtering functions now provided by the existing wetlands and the present floodplain would be reduced, because the lowered river channel and pool level would be isolated from those areas. The dam would continue to slow downstream transport of sand and coarser bed material, but the flow threshold required to carry sand over the lowered dam would be exceeded more often. These differences would result in slight additional amounts of sediment being transported through the reservoir.

Construction of this project, along with the additional sediment that could be transported through the smaller reservoir pool, could result in some increased sedimentation in the river downstream from Nolichucky Dam. During the construction period, the establishment and repeated dredging of the sediment trap would substantially reduce the amount of bed load material that could be carried into the downstream reach during flood events. At the same time, however, some additional turbidity could be present in the water and the riverbed downstream from the dam could develop minor accumulations of sand and silt in slow water areas during low-flow periods. All together, the construction effects would constitute a minor but sometimes measurable effect on water quality in the river downstream from the dam. After the project was completed and the sediment trap had filled, additional minor accumulations of sand could occur in the riverbed downstream from the dam during high-flow events. These accumulations would be only slightly more extensive than would occur under Alternative A or B.

If this alternative were completed and if the upstream sediment supply declined and became more typical for the region, the riverbed downstream from Nolichucky Dam eventually would contain proportionally more gravel and less sand. Over several decades, more gravel from upstream would be transported through the reservoir area and be deposited in the channel downstream from the dam as the sand in that part of the river would be moved on downstream into Douglas Reservoir. Even including the potential temporary increases in sedimentation effects associated with the construction work, the long-term return to more typical sedimentation rates and bed load conditions in the downstream part of the river would happen more quickly under Alternative C than it would occur under Alternative A or B.

Alternative D: Remove Nolichucky Dam

In many ways, adoption of this alternative would result in effects on surface water quality and sedimentation similar to those described under Alternative C. As in the description of this alternative (in Section 2.8), this evaluation of possible effects focuses on the similarities and differences between Alternatives C and D.

The vast majority of the sediment to be taken out of the reservoir would be removed using suction dredging, the same technique that would be used under Alternative C. All of the erosion and sedimentation control measures described under Alternative C would be followed under Alternative D, and the potential effects on surface water and sedimentation would be very similar to those described for Alternative C. This alternative, which would involve the removal or stabilization of as much as 19,000 acre-feet of sediment, would require additional disposal sites and could result in incremental increases in the amount of local erosion and off-site sedimentation. Including these potential incremental increases, the removal of sediment from the reservoir, accompanied by the use of the various sediment management and erosion control measures, could result in a small but sometimes noticeable increase in turbidity under low-flow conditions and a larger but virtually unnoticeable increase in turbidity over background levels during higher flows.

Under this alternative, sediment would be removed from both the upper and lower halves of the existing reservoir. This dredging and sediment stabilization work would likely be conducted in stages, each stage associated with a lowering of the water level in the former reservoir. Each time the water level was lowered, and during any interspersed flood events, the river flow would erode down through the remaining sediment deposits and expose or establish more of a channel essentially in the former riverbed. Sediment from this in-channel erosion would be carried downstream and nearly all of the larger sediment particles would be deposited in the excavated trap just upstream from the dam. Periodic dredging of the accumulated sediment in the trap would minimize the amount of bed load material that otherwise could be transported downstream over the dam.

Removal of the dam and powerhouse would not have any adverse effects on water quality. None of the demolition of the powerhouse would be conducted in the water, and none of the debris would be deposited or stored there. Some construction debris from the removal of the dam would be held in a dewatered part of the river channel just downstream from the work site, and some concrete debris could be used to armor the sides of the river channel downstream and, possibly, upstream from the dam site. This concrete debris would be placed in erosion-prone areas and would have beneficial effects on erosion, sedimentation, and water quality.

Under this alternative, all 6 miles of the existing reservoir would be converted to the valley of a free-flowing river channel. As described for Alternative C, no vegetation would be present on the land along this restored river channel as it was being formed. Appropriate measures would be taken to minimize the erosion of these disturbed areas, to stabilize them as soon as possible, and to establish vegetation as soon as these areas were ready for it. More than likely, the emerging slopes of the river valley would be stabilized and revegetated in bands as the water level was being lowered in the reservoir. This work would use the same erosion control and revegetation measures that were described under Alternative C. Also with Alternative C, some erosion from these areas would occur in spite of the control measures, largely because vegetation would not provide its maximum protection for between 5 and 10 years after it was planted.

As soon as the dam was completely removed, higher flows would start moving bed load material into the channel downstream from the dam site. Initially, much of this material would be sand, because it could be moved more easily than cobbles and other large particles. Modeling suggests that fine sand could travel all the way to the mouth of the Nolichucky River during one year of typical river flows. Gravel would move more slowly, at about 10 miles in a year with normal-flow variations. The accumulation of new sediment on the riverbed would average about 2 inches in depth, most of which would be deposited during the first year after the last part of the dam had been removed. Assuming normal-flow patterns, the sediment depth would increase only slightly after the first year or two, and would be fairly uniform after that. The surface particles on the bottom would become more stable (armor), and local changes in sediment depth probably would continue for a few years after average depth and particle size stabilized. The long-term result of this change would be a riverbed downstream from the present dam site with a particle-size distribution similar to the riverbed upstream from the present reservoir. As the sand load declined over a long period of time (20-50 years after dam removal), the bed of the Nolichucky River would become coarser and begin to resemble the beds of other rivers in the geographic area.

Overall, the construction activities associated with this major sediment and dam removal project would result in sporadic and generally insignificant effects on surface water quality and sedimentation in the Nolichucky River. Following the complete removal of the dam, however, the free movement of bed load materials would cause significant changes in the composition of the riverbed downstream from the dam site, adding sand and other coarse particles to the substrate. Water quality and sedimentation patterns in the river would stabilize within three to five years following the final removal of the dam. Within about five to eight years following the removal of the dam, the composition and appearance of the riverbed would be similar in both the upstream and downstream reaches of the river.

Comparison

Adoption of Alternative A or B would maintain present trends in water quality and sedimentation conditions in Nolichucky Reservoir and in the river downstream from Nolichucky Dam. The reservoir would continue to trap some sediment, slightly lowering the amount of bed load material being transported to the downstream part of the river, and releasing the remainder only during times of high flow. Over a series of decades or centuries and if the upstream sediment supply declines as predicted, the channel bottom in the reservoir would develop a gravel surface, and increasing amounts of gravel would be carried over the dam during flood events. Until then, there would be little deposition of bed load material in the river channel just downstream from the dam.

Adoption of either Alternative C or D would involve lowering or removing at least part of the dam and relocating and stabilizing large amounts of sediment present in the reservoir. Even with the use of best management practices, some significant but very local suspended sediment impacts could occur during and for a time after the construction periods associated with both of these projects. With regard to bed load effects, Alternative C would be beneficial to the downstream river reach during the construction period, because it would lower the amount of bed load material available to be transported over the dam. Alternative D could have slightly more extensive suspended sediment effects on the downstream river reach during the construction period than those associated with Alternative C, largely because Alternative D would involve the removal of more sediment and would occur over a longer length of time.

After the dam was lowered and the sediment in the pool reached equilibrium, Alternative C would have only an insignificant effect on sedimentation downstream from the dam. Under Alternative D, once the dam was removed, the river would be restored to a free-flowing condition, the remaining sediment storage in the reservoir pool would be eliminated, and all bed load would be available to be moved through the downstream part of the river. Fine sand and, later, gravel would accumulate on the downstream riverbed to an average depth of about 2 inches, most of which would be deposited during the first year after the last part of the dam was removed. This significant change in the composition of the riverbed downstream from the dam site would occur, and would stabilize, within a decade. Under any of the other alternatives, the dam would remain as a barrier to the movement of coarse sediment but sandy sediment would continue to move downstream over the dam during high-flow events.

4.5 AQUATIC LIFE

As described in Section 3.5, the present aquatic life in the Nolichucky River upstream from, in, and downstream from Nolichucky Reservoir is generally more abundant and more diverse than it was 40 years ago. Both the bottom-dwelling animals and the fish communities in the various parts of the river are not as abundant or as diverse as would be expected if the stream was in excellent condition. The present quality of the aquatic habitats and the status of the different types of aquatic species in the river appear to be related to the amount of sediment that is present. The lowest diversity of aquatic life occurs in the reservoir where there is an abundance of sand and other fine sediment. Somewhat better aquatic communities occur in the river upstream from Nolichucky Reservoir and far downstream from the dam where fine sediment is an obvious component of cobble and gravel substrates. The best aquatic communities in this river occur in part of the reach downstream from the dam where fine sediment is much less obvious in the streambed.

Alternative A: No Action

Adoption of the No Action Alternative would maintain present conditions in and around Nolichucky Reservoir and not affect present trends in the abundance and diversity of aquatic life in the Nolichucky River. Alternative A would not result in any modification of the effect Nolichucky Reservoir is having on aquatic life in the reservoir or downstream from Nolichucky Dam. If the sediment load coming down the river decreases over time and the reservoir continues to serve as a sediment trap (see Section 4.4), slow improvements could continue to occur in the aquatic habitats and aquatic communities along the length of the river. Over a very long time (100-200 years), the river channel within Nolichucky Reservoir could stabilize and develop gravel and cobble habitats that would support more diversity of fish and other aquatic species.

Alternative B: Acquire Landrights

Adoption of Alternative B would have essentially the same effects on aquatic life as those described under Alternative A. No changes would occur in the present effects of the reservoir on flood elevations or sedimentation patterns. The anticipated long-term reductions in the sediment load from upstream could still result in improvements in aquatic life in the reservoir and elsewhere in the river. Under Alternative B, public ownership or control over the land around the reservoir could add some additional benefit to aquatic life if it would help avoid or minimize potential local pollution and erosion effects on aquatic habitats in the reservoir.

Alternative C: Lower Nolichucky Dam

The adoption of Alternative C would change aquatic habitats both within and downstream from the present Nolichucky Reservoir. Changes would be caused by lowering the spillway and the pool level in the reservoir, as well as by modifying erosion and sedimentation patterns along this part of the river.

Lowering the spillway in Nolichucky Dam would reduce the length of Nolichucky Reservoir from 6 to approximately 3 river miles. Once the accumulated sediment was removed from the streambed, this change would allow aquatic life to recolonize the 3 miles of restored river habitat. The aquatic communities that would develop in that part of the river probably would be similar to those that now occur just upstream from the reservoir.

Lowering the spillway also would reduce the surface area of Nolichucky Reservoir by approximately 330 acres (from about 490 to about 160 acres). Once it reached a stable condition, the lowered reservoir pool would be essentially full of sediment and relatively little aquatic habitat would exist outside of the new river channel. The types of habitats and aquatic communities that would develop in this much smaller reservoir probably would be a mixture of conditions and species that now occur in the reservoir pool and those that occur in the upstream part of the river.

All of the other effects of Alternative C on aquatic life would be related to the fate of the sediment which, presently, is either trapped in Nolichucky Reservoir or exists as bed load and floodplain deposits along the upstream part of the river. Most of the potential effects on aquatic life downstream from Nolichucky Dam would depend on how much sediment the river would move out of the reservoir pool and where that material would be deposited. Some of this material would be carried and deposited as suspended sediment, and the remainder would be moved and deposited as bed load.

Suspended sediment affects fish and other aquatic life in much the same ways that dust clouds and smoke affect terrestrial plants and animals. The growth of aquatic plants can be slowed or prevented if sediment in the water reduces the amount of light that can get to them. Sight-feeding fish and aquatic insects can be severely affected if their ability to find food is hindered by turbid water. High levels of suspended sediment also can coat or damage the gills of fish as well as insects, mussels, and other invertebrates, which can affect their ability to get oxygen and may make them more vulnerable to disease, parasites, and toxicants (Waters 1995; Neves et al. 1997). Excessive silt in the water can reduce the survival of eggs and newly hatched fish, because silt-coated eggs are unable to absorb enough dissolved oxygen and young fish have more difficulty finding food in turbid water.

Bed load sediment affects aquatic life in a stream similar to the ways heavy snowfall affects terrestrial species. The extra sand, gravel, and larger particles blanket the bottom of the river and, until it is moved further downstream, can smother whatever is underneath. Adult fish and some bottom-dwelling species can move quickly enough to avoid being adversely affected by bed load deposits. Native mussels, other sedentary species, and fish eggs or young cannot escape being smothered by thick bed load deposits. Increased sedimentation can significantly reduce the abundance of some bottom-dwelling species that already may be rare in the river, such as native mussels, some aquatic insects, and small fish that feed in runs and riffles (Appendix B). Successful spawning is perhaps the weakest link in the life histories of migratory fish species (such as redhorse, carpsucker, buffalo, sauger, and walleye), because bed load deposits can smother their eggs and fry.

When flows are high enough to move sand along the river bottom, excessive bed load sediments also can have an abrasive or scouring effect that is detrimental to aquatic life. This scouring can affect aquatic organisms directly through mechanical damage to the animals themselves or by damaging important habitats. For example, riverweed (*Podostemum* spp.) is an aquatic plant that attaches to the surface of rocks in swift water and provides habitat for fish and aquatic insects. Bed load scour can shear riverweed stems and substantially reduce the amount of riverweed habitat present in a stream.

While both suspended sediment and bed load material can have adverse effects on aquatic life, the effects associated with bed load typically are more severe and more long-lasting. The larger size of bed load particles means that those particles settle out on the bottom more quickly and more energy is required to move them. A coating of fine sediment might not prevent animals or plant shoots from pushing through, but a similar depth of bed load material might form a blanket over an area that the resident species could not penetrate. In addition, bed load material deposited during a large flood probably would remain in place until the next flood at least that large would move it on downstream.

The evaluation of Alternative C presented in Section 4.4 indicates that, even with the careful use of appropriate best management practices, some sediment could be eroded off of the construction sites and carried downstream by the river. Heavy rainfall or high-flow events that occurred before stabilization efforts reached their maximum effectiveness (in 5 to 10 years) also could erode some material off of disturbed areas and exposed sediment deposits. Small particles in this eroded material would be carried downstream by the river, but most of the larger particles would accumulate in the sediment trap just upstream from the dam. Sediment removal activities along the upper half of the existing reservoir and periodic dredging from the sediment trap would reduce the amount of this material that could be carried over the dam during high-flow events. These sediment control measures could result in less bed load material being carried over the dam during this construction period than occurs under present conditions.

Once the pool level was lowered and the sediment trap filled in, some additional material from upstream would be carried through the smaller reservoir during high-flow events. During this post-construction period, as described in Section 4.4, the loss of bed load material from the reservoir would be only slightly more extensive than would occur under Alternative A or B.

Even though aquatic life in this part of the Nolichucky River has improved substantially during the last 40 years, the present communities are still affected by more than optimal amounts of turbidity and sedimentation (see Section 3.5 and Appendix B). Because turbidity and sedimentation downstream from Nolichucky Dam could increase over the present levels, adoption of Alternative C could reverse some of the recent improvements in the quality and abundance of aquatic life. If this alternative were adopted, the schedule for each part of the project would be reviewed and adjusted, in part, to minimize the potential for adding sediment to the river. In addition, aquatic communities downstream from the dam would be monitored periodically throughout the construction and early post-construction period to determine if additional measures should be taken to further minimize downstream sedimentation effects. While these review and monitoring provisions would not guarantee that aquatic life downstream from Nolichucky Dam would be protected from increased sedimentation effects associated with this project, they would indicate if additional controls should be applied to further minimize the effects of subsequent project activities. With the inclusion of the attention to scheduling activities, erosion control measures, and monitoring requirements, this alternative could be conducted with only insignificant effects on aquatic life downstream from Nolichucky Dam.

As indicated in Section 4.4, a long-term effect of this alternative could be a return to more normal sediment transport conditions in the river earlier than would occur under either Alternative A or B (in 50-60 years as opposed to 100-200 years). If this earlier return to more normal sediment transport rates did occur, more stable and, probably, slightly more diverse aquatic communities would develop along this entire reach of the river than occur there now.

Alternative D: Remove Nolichucky Dam

Adoption of this alternative would result in effects on aquatic life similar to those described under Alternative C, at least during the construction period. The following evaluation focuses on the similarities and differences between Alternatives C and D.

Under Alternative D, work at the dam site would continue until all of the dam structure and the powerhouse had been removed from the river channel. More than likely, the dam would be lowered in stages, and each time, material would be dredged from the sediment trap and along the length of the reservoir pool before the dam was taken down to the next lower level. Under this alternative, the entire 6-mile length of the present reservoir eventually would revert to the original river channel. As the dam was lowered and sediment was removed, the preimpoundment riverbed would be exposed. Eventually, the restored streambed would resemble the river as it now appears upstream from the reservoir. Aquatic life from upstream and, eventually, downstream would recolonize the habitats in this restored channel. Over time, the aquatic communities in this 6-mile reach would become very similar to those presently found upstream from the reservoir.

The construction effects on aquatic life downstream from Nolichucky Dam associated with this alternative would be similar to those described under Alternative C. As described in Section 4.4, however, the larger amount of sediment that would be removed or stabilized under Alternative D and the longer construction period would result in more potential for turbidity and sedimentation effects in the downstream river reach. Sediment removal activities along the length of the reservoir and, as long as it was in place, periodic dredging from the sediment trap would reduce the amount of sediment that could be carried over the dam during high-flow events. Especially during the early parts of this work, these sediment control measures could result in less impact on downstream aquatic life during the construction period than would occur under existing conditions.

As the dam continued to be lowered, the reservoir pool would retain less and less of the bed load material coming down the river during high-flow events. The results of modeling studies presented in Section 4.4 indicate that once the last part of the dam was removed, higher flows would start moving more bed load material into the channel downstream from the dam site. Initially, much of this material would be sand, followed more slowly by gravel and larger sediment particles. The new sediment is projected to average about 2 inches in depth all along the 46 miles of river downstream from Nolichucky Dam. Most of this additional material would be deposited during the first year after the last part of the dam had been removed. Assuming normal-flow patterns in the river, the sediment depth would increase only slightly during the second year, and the content of the river substrate would stabilize within five years following removal of the dam. Within this time period, the riverbed downstream from the dam site would develop a particle size distribution similar to that in the river upstream from the present reservoir.

This change in the sediment transport pattern would have immediate and significant adverse effects on some aquatic species in the downstream part of the river. As described under Alternative C, some fish and other active aquatic species could move out of the way and avoid being smothered by a layer of new sediment; however, aquatic species or life stages that were unable to move quickly enough would be covered by the sediment and could be smothered. A 2-inch coating of sand would smother many sedentary aquatic species now living in the downstream part of the river and reduce the food supply of species that prey on them. Once habitat conditions downstream from the dam began to resemble present upstream conditions, the aquatic communities that occur there also probably would recover to become similar to those in the upstream reach. The large numbers of fish and benthic species presently found in the river reach just downstream from Nolichucky Dam (see Section 3.5) probably would decline and not recover completely. After about five to eight years, when the composition of the substrate would have stabilized, the fish community in the downstream river reach probably would still be considered “good,” and the benthic community in that area probably would still be considered “fair”, both comparable to what exists now upstream from the reservoir. Bottom-dwelling fish and freshwater mussel stocks in the river reach downstream from the dam probably would be much less abundant, and depending on specifically where and how the sediment would be deposited, some uncommon species in these groups might be eliminated from the river.

If this alternative were adopted, the schedule for each activity would be reviewed and adjusted, in part, to minimize the potential for adding sediment to the river. In addition, aquatic communities downstream from the dam would be monitored periodically throughout the construction and early post-construction period to determine if additional improvements should be made to minimize downstream sedimentation effects further. Some of the projected adverse post-construction effects might be reduced by delaying the removal of the last part of the dam until most stabilization and revegetation components of the project had been completed. At least some of the adverse post-construction effects could be reduced or avoided if sediment removal or stabilization activities would be conducted in the river upstream from Nolichucky Reservoir, perhaps as parts of a companion to this project that would reduce sedimentation effects in all parts of the watershed.

In 20 to 50 years after Nolichucky Dam was removed as described under Alternative D, aquatic communities in the Nolichucky River within and upstream from the present reservoir probably would have improved somewhat over their present conditions. Downstream from the dam site, however, the aquatic communities probably would not have recovered to their present levels of diversity or abundance. Migratory fishes would be able to move up and down through at least 100 miles of free-flowing river, and more individuals of some of those species probably would occur upstream from the dam site than exist there now. If the upstream sediment deposits had not been reduced beyond the projected natural declines, most native mussels and some bottom-dwelling fish species now living downstream from the dam probably would have been eliminated from the river. Cobble and gravel habitats in the river might not be ready to support sensitive benthic species for another 20 to 50 years.

Comparison

Adoption of Alternative A or B would result in few or no project-related changes in the aquatic habitats and aquatic life that now exist in Nolichucky Reservoir or in the river upstream and downstream from Nolichucky Dam. Not taking any action (under Alternative A) or just acquiring land and easement rights around the reservoir (under Alternative B) would not lead to any changes in the aquatic habitats in the reservoir or the river and, consequently, in the aquatic life that would be present. If the long-term decline in sediment load in the river occurs as projected, aquatic habitats and aquatic life upstream from and in Nolichucky Reservoir could improve beyond their present conditions in 100 to 200 years.

Adoption of Alternative C or D would result in significant changes in aquatic habitats in what is now Nolichucky Reservoir. Under Alternative C, the upstream half of the reservoir (approximately 3 miles) would return to a flowing-water habitat, where more abundant and more diverse aquatic communities probably would become reestablished. The remaining, smaller reservoir pool probably would contain aquatic habitats and aquatic communities in between those that exist there now and in the upstream reach. Under Alternative D, the entire 6-mile reach within the present reservoir would return to a flowing-water habitat. The aquatic communities that would develop in that river reach would be similar to the communities presently found upstream from the present reservoir.

In the river reach downstream from Nolichucky Dam, some increases in turbidity and decreases in bed load material could occur during the construction associated with both Alternatives C and D. While any additional sedimentation in the reach downstream from the dam could reverse some of the improvements in aquatic life that have occurred there in recent years, monitoring would be conducted to see if additional measures would be required to help avoid subsequent construction effects on the resident aquatic life. Once the spillway was lowered under Alternative C, only slightly more bed load would be lost from the smaller reservoir than would occur under Alternative A or B and only insignificant effects on aquatic life would occur. Under Alternative D, the changes in sediment transport patterns downstream from the dam site would have significant adverse effects on bottom-dwelling aquatic species. These post-construction sedimentation effects might be reduced by delaying the last part of the dam removal and might be avoided if sediment removal activities were conducted in the upstream part of the river, perhaps as part of a separate, watershed-wide sediment reduction project.

Assuming only the projected slow decline in present sedimentation levels, the adoption of Alternative C could result in slightly more diverse aquatic communities in all parts of the river within 50-60 years. Under the same assumption, the adoption of Alternative D could result in more diverse aquatic communities within and upstream from the dam site within 20-50 years, in part, because aquatic life would be able to move throughout the entire river reach. Downstream, however, the post-construction increase in bed load sedimentation probably would result in less diverse aquatic communities and the elimination of some bottom-dwelling species, which might not be able to recover or be reintroduced successfully for an additional 20 to 50 years.

4.6 WETLANDS

The wetlands that have formed around and in Nolichucky Reservoir are unique among reservoir-related wetlands in east Tennessee (see Section 3.6). No other wetlands associated with reservoirs in this part of the

Tennessee River watershed include the wide range of vegetation communities, water levels, habitat associations, and absence of disturbance as occur around Nolichucky Reservoir. These wetlands have developed because of the stable minimum water level and the extensive sediment deposits that exist in Nolichucky Reservoir.

Alternative A: No Action

If the No Action Alternative were adopted, there would be no loss or alteration of the wetlands around Nolichucky Reservoir beyond the normal changes related to ongoing river and floodplain processes. Over time (75 to 100 years or more), the floodplain could accumulate additional sediment, and the present emergent and scrub-shrub wetlands could decrease in size and change into forested wetlands or into nonwetland habitats. At the same time, some wetlands probably would continue to develop or increase in size on islands, sand bars, and other areas as the reservoir continued to fill with sediment.

Most of the wetlands that exist around Nolichucky Reservoir occur on land owned by the federal government and, as such, are being managed in ways that avoid potential adverse effects. These wetlands could be adversely affected by actions on adjacent private land such as soil erosion, contamination with pesticides and fertilizers, and potential misuse (for example, the excessive use of all-terrain vehicles). Some wetlands on private land around the reservoir presently are being adversely affected by grazing cattle. These uses of wetlands on private land would likely continue under the No Action Alternative and could increase or decrease depending on farm economics and other factors unrelated to the way the federal lands around the reservoir would be managed.

Wetland areas along the river downstream from Nolichucky Dam would be unaffected by adoption of the No Action Alternative. Present sediment transport trends over the dam and existing protection and use patterns affecting the wetlands downstream from the dam would both likely continue. The expanding growth and downstream colonization of purple loosestrife also would be unaffected by adoption of the No Action Alternative.

Alternative B: Acquire Landrights

Adoption of Alternative B would affect wetlands around Nolichucky Reservoir in ways similar to what would occur under Alternative A. Wetlands presently located on federal land would remain in federal ownership and would not be adversely affected by this alternative. Wetlands within the 500-year floodplain presently located on private land that would be acquired by TVA could receive additional protection from any inappropriate present uses. Wetlands located in areas where TVA would acquire only a flowage easement probably would be protected from major modifications but still could be adversely affected by uses compatible with the flowage easements. TVA acquisition of land immediately adjacent to wetlands on federal property would reduce the possibility of direct impacts to these wetlands and would provide buffer zones that would further protect the wetland resources.

Alternative B would not lead to any losses or alterations of wetlands located downstream from Nolichucky Dam. Similarly, the adoption of Alternative B probably would not have any effect on the expanding population of purple loosestrife in the Nolichucky River watershed.

Alternative C: Lower Nolichucky Dam

Lowering the pool level in Nolichucky Reservoir would result in the loss of most or all of the present wetlands within the existing 500-year floodplain upstream from the dam. Approximately 318 acres of wetlands exist in and around the reservoir. This total includes areas that would meet USACE jurisdictional wetland criteria, as well as areas that would meet only the broader National Wetland Inventory criteria (Cowardin et al. 1979).

The water level in the wetlands in the Richland Creek embayment and on the islands, sandbars, and sediment deposits in Nolichucky Reservoir between the dam (River Mile 46.0) and about River Mile 47.5 are maintained by the reservoir pool level. Lowering the surface water elevation by 40 feet would completely drain the wetlands in this part of the reservoir.

The majority of the floodplain wetlands located between River Miles 47.5 and 56.2 are primarily dependent on the groundwater table, which is directly linked to the river water elevations (see Sections 3.3 and 4.3). As indicated in

Section 4.3, lowering the dam would be expected to lower the groundwater table by as much as 40 feet, especially near the dam. Virtually any lowering of the average annual groundwater table would result in changes to the plant communities and wildlife habitat in these floodplain wetlands. Tributary streams and other water sources would not be sufficient to maintain the existing wetlands around the reservoir. In most locations, the new 100-year flood elevation would be lower than the level of the existing wetlands. Even where large floods could affect a present wetland, those rare floods would not be sufficient to maintain existing conditions in the wetland habitats. Lowering the reservoir pool level would result in lowering the beds of tributary streams, which would increase the drainage of the existing wetland areas.

Once this project had been completed, some new emergent or scrub-shrub wetlands might develop along the shore of the smaller reservoir and the reestablished river channel. More than likely, the resulting area of wetlands around the much smaller reservoir would be considerably less than the current 318 acres of wetlands, and the quality of those wetlands would be lower than the quality of the wetlands that presently exist around Nolichucky Reservoir.

Wetland areas downstream from Nolichucky Dam would not be adversely affected if Alternative C were adopted. Some additional sediment would likely be transported downstream from the dam; however, that material would not have any significant effect on the few wetland areas along that part of the river. The disturbance of sediments in Nolichucky Reservoir and the increase in suspended sediment transport during the construction period could accelerate the spread of purple loosestrife seeds and shoots into additional habitats downstream along the length of the river.

If Alternative C were adopted, the project would include measures to mitigate the loss of the wetlands that would be destroyed. The project would include the preparation and implementation of a detailed mitigation plan to address the restoration and/or creation of wetlands acreage elsewhere in the Nolichucky River watershed. The mitigation plan would also probably include a long-term monitoring component to ensure the success of the wetland mitigation. Under present regulations, this mitigation plan may have to be approved by USACE under Section 404 of the Clean Water Act. While the inclusion of appropriate mitigation actions would achieve compliance with wetlands Executive Order 11990 and pertinent sections of the Clean Water Act, there would still be a loss of wetland functions, while the restored or new wetlands matured and developed ecological functions similar to those that had been destroyed. In addition, the restored or new wetlands would be unlikely to match the diversity and quality of the wetlands that now exist around Nolichucky Reservoir.

Alternative D: Remove Nolichucky Dam

Alternative D would have the same adverse effects on wetlands upstream from the dam as would Alternative C, resulting in the loss of the 318 acres of wetlands within the existing 500-year floodplain around Nolichucky Reservoir. The only potential difference between Alternatives D and C would be the area of wetlands that might develop after the project was completed. Unlike Alternative C, which would depend on natural river processes for possible reestablishment of areas suitable for wetlands, Alternative D specifies that areas of level floodplain would be constructed whenever possible. Depending on several factors, including groundwater depth and the elevation of the floodplain above the river level, these new floodplain areas might provide suitable conditions for the development of emergent, scrub-shrub, and forested wetlands, potentially replacing some of the wetland acreage that would be lost.

Similar to Alternative C, adoption of Alternative D would include measures to mitigate the loss of the wetlands that would be destroyed. Loss of up to 318 acres of wetlands associated with this alternative would require a detailed mitigation plan describing the restoration and/or creation of wetlands acreage elsewhere in the Nolichucky River watershed, accompanied by long-term monitoring to ensure the success of the wetland mitigation. The inclusion of these mitigation actions and their review and approval by the USACE, if necessary, would ensure compliance with the wetlands executive order and pertinent sections of the Clean Water Act; however, wetland functions would still be lost, while the mitigated wetlands mature and develop ecological functions similar to those that had been destroyed. In addition, any mitigation plan would be unlikely to replace the diversity and quality of the wetlands that now exist around Nolichucky Reservoir.

As under Alternative C, the wetland areas that exist downstream from Nolichucky Dam would not be adversely affected if Alternative D were adopted. Some additional sediment would likely be transported downstream from the dam; however, this material would not have any significant effect on the few wetland areas that occur along that part of the river. The disturbance of sediments in Nolichucky Reservoir and the increase in downstream sediment transport during the dredging and dam removal period could accelerate the spread of purple loosestrife seeds and shoots into additional habitats downstream along the length of the river.

Comparison

Adoption of Alternative A or B would not result in significant impacts to wetlands. Alternative A would not affect the present status or ongoing trends of the wetlands that exist in and around Nolichucky Reservoir. Depending upon how much land was acquired or was covered only by flowage easements, Alternative B could have beneficial effects on wetlands by bringing more areas under federal management and providing buffers that would protect wetlands from other uses on adjacent land. Alternatives A and B would not have any effects on wetlands upstream or downstream from Nolichucky Reservoir.

Adoption of either Alternative C or D would have significant adverse effects on the 318 acres of wetlands that presently exist around Nolichucky Reservoir. Even though appropriate measures would be taken to mitigate the loss of wetlands, the large expanse of high-quality wetland habitats around this reservoir would be difficult, if not impossible, to replace. Alternatives C and D would have insignificant effects on wetlands upstream or downstream from Nolichucky Reservoir.

4.7 FLOODPLAINS AND FLOOD RISK

The floodplains and flood risk evaluation involves ensuring that each of the action alternatives would fulfill the requirements of Executive Order 11988

(Floodplain Management), because each of them would involve activities within the 100-year floodplain. Information related to existing conditions and floodplain modeling studies (presented in Section 3.7) has been used in the following evaluation of the alternatives. Under Alternative A, B, or C, TVA would continue to maintain Nolichucky Dam and Powerhouse and comply with federal dam safety requirements. Under Alternative D, the dam and powerhouse would be removed, so maintenance of those structures would no longer be necessary.

Alternative A: No Action

Under this alternative, TVA would not take any action to reduce the flood levels, but would provide information to agencies and individuals regarding the potential flooding effects around Nolichucky Reservoir. Appendix E identifies the 100- and 500-year flood elevations for this and the other alternatives at various locations along Nolichucky Reservoir. TVA already has provided updated flood level information to officials in Greene County. All proposed development in the floodplain would continue to be subject to local floodplain regulations.

Alternative B: Acquire Landrights

As indicated in Section 2.3, approximately 1,060 acres of land located within the present 500-year floodplain around Nolichucky Reservoir are not in federal ownership or subject to federal flowage easements. Under this alternative, TVA would acquire either fee title or flowage easement rights over all of this property. The 500-year flood elevation was selected as the acquisition boundary, because it is consistent with the flood risk requirements along other TVA reservoirs. On land purchased in fee title, TVA would ensure that any future development would be consistent with Executive Order 11988 through the review of plans prior to approval of construction. If a decision were made to acquire flowage easement rights, the land would remain in private ownership, but TVA would have the right to allow floodwaters from Nolichucky Reservoir to temporarily and intermittently flood these areas without being held liable for damages. The flowage easement rights TVA would acquire would prevent the construction of any flood-damageable facilities or structures in the 500-year floodplain without prior written TVA approval. By acquiring these fee or easement rights, TVA would resolve the flood impacts of Nolichucky Dam and Reservoir on nonfederal lands and property and would prevent increased future flood risks. This action would be consistent with Executive Order 11988.

Flooding downstream from Nolichucky Dam would not be affected by this alternative, in part, because no modifications would be made to the spillway. Future flood elevations upstream from the dam could be affected by the accumulation of additional sediment in Nolichucky Reservoir and increased runoff from upstream development; however, neither the additional sediment deposits nor any increased runoff would be expected to result in noticeable increases in flood elevations.

Alternative C: Lower Nolichucky Dam

Under this alternative, the spillway in Nolichucky Dam would be lowered approximately 40 feet (to elevation 1,200) and up to 12,000 acre-feet of sediment would be removed from Nolichucky Reservoir. The sediment would be removed and deposited as described in Section 2.6. Lowering the spillway would reduce flood elevations at the dam and throughout the length of Nolichucky Reservoir (Appendix E). At Nolichucky Dam, the 500-year flood elevation would be lowered about 37 feet (from elevation 1,266.3 to elevation 1,229.3) and the 100-year flood elevation would be lowered about 38 feet (from elevation 1,260.3 to elevation 1,222.3). Lowering the spillway and removing sediment would reduce the 500-year flood elevations to impact only land within the existing federal landrights upstream from the dam. The revised 500-year flood profile would join the predam 500-year flood profile at about River Mile 51.5 (Figure 4). Lowering the 500-year flood elevations by this much would avoid the potential reservoir-related flood effects on nonfederal lands and property.

Using the wording of Executive Order 11988, the dam is a functionally dependent activity and, therefore, any modifications to the dam must take place in the floodplain. By lowering the dam and removing some of the sediment in the reservoir pool, adverse floodplain impacts would be minimized, because less land would be flooded during a 100-year flood event. The remaining floodplain depths upstream from the dam would be lower than they have been since before the dam was built in 1913.

Lowering the elevation of the spillway in Nolichucky Dam would not lead to any detectable change in flood elevations downstream along the Nolichucky River. As described in Section 1.2, Nolichucky Dam was built as a single-purpose power production project, without any flood storage or flood protection benefit. Once the reservoir fills up to the level of the spillway, the only effect Nolichucky Dam has on flood protection is a result of the width of the spillway opening. Even if the spillway were lowered 40 feet, it would still be the same width and would still pass the same amount of water during a given time and flood event.

Alternative D: Remove Nolichucky Dam

Under this alternative, all visible components of Nolichucky Dam and Powerhouse would be removed from the river valley. In addition, as much as 19,000 acre-feet of sediment would be removed from or stabilized in Nolichucky Reservoir to clear the river channel. The sediment would be removed and deposited as described in Sections 2.7 and 2.8. Removal of the dam would reduce flood elevations at the dam site and throughout the length of the former reservoir (Appendix E). At Nolichucky Dam, the 500-year flood elevation would be reduced about 57 feet (from elevation 1,266.3 to elevation 1,209.3) and the 100-year flood elevation would be reduced about 60 feet (from elevation 1,260.3 to elevation 1,200.3). The 500-year flood profile resulting from the dam and sediment removal would be approximately equal to the predam 500-year flood profile, well within the existing federal landrights upstream from the dam.

All other potential floodplain impacts would be similar to those addressed under Alternative C, and all aspects of the project would be consistent with Executive Order 11988. Nolichucky Dam could be removed with little or no effect on downstream flood elevations. Removing Nolichucky Dam would replace the 359-foot width of the spillway with a restored river channel cross section. Lower parts of this cross section would be narrower than the spillway width, while higher parts would be closer to the full width of the dam (482 feet). If this alternative were adopted, the detailed planning for this cross section could ensure that the effect of the restored channel on downstream flood elevations would be similar to the effect of the present spillway.

Comparison

Adoption of Alternative A would not change flood elevations around Nolichucky Reservoir and would not address the potential flooding effects on nonfederal land and property. Adoption of Alternative B would not change flood elevations around the reservoir but would address the potential flooding effects on nonfederal land and property, because TVA would acquire fee title or flowage easements over the approximately 1,000 acres of affected land.

Adoption of Alternative C or D would reduce flooding effect on nonfederal land and property upstream from Nolichucky Dam. Alternative C would address the potential flooding effects by lowering the dam and reducing the flood elevations to levels only affecting land already controlled by TVA. Alternative D would address the potential flooding effects by removing the dam and reducing the flood elevations to levels approximately equal to what they would have been prior to construction of the dam. These elevations would be well within the area already controlled by TVA.

4.8 TERRESTRIAL LIFE

The terrestrial habitats around Nolichucky Reservoir consist primarily of grasslands, upland hardwood forests, and floodplain hardwood forests (see Section 3.8). A wide variety of plant and animal species occur in these habitats, many of which are widespread and abundant in east Tennessee. The floodplain forests that occupy part of the wetlands around the reservoir and downstream from Nolichucky Dam are stopover points or breeding grounds for Neotropical migrants, ducks, shorebirds, and wading birds. Two heron colonies exist along the river downstream from the dam, an unusual use of a river corridor in east Tennessee.

Alternative A: No Action

Under the No Action Alternative, terrestrial plant and animal communities would continue as they are within the Nolichucky River valley. This alternative would not impact the floodplain hardwood forests, uncommon terrestrial communities, or unusual vegetation present around the reservoir. Waterfowl would continue to thrive in the wetland and reservoir habitats around Nolichucky Reservoir, and shorebirds would continue to use exposed bars and shallow water habitats as they migrate through the area. Over time, changes in land use practices could result in modifying the amount of some natural habitats around the reservoir, which would affect populations of some wildlife species. Adoption of Alternative A would not result in adverse impacts to terrestrial plant and animal populations or their habitats.

Alternative B: Acquire Landrights

Adoption of Alternative B would result in effects similar to the No Action Alternative. Under this alternative, TVA would acquire fee title or flowage easement rights over 1,060 more acres of land around Nolichucky Reservoir. Some uncommon wetlands and lower bluff slopes that presently are in private ownership probably would receive long-term protection under this alternative. An increase in public land around the reservoir also would relieve some land use pressures on wildlife and their habitats along the river. This alternative might not result in any significant changes in terrestrial wildlife populations in the project area; however, the increased amount of land in public ownership could lead to modest beneficial effects on wading birds and other animals that use these parts of the valley.

Alternative C: Lower Nolichucky Dam

Under Alternative C, lowering the reservoir pool elevation would reduce the total acres occupied by wetland communities around Nolichucky Reservoir. The smaller reservoir pool and greatly reduced amount of wetland habitat also would lower the number and types of terrestrial animal species that could use the area. Mobile species that could no longer find suitable habitat in these areas, such as larger mammals and some migratory birds, would likely move to other suitable habitats. The extent of the other suitable habitats, however, may be limited and/or they may already be at their carrying capacity and the long-term survival of the displaced animals is questionable. Less mobile species, such as amphibians and some small mammals, would decline in numbers in the area. The narrowed reservoir pool and reduced wetland quality would result in fewer habitats for wetland plant species, breeding wood ducks, resident Canada geese, and migrating waterfowl. These reductions would constitute a significant adverse impact, because the present wetland habitats are distinctive communities not commonly found along reservoirs in the eastern part of the Tennessee River Valley.

If this alternative resulted in the release of substantial sediment to the river downstream from Nolichucky Dam, it also could have an indirect effect on some wildlife species that feed in that area. As described in Section 4.5, increased sedimentation could adversely affect aquatic life in the river. Heavy bed load deposits could reduce the numbers of potential prey for bats, mink, muskrats, river otters and many birds. Increased turbidity could hamper the ability of waterfowl, shorebirds, belted kingfishers, herons, egrets, and ospreys to forage. The potential impact of these possible effects on terrestrial animals would depend on how much sediment was added to the downstream part of the river. As described in Sections 4.4 and 4.5, these sedimentation effects would be temporary and similar to high-water events that presently cause similar conditions in the river. If sedimentation effects are adequately controlled, this alternative would have only temporary and insignificant effects on terrestrial wildlife along the Nolichucky River downstream from the dam.

Alternative D: Remove Nolichucky Dam

Adoption of Alternative D would result in effects on terrestrial life similar to those described under Alternative C. Under Alternative D, the elimination of Nolichucky Reservoir would reduce the total acres occupied by wetland communities and, if not properly mitigated, could have adverse effects on terrestrial wildlife along the river downstream from the dam site. As described in Section 4.6, the amount of wetland habitat that would be lost under Alternative D would be similar to the amount lost under Alternative C. As described under Alternative C, the loss of these wetland plant communities would constitute a significant adverse impact to the terrestrial ecology of the region, because the present wetland habitats are distinctive communities not commonly found along other east Tennessee rivers or reservoirs. The effects on wildlife downstream from Nolichucky Dam due to sediment deposition in the river bed would be more severe and longer term than that described under Alternative C.

Adoption of Alternative D would require the use of more sediment disposal sites than Alternative C. The increased number of sediment disposal sites would result in the loss of more terrestrial wildlife habitats than Alternative C; however, much of this habitat loss would be temporary, while the disposal sites were being filled and restored to more natural conditions.

Over the long term, adoption of this alternative would allow the river valley to revert to more natural habitat conditions. This change would favor wildlife species that are more abundant in river valleys over those that typically occur in reservoir and wetland habitats. This restored river corridor on federal land would support a wide variety of resident and migrating terrestrial wildlife species.

Comparison

Both Alternatives A and B would maintain the present status of terrestrial plant and animal resources around Nolichucky Reservoir. Alternative B would include an increase in federal land, which could provide long-term protection for additional local plant communities and wildlife populations.

Adoption of Alternative C or D could or would result in reductions in wetland resources and, under Alternatives C and D, the overall water surface area in Nolichucky Reservoir. These changes could result in significant reductions in the size and number of wetland communities and impacts to terrestrial animal resources, mostly migratory waterfowl and post-breeding wading birds. Alternative D would involve more disturbances of terrestrial habitats than Alternative C; however, Alternative D also would allow the river to revert to a more natural condition than any of the other alternatives. Properly mitigated, Alternative C would not have adverse effects on terrestrial wildlife downstream from Nolichucky Dam. Alternative D, however, would have long-term adverse effects on downstream wildlife that, as with the effects on aquatic life, would likely not be mitigated.

4.9 ENDANGERED AND THREATENED SPECIES

One plant and 17 animal species listed at the federal or state level were encountered or are likely to occur in areas that could be affected by one or more of the alternatives (see Section 3.9). Three of these species (birdwing pearlymussel, oyster mussel, and gray bat) are federally and state-listed as endangered species, two (fluted kidneyshell and spectaclecase) are candidates for federal listing, one (blue sucker) is a Tennessee threatened species, and one (branching whitlow-wort) is a plant listed as special concern in Tennessee. The other 11 are animals listed as in need of management in

Tennessee: two fish (highfin carpsucker and tangerine darter), an amphibian (eastern hellbender), two birds (common barn-owl and Swainson's warbler), and five mammals (common shrew, meadow jumping mouse, smoky shrew, southeastern shrew, southern bog lemming, and woodland jumping mouse). The fluted kidneyshell is also listed as in need of management in Tennessee. Seven of these 18 listed species occur in the river, mostly downstream from the reservoir, while the other 11 occur in caves, wetlands, or upland habitats around the reservoir.

Alternative A: No Action

Adoption of the No Action Alternative would not result in any project-related effects on endangered, threatened, or other listed species. Present habitat conditions in the river and on the land surrounding the reservoir would not change, and the present status of listed species in the area would not be affected. Over many decades (75 to 100 years), declining sediment loads coming down the river could result in slow changes in the size and locations of wetland habitats around the reservoir and reductions in sediment deposits in the river. If these habitat changes did occur, they could lead to changes in the numbers and distributions of some listed terrestrial species and slow increases in the numbers and distributions of all the listed aquatic species still present in the river.

Alternative B: Acquire Landrights

The adoption of this alternative would have many of the same effects as Alternative A. In the short term, present habitat conditions in the river and on the land surrounding the reservoir would not change, and the present status of listed species in the area would not be affected. Similarly, long-term reductions in the sediment load in the river would lead to changes in some terrestrial habitats and listed species populations around the reservoir. The long-term sediment reductions also could lead to improvements in aquatic habitats and listed aquatic species in the river. Federal ownership or easement rights over all of the land in the 500-year floodplain upstream from the dam could result in increased protection for terrestrial habitats around the reservoir and benefits to populations of listed plants and animals that could live there. Overall, adoption of Alternative B would not result in adverse impacts to federally or state-listed plant or animal species and might lead to beneficial effects to some listed terrestrial species because of the increased protection for some habitat types it could provide.

Alternative C: Lower Nolichucky Dam

Lowering the pool level and stabilizing or relocating the accumulated sediment in Nolichucky Reservoir could lead to a variety of effects on endangered and other listed species. Lowering the spillway would lower flood elevations for a distance upstream from Nolichucky Dam and would increase the amount of bluff habitat available for the branching whitlow-wort. That habitat change would have a beneficial effect on this rare plant.

As described in Section 4.6, lowering the water level upstream from Nolichucky Dam would result in significant adverse effects on the 318 acres of wetland habitats that presently occur in and around the margins of the reservoir. The changes in these wetlands would make them less suitable habitats for Swainson's warbler and the smoky shrew. Both species also can occur in a variety of other habitats, and any members of these species that might exist in the wetlands around the reservoir probably would relocate to other suitable habitats in the area. Over time, new wetland habitats would develop along the margins of the smaller reservoir pool, some of which could be suitable for these species. Lowering the reservoir pool and the associated reduction in wetland habitats would not result in significant impacts on either of these occasional wetland species.

As described in Sections 4.4 and 4.5, the construction work associated with this alternative probably would result in more turbidity and less bed load in the river reach downstream from the dam. Information presented in Section 3.9 indicates that all eight listed aquatic species known from this part of the Nolichucky River (the four endangered or candidate mussel species [birdwing pearlymussel, oyster mussel, fluted kidneyshell. and spectaclecase] and the four state-listed species [the hellbender, blue sucker, highfin carpsucker, and tangerine darter]) typically occur in silt-free habitats in rivers. These species are uncommon in the Nolichucky River downstream from Nolichucky Dam, perhaps in part because of the relatively large amount of sediment that occurs there. If this alternative resulted in increased sediment in the river downstream from Nolichucky Dam, it could cause significant adverse effects on the listed aquatic species that persist there.

The adoption of this alternative would include careful planning of the construction activities to avoid excessive erosion, extensive measures to control erosion and sedimentation, and monitoring to determine if additional control measures would be necessary to minimize future adverse effects on downstream aquatic life. While these measures would not prevent the loss of large quantities of suspended sediment from the reservoir pool during flood events, they would minimize those increases and reduce the amount of bed load material that could be carried over the dam during floods. These measures probably would result in only insignificant effects on downstream populations of the highfin carpsucker and tangerine darter, both of which presently are exposed to comparable conditions in the river upstream from Nolichucky Reservoir. Adoption of this alternative, however, might result in significant adverse construction effects on one or more of the other listed aquatic species living only in the downstream reach of the river where the dam presently protects them from excessive sedimentation.

Increased sedimentation in the river downstream from Nolichucky Dam also could have indirect effects on the endangered gray bat. Gray bats feed on the flying adult stage of some aquatic insects, such as midges, stoneflies, mayflies, and caddisflies. Increased sediment levels could reduce the survival of these bottom-dwelling insects, which could reduce their abundance enough to affect where gray bats would feed. Gray bats can travel long distances to feeding sites (up to 22 miles); however, declines in the numbers of flying insects along the Nolichucky River might affect feeding activities of juvenile gray bats emerging from the cave located along this part of the river. As described in Section 4.5, adoption of this alternative would have only insignificant effects on aquatic life downstream from the dam, perhaps resulting in species populations similar to those now found upstream from the reservoir. Given that conclusion and the abundance of midges in the sampling results from the benthic site examined upstream from the dam (Appendix B), the likely effects on the gray bat also would be insignificant.

Following the construction period, this alternative would have similar effects on listed aquatic species as those described for Alternatives A or B.

Nolichucky Dam would still remain in place; however, the spillway would be 40 feet lower. Somewhat less suspended sediment and bed load material would be deposited in and along the margins of the smaller reservoir, and some more sediment would be carried over the dam to be deposited mostly on the floodplains along the downstream part of the river or transported on into Douglas Reservoir. If the expected long-term decline in sedimentation from upstream occurs, protected aquatic species living in the river upstream and downstream from the dam eventually would develop larger and more widespread populations than occur there now. As described in Sections 4.4 and 4.5, these improvements would occur somewhat more quickly under Alternative C (in 50-60 years as opposed to 80-100 years under Alternative A or B), largely because much of the sediment now stored in the reservoir would have been relocated out of the floodplain.

Alternative D: Remove Nolichucky Dam

Removing Nolichucky Dam and relocating and stabilizing the accumulated sediment in Nolichucky Reservoir could lead to a variety of effects on endangered and other listed species. Many of the effects on listed terrestrial species would be similar to those described under Alternative C; however, some effects on protected aquatic species could be more severe than would occur under Alternative C.

Lowering the water level to the former riverbed would increase the amount of bluff habitat available for the branching whitlow-wort, which would benefit that rare plant. The elimination of most wetlands around the present reservoir would decrease the amount of wetland habitat available to Swainson's warbler and the smoky shrew. This would have only insignificant effects on these two species, because both could move to other adjacent habitats during the construction and recovery period then could recolonize the river corridor if suitable habitats became established.

Like Alternative C, this alternative would have more substantial effects on the listed species that either exist in the river or depend upon other species living there. As described in Sections 4.4 and 4.5, the longer construction period associated with this alternative would result in more turbidity and sedimentation effects on the downstream river reach than would occur under

Alternative C. Sediment removal activities along the length of the reservoir and in the sediment trap would reduce the amount of bed load material that could be carried over the dam during high flows. These removal activities and the erosion control measures described in Sections 2.7 and 4.4 could result in less downstream sedimentation effects on listed aquatic species during early parts of the construction period than would occur under Alternative A or B. If these control measures failed during the construction period, listed aquatic species living only in the downstream reach might experience significant adverse sedimentation effects.

Once the last part of the dam was removed and none of the reservoir pool remained to serve as a sediment trap, flow in the river would start moving more sand and other bed load material into the downstream part of the channel. As described in Sections 4.4 and 4.5, within one year of typical river flows, an average of 2 inches of mostly sand-size particles would be deposited on the river bottom. While larger particles would continue to replace the sand in this deposit over the next 5 to 10 years, this would be a permanent addition to the substrate in the river. In many ways, the aquatic habitats in the downstream river reach would become similar to the present habitats in the reach upstream from Nolichucky Reservoir.

The effects of this significant change in the river substrate on listed aquatic species would be similar to those described in Section 4.5 for all aquatic life. Listed species capable of living in areas with these higher amounts of fine bed load particles would continue to occur in the river reach. This apparently would include the highfin carpsucker and tangerine darter, both of which occur now in the river reach upstream from Nolichucky Reservoir. Each of the six other listed aquatic species, however, probably would be adversely affected by the change in the substrate. Blue suckers and hellbenders, which typically live, feed, and reproduce in areas with little or no fine sediment, would find less suitable habitat in the river. The birdwing pearlymussel, oyster mussel, fluted kidneyshell, and spectaclecase, which occur most often in stable cobble and gravel substrates with little fine sediment, probably would be eliminated from the Nolichucky River. The designated critical habitat for the oyster mussel in the lower Nolichucky River would also be adversely affected.

The effects of this alternative on gray bats would be similar to those of Alternative C. As described in Section 4.5, the addition of more sediment probably would cause the populations of bottom-dwelling aquatic species (including bottom-dwelling insects) in the downstream river reach to become similar to the population levels now present upstream from the reservoir. Gray bats would encounter different flying adult insects along the downstream part of the river than they feed upon there now; however, ample insect food would still be present. The likely post-construction changes in aquatic life downstream from Nolichucky Dam would have only insignificant effects on the gray bat.

The potential adverse effects of this alternative on listed aquatic species might be reduced by delaying the removal of the last part of the dam until most stabilization and revegetation components of the project had been completed. At least some of the adverse post-construction effects could be reduced or avoided if sediment removal or stabilization activities would be conducted in the river upstream from Nolichucky Reservoir, perhaps as parts of a companion project to reduce sedimentation effects in all parts of the watershed. If the present populations of some listed aquatic species in the Nolichucky River are found to represent unique genetic stocks, it might be possible to use captive culture methods to maintain these stocks until they could be returned to suitable habitats in the river.

Twenty to 50 years after Nolichucky Dam was removed, this alternative would have caused somewhat different effects on the present endangered and other listed species from what would occur under Alternative A, B, or C. The branching whitlow-wort and the other listed terrestrial species would have recolonized suitable habitats along the river valley and, generally, would have benefited from the habitat changes caused by this project. Listed aquatic species capable of surviving in habitats with somewhat less amounts of sediment than presently occur upstream from Nolichucky Reservoir (such as the highfin carpsucker and tangerine darter) would have established populations throughout a 100-mile reach of the river and would likely occur in larger numbers at present. If the upstream sediment deposits had not been reduced beyond the projected natural declines, the birdwing pearlymussel, oyster mussel, fluted kidneyshell, spectaclecase, and perhaps the hellbender and blue sucker would no longer occur in the river. Cobble and gravel habitats in the river might not be coarse enough to support these sensitive benthic species for at least another 20 to 50 years. If and when the sediment load declined to more typical levels for the region, however, this alternative could lead to the recovery of much more free-flowing, big river habitat for endangered and threatened aquatic species than would occur under Alternative A, B, or C.

Comparison

Adoption of Alternative A or B would have similar effects on endangered and other listed species. Neither of these alternatives would have adverse effects on the listed species that presently occur around Nolichucky Reservoir or in the river downstream from Nolichucky Dam, because neither alternative would involve changes in existing habitats on the land or in the water.

Adoption of Alternative C or D would have only insignificant construction effects on the branching whitlow-wort and the listed terrestrial animal species that occur in this area. Once the construction period was over, either of these alternatives would have beneficial effects on this rare plant and most of the other listed terrestrial animal species.

Adoption of Alternative C or D could result in significant adverse effects on endangered and other listed aquatic species during the construction period if large amounts of sediment were released to the river downstream from the dam. Much of this potential for adverse effects during the construction period would be avoided by dredging material from the sediment trap and the use of aggressive erosion control measures; however, unexpected flood events could still cause short-term sedimentation episodes and adverse effects on some listed aquatic species populations.

Once the dam was lowered under Alternative C, only slightly more bed load material would be lost from the smaller reservoir than would occur under Alternative A or B and only insignificant effects on listed aquatic species and the gray bat would occur. Once the dam was removed under Alternative D, the changes in sediment transport downstream from the dam site would have significant adverse effects on the birdwing pearlymussel, oyster mussel, fluted kidneyshell, spectaclecase, and possibly the hellbender and blue sucker. The post-construction sedimentation effects on these species might be reduced by delaying the last part of the dam removal and might be avoided if sediment removal activities were conducted in the upstream part of the river, perhaps as part of a separate, watershed-wide sediment reduction project. If the present populations of some listed aquatic species in the Nolichucky River are found to represent unique genetic stocks, it might be possible to use captive culture methods to maintain these stocks until they could be returned to suitable habitats in the river.

Assuming only the projected slow decline in present sedimentation levels, the long-term effects of Alternative C on listed aquatic species would be similar to the long-term effects associated with Alternatives A or B. Using the same assumption, the long-term effects of Alternative D could result in the establishment of populations of silt-tolerant listed species (such as the highfin carpsucker and tangerine darter) throughout a 100-mile reach of the river, probably in larger numbers than exist in the river now. In contrast, however, the four listed mussels and perhaps the hellbender and blue sucker might not occur in the river. Cobble and gravel habitats in the river might not be coarse enough to support these sensitive benthic species for at least another 20 to 50 years. If and when the sediment load declined to more typical levels for the region, Alternative D could lead to the recovery of much more free-flowing, big river habitat for listed aquatic species than would occur under Alternatives A, B, or C.

4.10 LAND USE

Most of the more than 2,500 acres of land within the 500-year floodplain around Nolichucky Reservoir is occupied by forest (28 percent), pasture (26 percent), wetlands (12 percent), or is covered by water (23 percent; see Section 3.10). Residential and other development has occurred on about 75 acres (3 percent) in this area, mostly near Nolichucky Dam. The federal government owns fee title or flowage easement rights over approximately 1,350 acres (53 percent of the total) within the 500-year floodplain, 1,235 acres of which is located within the 100-year floodplain (60 percent of the total in that area). An evaluation of recent aerial photographs suggests that 72 buildings exist within the 500-year floodplain, 45 of which occur within the 100-year floodplain. Two-thirds of these structures are houses or mobile homes.

Alternative A: No Action

If TVA adopted the No Action Alternative and did nothing on the ground to address potential flooding effects on nonfederal land and property around Nolichucky Reservoir, the present flood status in the area would not change. Each year, there would be 1 in 100 chances that 32 homes, 12 other buildings, and property on 700 acres of land around the reservoir could be damaged during a flood. Similarly, each year there would be 1 in 500 chances that 13 additional homes, 10 other buildings, and property on about 430 additional acres could be damaged during a severe flood. At present, the 1 in 500 chances flood would affect a total of 32.5 acres of low-density residential housing, 28.9 acres of a golf course, 3.4 acres of commercial property, 6.7 acres being used for athletic fields and campgrounds, and 185.8 acres planted in crops. TVA already has provided flood elevation information to officials in Greene County, and more than likely, local floodplain ordinances would regulate the construction of buildings within the 100-year floodplain. Local regulations probably would not affect the construction of houses and other structures in areas that would be affected only by larger floods.

If this alternative were adopted, the potential flooding effects related to the presence of Nolichucky Dam and the sediment in the reservoir would continue to affect future uses of the approximately 1,100 acres of private land within the associated 500-year floodplain. Some uses of this land probably would be impacted by county floodplain regulations. Adoption of this alternative would not have any effect on present uses of the land downstream from Nolichucky Dam.

Alternative B: Acquire Landrights

Adoption of Alternative B would mean that TVA would acquire fee title or flowage easement rights over the approximately 1,100 acres of land within the 500-year flood boundary around Nolichucky Reservoir. Existing buildings on the land TVA would buy in fee probably would either be moved to other sites (perhaps by the previous owners) or would be demolished. Where TVA would acquire only a flowage easement over a tract of land, the owner would be required to decide what would be done to move or protect structures that could be affected by flooding. Future development on the federal land or land covered by TVA flowage easements would be carefully controlled to avoid or minimize potential flood damage. These changes in ownership and use would prevent future flooding impacts on nonfederal land and property around Nolichucky Reservoir.

This alternative would result in some changes in the use of the land within the 500-year floodplain around Nolichucky Reservoir. Most of the federal land probably would be added to the existing wildlife management area, presently managed by TWRA. Some of the federal land also probably would be used for environmental education activities and public parks. The use of private land over which TVA held flowage easements would be determined by the owners, so long as those uses were compatible with terms of the easements. More than likely, much of that land would continue to be managed as forests, pastures, and cropland. These changes in ownership around Nolichucky Reservoir would result in only insignificant modifications from the present uses of the affected land. This alternative would not have any effect on present land uses downstream from Nolichucky Dam.

Alternative C: Lower Nolichucky Dam

Under this alternative, TVA would lower the spillway of Nolichucky Dam and relocate and stabilize some of the sediment in the present reservoir pool. These changes in the height of the spillway and the reservoir pool would lower upstream flood elevations to the point that all of the increase in the 100-year and 500-year flood levels related to the presence of the dam and the sediment in the reservoir would occur on federal land. The modifications to the dam and removal or stabilization of the sediment would prevent dam-related flooding effects on nonfederal land and property.

Upstream from Nolichucky Dam, these changes in the reservoir pool level and flood elevations would mean that approximately half of the land within the present 500-year floodplain would no longer be subject to flooding (see Figure 4 and Appendix E). Local floodplain regulations would not impact the construction of homes and other structures on private land outside of the new

100-year floodplain along the river and smaller reservoir. The present federal land no longer located in the 500-year floodplain would remain in public ownership and would continue to be used for wildlife management, environmental education, and public parks.

Lowering the spillway and stabilizing or relocating the sediment in the reservoir pool would not have a significant effect on land uses downstream from Nolichucky Dam. As described in Section 4.7, lowering the spillway would not change downstream flood elevations or the present flood patterns along that part of the river. Some additional sediment probably would be transported past the dam and some of that sediment could be deposited on the downstream floodplains; however, the sediment management practices that would be used during the project would reduce the effects on land use to insignificant levels.

Alternative D: Remove Nolichucky Dam

Adoption of this alternative would result in land use impacts similar to those of Alternative C. Removal of the dam would lower flood elevations upstream from Nolichucky Dam to levels only slightly lower than would occur under Alternative C (Figure 4), and only slightly more land would be removed from the 500-year floodplain (Appendix E). Private land no longer in flood-prone areas would be available for other uses. All of the federal land would remain in public ownership and would continue to be used for wildlife management, environmental education, and public parks.

Removal of the dam would have only insignificant impacts on downstream land uses. Even though some additional bed load material might be deposited on the downstream land during and after the construction period, the use of erosion control measures would minimize those impacts on existing land use.

Comparison

Adoption of Alternative A would not change present land use conditions around Nolichucky Reservoir; flooding would still affect the use of nonfederal land and property in the area. Adoption of Alternative B, C, or D would eliminate project-related flooding effects on nonfederal land and property;

however, these alternatives would accomplish that purpose in very different ways. Alternative B would change the ownership of the land within the present 500-year floodplain but would have only insignificant effects on present land uses. Lowering or removing Nolichucky Dam under Alternative C or D would lower the flood elevations around the present reservoir and would make some private land within the present floodplain available for other uses. Under each of the alternatives, TVA would assist landowners and Greene County officials in recognizing the flood risks and minimizing flooding impacts on that land. All federal land around Nolichucky Reservoir would remain in public ownership and would continue to be used for wildlife management, environmental education, and public parks.

4.11 VISUAL CHARACTER, RECREATION, AND MANAGED AREAS

Section 3.11 describes the visual setting around Nolichucky Reservoir and adjacent parts of the Nolichucky River, the recreation activities that are pursued there, and the resource management areas that have been established in the area. In general, the natural communities in this part of the Nolichucky River watershed provide scenic variety, attractiveness, and visual harmony. Except for some developed recreation facilities at Kinser Park, this setting supports mostly quiet, almost solitary, recreation experiences that are quite different from what occurs on other reservoirs and rivers in east Tennessee.

Alternate A: No Action

Adoption of the No Action Alternative would maintain the present visual character, recreation uses, and resource management areas around Nolichucky Reservoir. The lack of any change in the natural communities or use of the land around the reservoir would maintain the present visual setting. The likely uses of the wildlife management area would stay the same: hunting, fishing, and wildlife observation. Kinser Park and the Cedar Creek Learning Center would likely continue to operate as they have in the recent past. Present recreational use of the river upstream of the reservoir and downstream from Nolichucky Dam would continue, and no changes related to this project would occur on the managed areas located further downstream along the river.

As described in Sections 4.4 and 4.6, the continuing accumulation of sediment in Nolichucky Reservoir would, over a period of many decades, fill the remaining space in the reservoir pool and the adjacent wetlands. While the river would maintain an active channel, that channel would be bordered by wide and high sand-filled floodplains. Water-based recreation would continue to decrease as the open channel became more narrow. As the wetland habitats filled in, activities on the wildlife management area might become more focused on upland game instead of waterfowl. Recreation activities in Kinser Park would not change, but outdoor education activities at the Cedar Creek Learning Center probably would shift from water-related projects to those associated with upland habitats. These long-term changes on Nolichucky Reservoir would not have any effects on the visual setting, recreation use, or on the management areas located along the downstream reach of the river.

Alternate B: Acquire Landrights

If TVA acquired the 1,100 additional acres of land or flowage easement rights around Nolichucky Reservoir, the visual setting, size, composition of the wildlife management area, and recreation use of the area would change. Federal ownership and limited control over what is now private land around the reservoir would reduce the likelihood that future development would disrupt the visual harmony and attractiveness of the project lands. Much of the land that would be acquired by TVA probably would be managed as part of the existing wildlife management area. Increasing the size of the wildlife management area would lead to additional hunting and other recreation opportunities on that land. Some of the acquired land also might be used to expand the size of Kinser Park and the environmental education area adjacent to the dam, also leading to increased recreation use in those areas.

The long-term filling of the reservoir described under Alternative A would still occur under this alternative, and the long-term effects on the visual setting, recreation use, and wildlife management area would be the same as those described under Alternative A. The increased size of the wildlife management area would provide additional opportunities for upland hunting and wildlife observation, which could offset the loss of present water-based activities as the size and quality of the reservoir habitats declined. As under

Alternative A, this alternative would not have any effects on the visual quality or recreation use of the downstream reach of the river or on the management areas located there.

Alternate C: Lower Dam and Stabilize Sediment

Adoption of this alternative would involve construction activity at the dam site and around the reservoir, which would result in changes in the visual setting, natural communities, and recreation use of the area. Once the construction work was completed, this alternative would begin to produce visual and recreation settings somewhat similar to what would occur under Alternative A.

While sediment in the reservoir pool was being stabilized and the spillway was being lowered, construction effects around the reservoir would include heavy equipment use, increased truck traffic, temporary stockpile areas, and large areas of disturbed land. These disruptions would be viewed in the foreground by local residents, recreation users, and motorists using the bridges, including the State Route 70 bridge adjacent to the dam site. The construction activities and traffic would add visual discord, while reducing coherence and harmony in the landscape. Scenic integrity would be reduced in some areas during the construction period. Waterfowl and recreation use on the reservoir, including the wildlife management area, would be reduced or precluded throughout most of the construction period. Recreation use on the river downstream from the dam might be reduced during the construction period depending upon how well the stabilization measures would prevent excess sediment loss over the dam. Managed areas located downstream would not be impacted, because of their distance from the construction activities.

By the end of the construction period, the sediment and shoreline stabilization measures would have begun to restore a more natural visual setting in the area, and scenic harmony and attractiveness would begin to be reestablished. The restored 3-mile section of river upstream from the smaller reservoir pool and the reservoir pool itself would develop natural channels and shoreline vegetation as the remaining sediment became stabilized in each area. Upland areas disturbed during the construction period and former wetland habitats above the level of the new reservoir pool would be planted or colonized by different plant species, and new terrestrial communities would develop in those areas. The mix of recreation activities would be similar to what would take place under Alternative A or B. The upstream half of the former reservoir would provide a variety of recreation opportunities, but the smaller reservoir would probably be less attractive for fishing, boating, canoeing, or tubing because of its small size and sand bottom.

As the aquatic and terrestrial habitats were stabilizing, TVA, in cooperation with TWRA and other stakeholders, would decide how to manage the modified federal land. These decisions could result in adjustments to the boundaries of the present wildlife management area, Kinser Park, and the Cedar Creek Learning Center that would make those facilities more compatible with surrounding land uses. Some of the interactions with the natural resources in the area would be different from the present uses around the reservoir; many of them would become more typical of activities along other relatively large, free-flowing rivers in east Tennessee.

Alternative D: Remove Nolichucky Dam

Construction activities associated with this alternative and the effects on these resource areas would be very similar to what was described under Alternative C. Visual discord would occur during the construction period due to the increased truck traffic, temporary stock piles, and expansive areas of disturbed land. These disruptions would be seen most frequently in the foreground by local residents, recreation users, and motorists using the bridges, especially the State Route 70 bridge just downstream from the dam. The proposed 10- to 12-year construction period might lead some area residents to consider these disruptions to be permanent. Scenic integrity around the reservoir would be low during this time. The construction activities associated with dam removal and dredging would reduce the number of waterfowl and recreation users on the river. There would be no disruption to the majority of Kinser Park recreation users; however, some activities of the Cedar Creek Learning Center probably would have to occur at some other site.

Following the construction period, however, the removal of the dam and sediment would restore a natural visual setting in the river valley, and high scenic integrity would develop. Removal of the dam and powerhouse would eliminate these vertical and broadly horizontal, adversely contrasting features in the landscape. Establishing a natural-looking streambed, contouring the banks and slopes, and planting native vegetation would restore a natural landscape that would, over time, improve the visual quality of the area.

Once the dam was removed, recreation activities in the area could expand to include tubing and float fishing. In addition, the presently impounded section of the Nolichucky River could provide as good or better potential canoeing experiences as now exist in the first 10 miles upstream or downstream from the reservoir. Upland areas along the river corridor would not only be restored, but also would include a large amount of habitat previously occupied by wetlands. This would mean an eventual change in what species would be present and hunted, but the basic activities of hunting and wildlife observation would continue. In cooperation with TWRA and other agencies, TVA would decide how the federal land and landrights would be managed, possibly resulting in modifications to the boundaries of the wildlife management area, Kinser Park, and the Cedar Creek Learning Center. Public ownership of the land all along the present reservoir would simplify and enhance recreation development of this free-flowing river corridor.

Although the potential for downstream movement of sediment would be greater under Alternative D, managed areas located downstream of the dam would not be impacted, because any increase in the sediment load would be dissipated and deposited before reaching these areas.

Comparison

Alternatives A and B could have similar effects on the visual setting, recreation use, and managed areas around Nolichucky Reservoir. Alternative A would essentially maintain the present conditions while Alternative B would result in increased stability in the landscape, a possible increase in the size of the wildlife management area, and more land available for present recreational opportunities. Under Alternatives A and B, the projected long-term filling of the reservoir would mean that reservoir-based activities would become increasingly less important to recreation users in Kinser Park and that hunting and wildlife observation activities in the area would shift focus to upland species.

During their respective construction periods, both Alternatives C and D would involve disruptions in the visual setting, recreation use, and outdoor activities on the wildlife management area. In the long-term, however, both of these alternatives would restore part or all of the area to a more natural, large-river setting. While Alternative C would restore about 3 miles of river to free-flowing conditions, the effect on the remainder of Nolichucky Reservoir would be similar to what would occur under Alternatives A and B. Eventually, there would be little if any water recreation activities on the impounded part of the Nolichucky River.

In the long-term, Alternative D could result in the most recreation benefits for this area. Hunting, wildlife observation, and bank fishing activities associated with the wildlife management area probably would continue, although the various target species would change. Canoeing, tubing, and float fishing probably would be added to the list of recreation activities that could be conducted in this area, especially given the availability of land already in federal ownership and the existing public infrastructure. Although the construction period would be longer for Alternative D, the resulting visual character along and adjacent to the river would have the highest scenic attractiveness when compared to the other alternatives.

None of the four alternatives would result in significant impacts to the visual character, recreation use, or managed areas on the river downstream from the dam.

4.12 CULTURAL RESOURCES

Archaeological and historical resources are probably abundant in the area adjacent to Nolichucky Reservoir; however, relatively few studies of those resources have been conducted (see Section 3.12). Available information suggests that as many as 200 archaeological sites and at least 19 historic structures (including Nolichucky Dam and Powerhouse) exist within the 500-year floodplain around Nolichucky Reservoir. Many of these sites and structures probably would be considered eligible for listing on the NRHP. Additional archaeological sites almost certainly are present in the reservoir pool, buried under sediment deposited since the dam was built.

The NHPA provides that federal agencies, including TVA, consult with the SHPO before conducting any action that could adversely affect eligible archaeological sites or historical structures. Acceptable ways to avoid or mitigate potential adverse impacts include moving a structure, protecting the site or structure in some way, or documenting the site or structure (in photographs, historic monographs, measured drawings, systematic investigation, etc.) before the effect occurs. The appropriate avoidance or mitigation measures would be determined in consultation with the SHPO, other affected parties, and, if necessary, the federal Advisory Council on Historic Preservation.

Alternative A: No Action

Adoption of the No Action Alternative would not change the present status of archaeological sites or historic structures around Nolichucky Reservoir. TVA would continue to maintain the dam and powerhouse in a manner that preserves their historic integrity. The sediment covering buried sites would not be disturbed, and the potential flooding effects on eligible historic structures would not be reduced. Available information indicates that 11 of the 19 potentially eligible structures within the 500-year floodplain around Nolichucky Reservoir occur within the 100-year floodplain. It is possible that all of these structures would not meet eligibility requirements for listing. It is also possible that all of them do not still exist and, if still in existence, not all of them would be seriously affected by any specific flood event.

Because no funding or licensing (i.e., no change) would be involved under this alternative, the SHPO, by letter dated April 28, 2005, concurred with TVA's finding that there would be no "undertaking," and therefore, there would be no further Section 106 obligations (see Appendix G).

Alternative B: Acquire Landrights

If TVA acquired fee ownership or flowage easements over all of the land within the 500-year floodplain around Nolichucky Reservoir, the potential effects on archaeological sites and historic structures would be essentially the same as described under Alternative A. TVA would continue to maintain the dam and powerhouse in a manner that preserves their historic integrity. Where TVA would acquire land containing archaeological sites or historic structures, the agency would be obliged to protect those resources from adverse effects. Maintaining the present flood elevations around the reservoir probably would not adversely affect buried sites but could continue to threaten the integrity of historic structures located in the floodplain. As described above and in Section 3.12, as many as 200 archaeological sites and up to 19 potentially eligible historic structures could exist within the 500-year floodplain around Nolichucky Reservoir. Not all of these sites and structures, however, would be likely to meet eligibility requirements and not all of them would be seriously affected by specific flood events.

Alternative C: Lower Nolichucky Dam

Lowering the spillway in Nolichucky Dam and removing some of the sediment from the reservoir pool would lower the 100- and 500-year flood elevations upstream from the dam and affect archaeological sites and historic structures. Lowering the flood elevations upstream from the dam would reduce the flood potential on historic structures around the reservoir. Because Nolichucky Dam is eligible for listing as an historic structure, the proposal to modify the spillway would require consultation with the Tennessee SHPO and, if necessary, the Advisory Council on Historic Preservation. This proposed modification would likely involve a relatively simple agreement and a modest amount of documentary mitigation.

Lowering the pool level in the reservoir and relocating and stabilizing the accumulated sediment could have adverse effects on buried archaeological and historic resources. While the intent of the sediment work would be to relocate and stabilize recent deposits in areas where they would not be eroded by the river, portions of the original valley floor probably would be uncovered. Archaeological or historic sites that had been under water or buried since the dam was built could be exposed in these areas. Sediment also could be deposited in places containing archaeological sites. Prior to the use of any disposal site, TVA would determine if archaeological resources in the area could be adversely affected and would avoid or minimize those potential effects as appropriate. As the reservoir pool level was being lowered and sediment was being removed down to the original valley floor, TVA would look for archaeological and historic resources that might be exposed and would take appropriate action to document and preserve cultural resources that are found. Both of these activities would be conducted in accordance with the NHPA following consultation with the SHPO and other consulting parties.

Alternative D: Remove Nolichucky Dam

This alternative would address the flooding effects of Nolichucky Dam and Reservoir on archaeological and historic resources using the same general approach as described under Alternative C. The differences from Alternative C associated with this alternative would involve the complete removal of the dam and powerhouse, the potential to expose more archaeological or historic sites as sediment was removed from the remainder of the reservoir pool, and more potential to relocate sediment to sites containing archaeological resources.

For a variety of reasons including their age, Nolichucky Dam and Powerhouse are eligible for listing on the NRHP. The recovery of historic artifacts and detailed documentation of their construction and appearance would likely be required prior to the removal of these structures.

The protection of buried archaeological and historic sites from effects associated with the dredging and disposal of sediment in the reservoir would be virtually identical to Alternative C. TVA would avoid or mitigate the potential effects of depositing sediment in areas containing buried archaeological resources and would look for and preserve archaeological and historic resources that might be exposed as the original ground level under the reservoir pool was being uncovered. All of these activities would be conducted in accordance with the NHPA following consultation with the SHPO and other consulting parties.

Comparison

Adoption of Alternative A or B would not involve any physical activity that could adversely affect historic structures and archaeological sites in the floodplain upstream from Nolichucky Reservoir. Some 200 archaeological sites and up to 19 historic structures would continue to be located within the 500-year floodplain and could be impacted during future floods. Alternative B would result in TVA owning many or all of these sites and structures, along with the responsibility to protect and preserve them.

Adoption of Alternative C or D would reduce the flood elevations upstream from the dam and would likely provide protection for most historic structures within the present 500-year floodplain. Alternative C would require the modification of Nolichucky Dam, could expose some presently buried archaeological or historic sites along part of the river channel, and might result in depositing dredged sediment on top of buried archaeological sites. Alternative D would have more extensive effects than Alternative C, because it would require the complete removal of Nolichucky Dam and Powerhouse, could expose more buried sites along the river, and would require the use of more sediment disposal sites. Each of these potential adverse effects could be avoided or minimized by careful planning and the inclusion of measures to protect and adequately document cultural resources in the area.

Physical activities associated with each of the action alternatives would be conducted in accordance with the NHPA following consultation with the SHPO and other consulting parties, as appropriate. Adoption of Alternative C probably would result in the protection of historic structures from project-related flooding effects, while Alternative A or B would continue the potential for those structures to be flooded. Alternative D also would protect historic structures from flooding; however, it would include removing all of the historic Nolichucky Dam and Powerhouse. From an archaeological perspective, Alternative B would bring more sites into federal ownership without disturbing any sites already buried under the reservoir. Alternatives C and D would not extend federal protection to any additional sites and could expose presently buried sites along half or all of the length of the reservoir. Alternative A probably would result in fewer adverse impacts on archaeological sites than Alternatives C or D, but also would provide fewer beneficial effects on those resources than would occur under Alternative B. Properly conducted, mitigated, and documented during appropriate consultation with the SHPO and other parties, none of these alternatives would result in more than insignificant effects on archaeological and historic resources.

4.13 SOCIOECONOMICS

Section 3.13 provides statistics concerning the present population and economic conditions in Greene County and the adjacent seven-county labor market area. Greene County contains about 13 percent of the population and about 15 percent of the labor force in the labor market area. Greene County is considerably more oriented toward farming, slightly less oriented toward services, has a relatively higher unemployment rate, and a slightly lower average personal income than several other counties in the labor market area.

The primary uses of the land within the 500-year floodplain around Nolichucky Reservoir are pasture and cropland (33 percent), forests (28 percent), water (23 percent), and wetlands (12 percent; see Section 3.10). At present, developed areas represent about 3 percent of the 500-year floodplain around this reservoir. Most recent development in the area around Nolichucky Reservoir has occurred within a few miles of the dam.

Alternative A: No Action

Under this alternative, TVA would not take any action to resolve the potential flood impacts associated with the presence of the reservoir and the accumulated sediment. Greene County probably would use local flood ordinances to regulate the construction of homes and other structures within the 100-year floodplain around the reservoir but probably would not affect development in the remainder of the 500-year floodplain. Firms presently dredging sand from the reservoir would continue to do so, and this would help address the problems associated with accumulated sediment. Adoption of this alternative would not change the present population or economic status of the area around the reservoir.

Alternative B: Acquire Landrights

If this alternative were adopted, TVA would acquire fee title or the right to flood the approximately 1,100 acres of land now in private ownership within the 500-year flood boundary around Nolichucky Reservoir. Federal ownership or easement rights over all of the land within the 500-year floodplain and the removal or protection of flood-prone structures within this area would resolve concerns about possible flood risks associated with the reservoir. The presence of approximately 2,500 acres of public land or easement rights surrounding the reservoir probably would tend to encourage future development activities in the general area to shift away from the reservoir. Wildlife protection and controlled hunting would likely continue on an enlarged wildlife management area around the reservoir, and additional recreation facilities might be developed, possibly including an enlarged form of Kinser Park. Entities presently approved and dredging sand from the reservoir probably would continue to do so. These land use changes and potential increases in recreational opportunities would result in some direct and indirect increases in local income and, possibly, employment as they increase the overall attractiveness of the area. Over time, some land uses outside of the 500-year floodplain might shift from agriculture to residential development, resulting in some increases in land values.

The purchase of additional landrights in this area would have only minimal impacts on the present TVA in-lieu-of-tax payments. These additional federal landrights would have little or no impact on the total in-lieu-of-tax payments distributed to the state of Tennessee, and the state would likely make only a minimal increase in the redistribution to Greene County. Privately owned land that would be acquired by TVA would be removed from the local property tax rolls; however, land affected by easements would remain on the tax rolls.

Overall, adoption of this alternative would result in minor, positive long-term effects on the local economy. The potential changes in land ownership would result in lower property tax receipts, while the net impact on the local economy associated with likely increases in recreational use of the enlarged public land holdings probably would be modest and positive.

Alternative C: Lower Nolichucky Dam

As described in Section 2.6, construction activity associated with lowering the spillway and stabilizing or relocating sediment from the reservoir pool would occur over 5 to 10 years and would cost between $45 million and $70 million.

The size of the workforce would vary, but the peak would be about 35 to 50 workers when the spillway was being lowered. These employment levels would make up only a small addition to Greene County's economy, about 0.13 percent or less of the county's labor force. The construction earnings and local purchases of supplies and materials would provide some temporary additional economic benefits to the local area.

Lowering the water level and stabilizing or relocating sediment out of the reservoir pool would lower flood elevations upstream from Nolichucky Dam. This change would substantially reduce the potential flood risk on about half of the land presently within the 500-year floodplain around Nolichucky Reservoir. Private land within this area could be used for other purposes, including residential development. As indicated in Section 4.10, all federal land would remain in public ownership. Commercially useful sand deposits probably would not be available at the present sand dredging sites along the reservoir; however, large quantities of sand and sediment from the river would be readily available at one or more upland disposal sites.

The net impact of these changes on the local economy in terms of income and employment probably would be positive, especially over the long term. How much impact these changes would have on the local economy is highly uncertain, because each change would lead to decisions that would be made by many individuals and governmental agencies.

Alternative D: Remove Nolichucky Dam

Construction activity associated with removing the dam and powerhouse and stabilizing or relocating sediment would continue for as long as 12 years and would cost between $90 million and $150 million. The size of the workforce would vary, but the peak would be about 60 to 70 workers, somewhat larger than under Alternative C. Maximum employment levels would be a small net addition to the economy of Greene County, less than 0.19 percent of the county's labor force. The construction earnings and any local purchases of supplies and materials would provide temporary additional economic benefit to the local area.

As described in Section 2.8, removal of the dam and stabilizing or relocating sediment out of the reservoir pool would lower flood elevations upstream from the present dam site. This change would greatly reduce the potential flood risk on much of the land presently within the 500-year floodplain around Nolichucky Reservoir. Lowering the existing flood levels would make some private land within the present floodplain suitable for other uses and could result in additional residential development in this area. Federal land around the reservoir would remain in public ownership. Commercially useful sand deposits probably would not be available at the present sand dredging sites on the reservoir; however, large quantities of sand and sediment from the river would be readily available at a number of upland disposal sites.

The net impact of these changes on the local economy in terms of income and employment probably would be positive, especially over the long term. How much impact these changes would have on the local economy is highly uncertain, because each change would lead to decisions that would be made by many individuals and governmental agencies.

Comparison

Alternative A probably would maintain the present economic status in the area while each of the action alternatives would affect the local economy in slightly different ways. The increased federal landrights associated with Alternative B would provide flood relief for present landowners and more recreational opportunities that could lead to modest long-term economic benefits. Alternatives C and D would improve the development value of some private land now subject to occasional flooding but probably would lead to changes in the part of the local economy associated with recreation. The net impact of the three action alternatives (Alternatives B, C, and D) on the local economy probably would be positive; however, in each case the magnitude of the effects would vary depending on future decisions made by individuals and governmental agencies.

4.14 ENVIRONMENTAL JUSTICE

As discussed in Section 3.14, Greene County and the surrounding labor market area have very low minority populations but slightly higher poverty levels compared to other parts of Tennessee and the nation. In the immediate project area, the population is relatively sparse, scattered, and generally resides outside of the floodplain. According to the 2000 census, the census tracts on both sides of Nolichucky Reservoir have lower percentages of minorities and lower poverty levels than the county average. This is also true for the tracts on both sides of the river immediately below the dam, except that the poverty rate in the tract southeast of the river (Census Tract 911) is slightly higher than the county average.

All of the impacts associated with the action alternatives that would occur outside of the floodplain would be dispersed throughout the area and would not have any disproportionate effect on minority or low-income parts of the population. The activities that would occur within the floodplain under one or more of the alternatives would not have a disproportionate effect on minority or low-income parts of the population, because few people and low percentages of these racial and economic groups live there.

4.15 CUMULATIVE IMPACTS

Preceding sections in this chapter have discussed the potential effects of the alternatives on specific resource areas, generally considered from the perspective of one resource area at a time. This and the following three sections recognize the potential for overall effects of the alternatives, including the likely effects that could occur because of actions taken by others.

The analyses conducted while preparing this EIS indicate that there are very few ongoing or predictable future activities in the Nolichucky River watershed that could interact to produce cumulative impacts in the vicinity of Nolichucky Reservoir. As described throughout the document, these interacting activities include the ongoing reduction in sedimentation effects to the river related to upstream mining practices (primarily discussed in Sections 1.2 and 3.4), the related improvement in aquatic life in the river as the sediment load has declined (Section 3.5), the ongoing sand harvesting operations in upper Nolichucky Reservoir (Section 1.2), and the present quality of wetlands habitats that have developed on the sediment deposits in Nolichucky

Reservoir (Section 3.6). The cumulative effects of these related activities, including projections about long-term effects, are presented at the ends of the discussions of each alternative in Sections 4.4, 4.5, 4.6, 4.9, 4.10, 4.11, and 4.13. These discussions and the summaries presented in Section 2.9 adequately address the cumulative effects of these activities as they would be affected by each of the project alternatives.

4.16 UNAVOIDABLE ADVERSE IMPACTS

Each of the alternatives TVA could decide to take has the potential to cause some unavoidable adverse impacts. If TVA adopted Alternative A, the existing potential for adverse flooding effects on nonfederal land and property would remain, including the potential flooding effects on approximately 68 structures, 19 of which might be eligible for listing on the NRHP. Adoption of Alternative B would involve the potential for unavoidable adverse effects on the individuals who would have to sell either ownership or easements affecting their land within the 500-year floodplain around Nolichucky Reservoir, in addition to the potential for adverse effects on the structures within that floodplain. Adoption of Alternative C would result in the loss of approximately 318 acres of high-quality wetlands, a reduction in the size and recreational use on the reservoir, and the potential for sedimentation effects in the river downstream from Nolichucky Dam. Adoption of Alternative D would include all of the potential effects described under Alternative C, in addition to more severe effects on aquatic life downstream from the dam and the potential elimination of two endangered aquatic species. Under each alternative, some of these adverse effects could be reduced through mitigation measures; however, some unavoidable adverse effects probably would still occur.

4.17 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The intent of all four action alternatives would be to make long-term changes in the use of the land within parts of the area around Nolichucky Reservoir that would avoid adverse effects on nonfederal land and property. Adoption of Alternatives B, C, or D would provide long-term protection and stability for the land and property around the reservoir. Adoption of Alternative A could perpetuate present uses of the area; however, large floods could cause substantial losses in long-term productivity of the structures and facilities that have been built on the floodplain.

4.18 IRREVERSIBLE AND IRRETRIEVABLE RESOURCE COMMITMENTS

Adoption of Alternative A would not result in the irreversible commitment of land resources in the area; however, this alternative may result in allowing or encouraging individuals to make irretrievable commitments in homes and other structures that could be damaged or destroyed during future floods. Adoption of Alternative B may result in the irreversible and irretrievable commitment of an additional 1,060 acres of land, for a total over 2,500 acres in the 500-year floodplain around Nolichucky Reservoir, to flood protection. Much of this land probably would be available for public recreation, environmental education, and other uses compatible with occasionally being flooded. Adoption of Alternative C or D would result in the irreversible and irretrievable commitment of the fuel and other energy required lowering the dam and stabilizing or removing sediment from the existing reservoir pool. Much of the removed sediment probably could be sold and used for a variety of purposes.