CHAPTER 4

4.0 ENVIRONMENTAL CONSEQUENCES

Chapter 4: Environmental Consequences and Chapter 3: Affected Environment form the detailed scientific and analytic basis for the summary comparisons presented in Chapter 2, Section 2.2 Description of Alternatives.

Section 2.4 contains by alternative the predicted attainment and nonattainment of the purpose and need defined in Chapter 1. By resource, Chapter 4 presents the detailed predicted effects of implementing Alternative 1 - Do Not Build Additional Transmission Facilities (No Action) and Alternative 2 - Construct the Rutherford 500-kV Substation, 500-kV Transmission Line, and 161-kV Transmission Lines (Action).

4.1. Groundwater

4.1.1. Alternative 1 – No Action

Under the No Action Alternative, the Rutherford Substation, and the Maury, Almaville, and Christiana transmission lines would not be built and, therefore, no environmental impacts to groundwater would occur. Changes to groundwater would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.1.2. Alternative 2 – The Action Alternative

In general, there are several potential impacts to groundwater that could occur from substation and transmission line construction and maintenance. ROW clearing and site grading for structures, access roads, and substation components could create erosion. Sediments from this erosion could potentially clog sinkholes or springs. Sedimentation of springs can cause groundwater levels to rise artificially, while sedimentation of sinkholes can reduce groundwater levels. Alterations in land use and changes to surface water flow patterns can affect the inflow of water to a sinkhole and, depending on the type of sinkhole, can change sinkhole flooding response to storms (Bradley and Hileman 2006).

Herbicides that are applied to the ROW either for construction site clearing or to control vegetation for maintenance could contaminate groundwater resources. Some herbicides break down before entering the water table, but some are known to have a long residence time in groundwater. Impacts of newer herbicides on groundwater are unknown at this time. There is a wide range of human health effects that could occur when exposed to herbicides in drinking water.

Fertilizers that are applied to a project area to establish ground cover could leach into groundwater. Fertilizers contain nitrogen and phosphorous. Nitrogen in drinking water at levels above maximum contaminant levels is known to cause serious illnesses in infants. Phosphorous from fertilizers could affect the odor and taste of groundwater supplies.

A majority of the proposed project area is underlain by karst terrain. The proposed ROWs intersect a total of 68 karst features and a State Designated Source Water Protection Area. BMPs as described in Muncy (1999) would be used during the construction of the transmission lines and access roads to avoid many impacts on groundwater and to control

storm water runoff and sediment infiltration. Additional protection measures to springs associated with some of the sinkholes are described in Section 4.3 and Appendix J.

TVA applies herbicides in accordance with the manufacturers' labels. During revegetation and maintenance activities, application of herbicides and fertilizers should be avoided in the areas along the ROW where karst features occur to prevent groundwater contamination. In areas requiring chemical treatment, only USEPA-registered herbicides would be used in accordance with manufacturers' label directions and no herbicides with groundwater contamination warnings would be used in karst areas. BMPs dealing with herbicide and fertilizer application would also be followed to prevent potential adverse impacts to groundwater.

Oil and grease from transformers and other equipment could enter groundwater via soil accumulation or storm water runoff. This potential would be mitigated by TVA's standard use of oil containment facilities, which would prevent leaking transformer oil and other pollutants from entering groundwater.

With the use of TVA's BMPs and use of control measures normally applied by TVA, potential effects to groundwater quality would be insignificant.

4.1.2.1. Rutherford 500-kV Substation

The substation was sited at a location that avoids karst features. The use of BMPs and oil containment facilities would further help ensure that groundwater is not affected.

A septic system to serve the proposed substation would be built on the substation site. As described in Section 3.11, the soils on much of the substation site are suitable for a septic system. The TDEC regulates installments of septic systems, and its Subsurface Sewage Disposal Program involves permitting construction, inspection, and approval of underground septic systems for wastewater disposal in areas lacking wastewater treatment plants. As long as the septic system is designed, installed, and operated in accordance with state regulations, adverse impacts to groundwater from the septic system are unlikely.

4.1.2.2. Maury Transmission Line

Twenty-four karst features were identified along the Maury Transmission Line and are clustered in four large areas. To prevent impacts to groundwater, no herbicides with groundwater protection warnings would be used in these sections of the Maury Transmission Line between Double Branch and Double Branch Road, Greens Mill Road and Cornstock Road, and Cross Keys Flat to Boon Creek.

BMPs would be used in areas around sinkholes and other karst features to prevent sediment and storm water runoff from washing into groundwater entryways. A section of the proposed Maury Transmission Line ROW and two access roads are within a State Designated Source Water Protection Area. To prevent impacts to groundwater, no herbicides and no fertilizers would be used in the section of the Maury Transmission Line ROW from Windrow Road to Arno-Allisona Road.

4.1.2.3. Almaville Transmission Line

Sixteen sinkholes were identified along the Almaville Transmission Line ROW and access roads to the ROW. No herbicides with groundwater protection warnings and no fertilizers would be used in these sections of the Almaville Transmission Line from where the ROW

intersects the existing Murfreesboro-East Franklin Transmission Line, north to where the Almaville Transmission Line turns to the west.

BMPs would be used in areas around sinkholes and other karst features to prevent sediment and storm water runoff from washing into groundwater entryways. Minimal clearing and grading around large sinkholes and cave entrances, along with other BMPs, would be applied to prevent impacts to groundwater.

4.1.2.4. Christiana Transmission Line

Thirty-one karst features were identified along the Christiana Transmission Line ROW and access roads to the ROW. Seven of these are shared with the Maury Transmission Line. No herbicides with groundwater protection warnings and no fertilizers would be used in the section of the Christiana Transmission Line within 500 feet of the entrance to Nanna Cave.

Additionally, should groundwater conduits be discovered within the TVA transmission line ROW at a later date that affect the stream at Snail Shell Cave or Nanna Cave, TVA would modify its construction and maintenance procedures to eliminate herbicide use in the conduit areas.

BMPs would be used in areas around sinkholes and other karst features to prevent sediment and storm water runoff from washing into groundwater entryways. Minimal clearing and grading around large sinkholes and cave entrances, along with other BMPs, would be applied to prevent impacts to groundwater.

4.2. Surface Water

4.2.1. Alternative 1 – No Action

Under the No Action Alternative, the Rutherford Substation, and the Maury, Almaville, and Christiana transmission lines, and their associated access roads would not be built and, therefore, no environmental impacts to surface waters would occur. Changes to surface waters would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.2.2. Alternative 2 – The Action Alternative

Soil disturbances associated with access roads or other construction activities can potentially result in adverse water quality impacts. Erosion and sedimentation can clog small streams and threaten aquatic life. Removal of the tree canopy along stream crossings can increase water temperatures, algal growth, dissolved oxygen depletion, and adverse impacts to aquatic biota. Improper use of herbicides to control vegetation could result in runoff to streams and subsequent aquatic impacts.

TVA routinely includes precautions in the design, construction, and maintenance of its transmission lines and substations to minimize these potential impacts. Permanent stream crossings that could not be avoided would be designed not to impede runoff patterns and the natural movement of aquatic fauna. Temporary stream crossings and other construction and maintenance activities would comply with appropriate state permit requirements and TVA requirements as described in Muncy (1999). Transmission line conductors would span stream crossings, and canopies in all SMZs would be left undisturbed unless there were no practical alternative. For access to the ROWs during construction and maintenance activities, TVA would utilize existing paved or gravel roads or

farm roads to the greatest extent possible. ROW maintenance would employ manual and low-impact methods wherever possible. In areas requiring chemical treatment, only USEPA-registered herbicides would be used in accordance with label directions designed in part to restrict applications in the vicinity of receiving waters and to prevent unacceptable aquatic impacts. Proper implementation of these controls is expected to result in only minor, temporary impacts to surface waters. No cumulative impacts are anticipated.

4.3. Aquatic Ecology

4.3.1. Alternative 1 – No Action

Under the No Action Alternative, the Rutherford Substation and the Maury, Almaville, and Christiana transmission lines would not be built and, therefore, no environmental impacts to the aquatic ecology of the area would occur. Changes to aquatic ecology would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.3.2. Alternative 2 – The Action Alternative

Aquatic life could be affected by the proposed action either directly by the alteration of habitat conditions within the watercourses or indirectly due to modification of the riparian zone and storm water runoff resulting from construction and maintenance activities along the transmission line route. Potential impacts due to removal of streamside vegetation within the riparian zone include increased erosion and siltation, loss of in-stream habitat, and increased stream temperatures. Other potential construction and maintenance impacts include alteration of stream banks and stream bottoms by heavy equipment and runoff of herbicides into streams.

The proposed action may cause a temporary increase in sedimentation that could have an effect on aquatic animals adapted to riverine environments. Turbidity caused by suspended sediment can negatively impact spawning and feeding success of many fish species (Sutherland et al. 2002). Pollution resulting from silt deposits has been observed to destroy or greatly diminish crayfish populations in many localities in the eastern U.S. (Hobbs and Hall 1974). Likewise, mussel species adapted to a sand and gravel bottom environment cannot long survive in one composed of fine sediment and are quickly destroyed by silt that clogs the gills, smothering the animal (Parmalee and Bogan 1998).

In order to minimize potential impacts to aquatic life, BMPs as outlined in Muncy (1999) would be applied to all construction and maintenance activities.

Watercourses that convey surface water only during storm events (i.e., WWCs) and that could be affected by the proposed transmission line route would be protected by standard BMPs as identified in Muncy (1999). These BMPs are designed in part to minimize disturbance of riparian areas, and subsequent erosion and sedimentation that can be carried to streams. WWCs are included on transmission line design drawings, and protection of these areas is addressed through the storm water permitting process.

Two intermittent streams located on the proposed substation site would not need to be filled or rerouted around the site. However, a small farm pond on the site would be filled. TVA would acquire any necessary permits prior to this action (i.e., ARAP, 404). The intermittent streams do not support a persistent aquatic community or contain any unique or important aquatic habitat, and no notable aquatic community or habitat is present within the pond.

With the implementation of BMPs to minimize the potential for sediment transport downstream of these watercourses, no significant impacts would result to aquatic communities in this watershed.

Standard Stream Protection (Category A) would protect all perennial and intermittent streams along the proposed transmission lines as defined in Muncy (1999). This category of protection is based on the variety of species and habitats that exist in the streams as well as the state and federal requirements to avoid harming certain species (Appendices H and J). The width of the SMZs is determined by the type of watercourse, primary use of the water resource, topography, or other physical barriers (Muncy 1999). Of note, any perennial and intermittent streams crossed by the proposed transmission lines listed on the TDEC 2006 303d list (TDEC 2006) would receive a minimum 60-foot buffer as outlined in the TDEC General NPDES Permit (TDEC 2005). Since appropriate BMPs and SMZs would be implemented during construction, operation, and maintenance of the proposed transmission lines and substation, any impacts to aquatic life resulting from the proposed action would be insignificant.

4.4. Vegetation

4.4.1. Alternative 1 – No Action

Adoption of the No Action Alternative would not result in any project-related impacts to the terrestrial ecology of the region since terrestrial communities would not be modified in any way if no actions were taken. Terrestrial communities would vary over time as other factors such as human population, land use and development, and recreational patterns change within the area.

4.4.2. Alternative 2 – The Action Alternative

4.4.2.1. Rutherford 500-kV Substation

Adoption of Alternative 2, the Preferred or Action Alternative would permanently remove vegetation on much of the Rutherford Substation site and would alter vegetation on virtually the entire site. However, this conversion would not significantly impact the local or regional ecology because no uncommon or high-quality terrestrial plant communities occur on the substation site; over 95 percent of the substation site is highly disturbed herbaceous vegetation.

4.4.2.2. Maury, Almaville, and Christiana Transmission Lines

Adoption of the Action Alternative would result in the clearing of approximately 370 acres of forested land to accommodate the proposed new Maury, Almaville, and Christiana transmission lines. This construction of new transmission lines would result in a marginal increase in cumulative impacts to forest area when considered with population growth in the region. A substantial portion of the forested areas that would be cleared is currently mature forest that would be converted to acreage with herbaceous and shrubby vegetation.

The central portion of Tennessee, where the transmission lines would be built, has experienced a small increase in forest cover between 1989 and 2005. The increase is around 6 percent or approximately 150,000 acres (Miles 2007). Because of inherent error involved in statistical sampling, the actual acreage of forest cover change may be slightly larger or slightly smaller. The vast majority (>99 percent) of the forest that has regenerated in Central Tennessee since 1989 has done so naturally and has the potential to become

diverse, mature forest comparable to that which would be lost to accommodate the new transmission lines.

Increases in forest cover in Central Tennessee have diminished since the late 1990s resulting in no significant change in forest acreage from 1999 to 2005. In the near future, it is likely that blocks of forested land would be converted to other land uses in response to population growth, but it is uncertain if these reductions in forest area would appreciably impact regionwide trends in forest cover.

Rare plant communities located in the immediate project area are associated with limestone glades and include the Southern Limestone Glade Margin Shrubland, Interior Low Plateau Limestone Glade Ephemeral Pool, Limestone Annual Grass Glade, and the Limestone Seep Glade. All of these glade communities are considered globally rare (NatureServe 2007; Appendix L).

The Southern Limestone Glade Margin Shrubland occurs along the edges of glades where the soil is somewhat deeper and able to support shrubs rather than just grasses. This community type was observed in two glade areas along the proposed Maury Transmission Line route, in one large area along the proposed Almaville Transmission Line route, and in three areas found within the proposed Christiana Transmission Line ROW. This shrubland type is more stable than some other glade communities; it is threatened by development and land use conversion.

The other three rare communities are dominated by grasses and/or herbs and typically have few to no shrubs or trees. The Interior Low Plateau Ephemeral Glade Pool occurs in thin soil areas, which are wet in the winter and spring, but are generally dry in the summer. Three areas of this community type were observed within the proposed transmission line routes including one in the proposed Maury Transmission Line route and two within the proposed Christiana Transmission Line route. This community type may cover large areas and is more stable than some other glade communities, The Limestone Annual Grass Glade plant community occurs in very thin soil areas over limestone where there is not sufficient soil to support a dominant cover of perennial grasses or woody plants (NatureServe 2007). This rare community occurs in several areas within the proposed transmission line route including two glade areas on the proposed Maury Transmission Line route, one glade area on the proposed Almaville Transmission Line route, and two glade areas on the proposed Christiana Transmission Line route. Due to limited succession that occurs on the thin soils associated with this habitat, it is relatively stable. The Limestone Seep Glade community is the rarest and most fragile of the community types observed. This community is supported by nearby limestone seeps accounting for wet conditions during winter and spring and occurs in two areas on the proposed Maury Transmission Line route and two areas on the proposed Almaville Transmission Line route. All occurrences of this rare glade community contain endangered or threatened plant species.

Limestone glades are threatened by development and land use conversion and large areas of glades have been lost in recent decades (NatureServe 2007). This has resulted in several glade types becoming rare and contributed to the endangered or threatened status of several plants occurring in glades. Potential impacts from transmission line construction and operation include the elimination of vegetation during initial ROW clearing, soil compaction by construction equipment, introduction of invasive species, and elimination of native vegetation during ROW maintenance activities. TVA would take several measures during transmission line construction and maintenance to minimize these potential impacts.

These include avoiding placing transmission structures on the glades, restricting vehicle access, use of native and/or nonnative, noninvasive species during revegetation, and restrictions on the use of herbicides. These measures are described in detail below in Section 4.4.2.3 and specific measures for minimizing impacts to endangered and threatened species occurring on the glades are described below in Section 4.6.2.

4.4.2.3. Summary of Impacts and Proposed Mitigation Measures

The construction and operation of the proposed substation and transmission line would result in the long-term clearing of about 370 acres of forest. About 3 acres of forest would be permanently removed from the substation site, and the 367 acres of forest cleared from transmission line ROWs would be maintained in an early successional state. The majority of this forested area is oak-hickory and maple-dominated forest types, which are common in the region. Although the clearing would increase the fragmentation of adjacent forests, regional impacts would not be significant.

The nonforested portion of the substation site is primarily pasture, which would be permanently cleared and converted to an industrial site. The nonforested portions of the proposed transmission line ROWs are a combination of pasture, cropland, and brushy fields. These areas would continue to be maintained in an early successional state, and there would be little long-term impact on their vegetation. Other nonforested areas on the transmission line ROWs are limestone glades, some of which are considered globally rare. TVA would implement the following mitigation measures to minimize impacts to these areas. With implementation of these measures, impacts to vegetation are expected to be insignificant.

- Globally rare glade habitat areas would be marked on the transmission line and access road engineering design specification drawings that would be used during the design, construction, and maintenance activities along the transmission line.

- During the construction and maintenance of the transmission lines, TVA would avoid the areas associated with the globally rare glade habitats. Unless there is no practical alternative, structures placement would be designed strategically to avoid these areas. Additionally, unless there is no practical alternative, access roads, and the associated vehicle traffic would be excluded from these areas along the ROW. These areas would be fenced during construction to ensure further avoidance.

- Vegetation management in the globally rare glade habitats would be accomplished through mechanical clearing, and no herbicides would be used.

- TVA would minimize the invasion of invasive exotic plant species into areas currently free of invasive plants by revegetating disturbed sites with seed mixtures determined by TVA botanists to consist of native and/or nonnative, noninvasive plant species.

4.5. Wildlife

4.5.1. Alternative 1 – No Action

Under the No Action Alternative, the proposed transmission lines, substation, and associated access roads would not be constructed. Therefore, there would be no project-related impacts to wildlife or their habitats. Changes to wildlife would nonetheless occur over time as other factors such as population trends, land use and development, quality of

air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.5.2. Alternative 2 – The Action Alternative

Construction of the proposed transmission lines, substation, and associated access roads would result in a change in the composition of wildlife habitats along the length of the routes and at the substation site. Most forested habitats and other woody vegetation would be removed, and would be converted and maintained as early successional habitats. The initial clearing would likely temporarily displace larger animals, such as deer and turkey, from the project area into nearby areas. Some smaller less mobile animals occupying the areas to be cleared, such as mice, shrews, frogs, and salamanders, would be impacted by construction activities. Following the construction and revegetation of the previously forested areas, wildlife favoring forest edges and early successional habitats would occupy the areas, changing the overall species composition to more early successional species and less forest species.

Environmental effects resulting from the proposed actions are expected to include the loss of approximately 370 acres of forested habitat, increased fragmentation of remaining adjacent forests, and an increase in both early successional and edge habitats within the proposed project area. The increase in early successional and edge habitats would benefit early successional species and species that tolerate disturbance well. The loss of forest habitats in the proposed project area and further fragmentation of adjacent forested areas would negatively affect forest wildlife and species dependent on forest-interior habitats. However, most of the forested habitats in the project area are already largely fragmented, with the exception of a large area of contiguous forest occurring in the vicinity of Scales Mountain, Indian Mountain, and the proposed Almaville Transmission Line.

Ten caves have been recorded within 3 miles of the various project components. Three of the caves are entrances to the extensive Snail Shell Cave System, and four additional entrances to this cave system also occur in the vicinity. Another small cave was found within 50 feet of the Maury Transmission Line route during field investigations. Numerous karst features, such as sinkholes, also exist within the project area.

4.5.2.1. Rutherford 500-kV Substation

The close proximity of early successional herbaceous, grassland, and shrub habitats, a wetland, and a small forested area creates a diverse environment that hosts numerous wildlife species. Adoption of the Action Alternative would permanently remove the existing vegetation on much of the 53.1 acres, and replace it with large expanses of graveled areas and smaller areas of mowed lawn. Although a diverse community of terrestrial animals uses this mixture of habitats, the effects on wildlife from this conversion would not be significant as the site is already highly disturbed and modified, and similar habitats occur in abundance within the surrounding landscape. Animals inhabiting the proposed substation site would move to adjacent habitat during construction activities, while some less mobile animals may be destroyed. Wildlife observed on site are common and representative of the region, and no direct or indirect significant impacts to wildlife or their habitats are expected.

There are no caves, heron colonies, or other unique terrestrial animal habitats on the proposed substation property. These features would not be affected by the proposed construction and operation of the substation.

4.5.2.2. Maury Transmission Line

The conversion along this route of 190 acres of forest to early successional habitat would result in a change in wildlife habitat and subsequently the species composition along the length of the transmission line route. However, the changes are not expected to be significant, as 70 percent of the proposed Maury Transmission Line route is already early successional, 23 of the proposed access roads are already existing (four extending through portions of pasture or agricultural fields to reach the ROW), and the remaining forested habitat is largely fragmented. The forest conversion and resulting fragmentation would not be significant but would lead to an increase in early successional species. Larger, more mobile species occurring in forests would be displaced into the adjacent forest habitat and less mobile species would likely be eliminated. Because of the heavily fragmented nature of the forests along this route, the impacts on area-sensitive forest species, including several Neotropical migrant songbirds, would be small. Wildlife observed on this section are common and representative of the region, and no direct or indirect significant impacts to wildlife or their habitats are expected.

All known caves in the vicinity, with one exception, are more than 0.5 mile from the proposed Maury Transmission Line route. The exception is a newly discovered cave with an out-flowing stream located within the ROW. Although the stream downstream of the cave provides habitat for several amphibians, the cave itself is small and likely floods during rain events. This type of cave typically does not support unique or rare terrestrial cave organisms. The use of BMPs (Muncy 1999) would reduce potential impacts to the stream emerging from this cave. Several karst features and sinkholes were located along this proposed route, but none appeared capable of harboring unique or rare animals. The change in habitat around these areas would not significantly affect area wildlife.

4.5.2.3. Almaville Transmission Line

The conversion along this route of 68 acres forested habitat to early successional habitat would result in a change in wildlife habitat, and subsequently species composition, along the length of the transmission line route. Approximately 80 percent of this proposed route is forested, and the conversion of this habitat to early successional habitat would displace animals found in forested habitat into adjacent forested habitat. It would also create habitat for animals that use early successional habitat. Although much of the landscape surrounding this proposed route is similar to the proposed Maury and Christiana Transmission Line routes and many of the forested areas are largely already fragmented, a large area of relatively contiguous forest exists near the intersection of this line with the existing Murfreesboro-East Franklin Transmission Line in the vicinity of Indian Mountain and Scales Mountain. Some species, including several Neotropical migrant songbirds, are dependent on large forested areas and are negatively affected by forest conversion. Although the population and diversity of these area-sensitive forest species are higher in this area than in other parts of the project area, they are not high on a regional basis, and the impacts would not be significant. Conversely, several species that require early successional habitats would benefit from the increase in this habitat type along the proposed route. Most species that would be affected by these changes are locally and regionally common and would not be significantly impacted. Increased fragmentation of these habitats would be insignificant, and no direct or indirect significant impacts to wildlife or their habitats are expected. Proposed access roads for this segment are either on existing roads or extend through areas previously converted to early sucessional habitat (pasture) and thus are not expected to significantly impact wildlife or their habitats.

All cave records are greater than 2 miles from this proposed transmission line route, and no additional caves were observed. Several karst features and sinkholes were located along this proposed route. There were no significant features capable of harboring unique or rare animals. The change in habitat around these areas would not significantly affect area wildlife.

4.5.2.4. Christiana Transmission Line

The conversion along this route of 109 acres of forested habitat to early successional habitat would result in a change in wildlife habitat composition, and subsequently species composition, along the length of the transmission line route. Approximately 60 percent of the habitat along this proposed route is forested, and the conversion to early successional habitat would displace animals found in forested habitat into adjacent forested habitat. The proposed action also creates favorable habitat for animals that use early successional habitat. The landscape surrounding this proposed route is similar to the proposed Maury Transmission Line route and forested habitats are already largely fragmented. The forest-dependent species are not currently supported by the present forest habitat and would not be impacted. Proposed access roads for this section are either on existing roads or extend through early successional habitat or agricultural fields and are not expected to significantly impact wildlife or their habitats.

Unique features located along this proposed route include two vernal pools used by breeding amphibians, numerous sinkholes, and other karst features. The vernal pools may dry faster when converted to early successional habitat and may no longer be suitable for breeding amphibians. Although no other vernal pools were found in the immediate vicinity, the loss of the vernal pools would not affect overall amphibian populations. None of the sinkholes or karst features are significant features capable of harboring unique or rare animals. The change in habitat around these areas would not significantly affect area wildlife.

Caves are an important terrestrial feature, as they provide a unique habitat for numerous species of invertebrates, mammals (especially bats), amphibians, and some reptiles. Seven entrances to the extensive Snail Shell Cave System, and five additional caves not part of the cave system, occur within 3 miles of the proposed Christiana Transmission Line route. The latter five caves would not be impacted by the proposed transmission line. With the exception of Nanna Cave, the seven entrances to the Snail Shell Cave System are 0.2 mile or greater from the proposed actions and would not be disturbed. The edge of the transmission line route as originally proposed was located approximately 65 feet from the entrance to Nanna Cave. With adjustments to the transmission line route designed to minimize the potential for impacts, the closest edge of the ROW would be approximately 150 feet from the Nanna Cave entrance. With this distance and the mitigation measure listed below, as well as the mitigation measures listed in Section 4.1.2, no project-related impacts to the Snail Shell Cave System and Nanna Cave are anticipated.

4.5.2.5. Summary of Impacts and Proposed Mitigation Measures

The construction and operation of the proposed substation would result in the permanent elimination of about 3 acres of young forest, about 50 acres of pastures, and a pond. These wildlife habitats are abundant in the region and the effects on wildlife would be insignificant.

The construction and operation of the proposed transmission lines would result in the long-term conversion of about 357 acres of forest and increase the fragmentation of adjacent

forested areas. This would eliminate habitat for many forest-dependent wildlife species and reduce the suitability of remaining adjacent forested areas for species requiring extensive contiguous forests, including several Neotropical migrant birds. Most of the forests in the area are already fragmented. The largest affected contiguous forest areas are along the proposed Almaville Transmission Line.

Conversely, the increase in early successional habitats within the maintained ROWs would benefit many wildlife species dependent on this habitat. The construction and use of the proposed access roads would also not reduce the amount of suitable wildlife habitat, as most roads require no major improvements or expansions.

Several caves, some of which contain significant wildlife populations, occur in the project area. Most of these would not be affected. One significant cave system that could be affected is the Snail Shell Cave System; its Nanna Cave entrance is near the proposed Christiana Transmission Line. The following mitigation measure would reduce potential impacts to this cave system; with its implementation and implementation of the mitigation measures listed in Section 4.1.2, no adverse impacts to caves would occur.

- During construction and maintenance activities, no herbicide spraying or mechanical clearing would occur within a 500-foot radius of the entrance to Nanna Cave. This area would be hand cleared only (chainsaws may be used, but not heavy equipment) to prevent pollution effects resulting from chemicals and sediment erosion from disturbed soil. All vehicles and heavy equipment are restricted from the area unless confined to existing access roads. If the placement of a pole in this buffer or in the area of this route crossing a subterranean section of the Snail Shell Cave System was unavoidable, no blasting would be used during its installation.

4.6. Endangered and Threatened Species

4.6.1. Alternative 1 – No Action

Under the No Action Alternative, TVA would not undertake the proposed actions to address the transmission system problems and the resulting impacts to endangered and threatened species resulting from the Action Alternative would not occur. The status and conservation of the potentially affected listed species and critical habitats would continue to be determined by the actions of others. Changes to endangered and threatened species and their habitats would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.6.2. Alternative 2 – The Action Alternative

Implementation of this alternative would affect several federally and state-listed species and their habitats. These impacts are described below for aquatic animals, terrestrial plants, and terrestrial animals.

4.6.2.1. Aquatic Animals

4.6.2.1.1. Maury Transmission Line

The proposed Maury Transmission Line would cross Rutherford Creek 4.75 miles upstream of its junction with the Duck River. This portion of the Duck River is DCH for the Cumberlandian combshell and oyster mussel. Additionally, four federally listed as endangered species—the birdwing pearlymussel, Cumberland monkeyface, orange-foot

pimpleback, and the tan riffleshell—and two federally listed candidate species—the rayed bean and slabside pearlymussel—occur in the Duck River downstream of its confluence with Rutherford Creek and could potentially be affected as a result of construction and maintenance activities. However, because BMPs and SMZs would be implemented, any effects on federally or state-listed species as a result of construction or maintenance activities along the Maury Transmission Line would be short term and insignificant. With the implementation of TVA's standard BMPs and SMZs the construction, operation, and maintenance of this transmission line is not likely to adversely affect the above listed species or DCH.

4.6.2.1.2. Almaville Transmission Line

The salamander mussel, a state-listed mussel, is a historical record and is most likely extirpated from the state (Parmalee and Bogan 1998). The federally listed as endangered Nashville crayfish is only known from the Mill Creek system in Davidson County and northern Williamson County. The Almaville Transmission Line would not cross any streams in the Mill Creek system. Therefore, no impacts would occur to these species.

Clearing of riparian vegetation and soil disturbance associated with construction of stream crossings and other construction or maintenance activities have the potential to result in runoff entering watercourses in the Almaville project area. This could affect the tan riffleshell, a federally listed as endangered mussel, and the rabbitsfoot, a state-listed mussel, both of which occur in a project area watershed. However, because TVA's standard BMPs and SMZs would be implemented, any impacts to federally or state-listed species as a result of construction, operation, and maintenance of the Almaville Transmission Line would be short term and insignificant and are not likely to adversely affect the tan riffleshell or rabbitsfoot.

4.6.2.1.3. Christiana Transmission Line

The federally and state-listed aquatic species that could potentially be affected as a result of the construction, operation, and maintenance of the Christiana Transmission Line are the same as along the Almaville Transmission Line. Potential impacts are expected to be similar to those described for the Almaville Transmission Line.

4.6.2.2. Terrestrial Plants

4.6.2.2.1. Rutherford 500-kV Substation

A population of water stitchwort was identified in a 0.49-acre wetland on the proposed substation site. Over 60 other occurrences of this state-listed species occur in Tennessee. The current number of populations in the state is considerably higher than in 1993 when water stitchwort was ranked S1 (extremely rare or critically imperiled in the state with five or fewer occurrences). Most of the known populations were discovered during a concerted search for water stitchwort in 1993 (McKerrow and Shea 1993). In addition, the habitat requirements for the species are broader than originally thought. The 1993 search focused on seepage areas associated with rivers and creeks in Tennessee, a somewhat different habitat than the occurrences found during this survey. The presence of the species in heavily disturbed wetlands such as on the proposed substation site, as well as in similar habitats elsewhere in the state, suggests the species occupies a broader range of habitats than assumed in 1993 and that its survival in the state is not threatened. The 0.49-acre emergent wetland would be spanned by the transmission lines entering the Rutherford 500-kV Substation and, thus, this population is not expected to be affected. Additionally,

because of the increase in water stitchwort records and the ability of the species to occupy a less specific habitat than previously thought, any impacts that potentially could occur to this population on the proposed substation site would not significantly affect the status or survival of the species in the state.

4.6.2.2.2. Maury Transmission Line

The proposed Maury Transmission Line would pass through five separate areas inhabited by state-listed plants. No federally listed plants occur within or immediately adjacent to the proposed ROW.

The first area is an open forest containing a stand of the toothache tree. Toothache tree is a thicket-forming shrub or small tree that reproduces vigorously through root sprouts and is tolerant of a variety of light conditions. The majority (approximately 80 percent) of the population is in the proposed ROW and would be disturbed by construction. There are eight other occurrences of this state-listed species in Tennessee, all of which are in the Nashville Basin. Six of the toothache tree occurrences are described as containing “few” to “dozens” of stems, and two occurrences are described as having “numerous” and “hundreds” of stems. All of these records indicate the populations occur on previously disturbed sites; this suggests the toothache tree is tolerant of some disturbance. With implementation of the mitigation measures listed below in Section 4.6.3, the population within and adjacent to the ROW would not be significantly impacted. This determination is based on the fact that about 20 percent of the population is outside of the ROW and would not be disturbed, and because of the colonial nature and vigorous resprouting of the plant, the portions of the population that would be cut back during construction and maintenance would likely continue to resprout from the roots.

The four other areas where state-listed plants were observed are all limestone glades. Several limestone glades with state-listed plants such as limestone fameflower, water stitchwort, Tennessee glade-cress, and yellow sunnybell are located within the proposed transmission line route. Implementation of the mitigation measures listed below in Section 4.6.3 would minimize impacts to these state-listed plants.

A portion of one occurrence of Tennessee glade-cress extends along the gravel shoulder of an existing, improved road and may be impacted by clearing and transmission line construction if the road is used to access the ROW. Another portion of this occurrence is located in a cedar glade within the ROW and would be protected by the mitigation measures described in Section 4.6.3. Individual plants along the road would be directly impacted by TVA vehicles driving across the shoulder to access the ROW. Effects would be negative, but it is unclear if the damaging impact would be long term because Tennessee glade-cress can inhabit disturbed areas and would be capable of recolonizing the road shoulder after construction provided the gravelly nature of the site is not altered. Since the existing road shoulder is gravel and currently receives some vehicle traffic, it is reasonable to assume that a temporary increase in vehicle traffic to access the ROW would not alter the roadside to the extent that this portion of the glade-cress occurrence would be permanently eliminated. Because less than half of the total occurrence of this plant at this location would be impacted by the access road, any impacts to Tennessee glade-cress on a state-level would not be significant.

Botanical surveys of Maury Transmission Line access roads conducted in February 2008 identified one new area that contains gladelike habitat capable of supporting several different state- and federally listed plant species. Since the area was surveyed during the

winter when most plant species were not visible above ground, additional surveys would be conducted during the growing season before TVA would make any improvements to the road. If listed species were found, implementation of the mitigation measures listed below in Section 4.6.3 would minimize impacts such that they would not be significant.

4.6.2.2.3. Almaville Transmission Line

Adoption of Alternative 2 would result in transmission line construction through two separate limestone glades with the state-listed yellow sunnybell. Implementation of the mitigation measures listed below in Section 4.6.3 would minimize impacts to yellow sunnybell.

The Almaville Transmission Line ROW would occupy approximately 3.8 acres of the 469 acres of DCH for Braun's rock-cress on the western knobs of both Scales and Indian Mountains. TVA determined that conversion of forest to ROW along the Almaville Transmission Line portion of proposed transmission line crossing DCH would not adversely modify primary constituent elements to the extent that the value of critical habitat would be appreciably reduced.

This determination of no adverse modification was based primarily on the lack of soil moisture necessary to support populations of Braun's rock-cress in the proposed ROW within DCH on Scales Mountain and Indian Mountain. The proposed ROW within the DCH has a southeastern and southwestern aspect; populations of Braun's rock-cress in the vicinity almost exclusively occupy mesic, north-facing slopes. This difference is important because north-facing slopes are richer and have higher soil moisture content than south-facing slopes. All known occurrences of Braun's rock-cress occurring on knobs in Rutherford County are located on or near Bigby-Cannon Limestone outcrops. Most of the proposed ROW within DCH on Scales Mountain and all of the proposed ROW within DCH on Indian Mountain occur on bedrock geology other than Bigby-Cannon Limestone, making future colonization of these areas by Braun's rock-cress unlikely even if the transmission line were not constructed. The combination of southerly exposure and bedrock geology along the proposed ROW is not consistent with the habitat preferences illustrated by known populations of Braun's rock-cress in Rutherford County, Tennessee.

An invasive exotic species, tree-of-heaven, is located within the proposed ROW near a population of Braun's rock-cress on Scales Mountain. Tree-of-heaven is a potential threat to the nearby Braun's rock-cress population, as the species can be impacted by invasive species (USFWS 2004). The proposed ROW clearing could worsen the tree-of-heaven problem and increase the risk to the nearby Braun's rock-cress. The mitigation measure on treatment of tree-of-heaven would minimize the potential impacts to Braun's rock-cress.

4.6.2.2.4. Christiana Transmission Line

Adoption of Alternative 2 would result in transmission line construction through nine separate areas inhabited by state-listed species. Three forested areas containing the state-listed Canada lily would be affected by the conversion to a nonforested ROW. Impacts to Canada lily as a result of the conversion are difficult to determine because the species can also occur in open areas if sufficient water were present. Mitigation measures would be used to avoid ground disturbance in the immediate vicinity of the lily occurrences, so that no direct damage would occur to these occurrences. Since the plants did not appear to be reproducing under current conditions found at each site, it is conceivable that the removal of forest canopy could produce favorable conditions that would enhance the occurrences. It is equally possible, however, that the increased sunlight associated with canopy removal,

along with the introduction of aggressive, early successional species, could cause greater stress on the Canada lily plants than that found under current conditions. Assuming that the plants are removed by transmission line construction or that they do not survive following construction under the new habitat conditions, impacts at the state level to the Canada lily would be considered insignificant because over 70 occurrences are known from Tennessee.

A previously unreported occurrence of limestone fameflower was observed in a limestone glade occurring within the proposed transmission line ROW just east of Dyer Cemetery. Implementation of the mitigation measures described below in Section 4.6.3 would minimize impacts to these four occurrences of state-listed Canada lily and limestone fameflower.

A large occurrence of Alabama snow-wreath occurs in and adjacent to the ROW along the Christiana Transmission Line route. The occurrence has tens of thousands of stems over several acres and is among the largest known occurrences of the species. TVA has rerouted the original proposed transmission line segment to minimize impacts to this occurrence. Construction of the rerouted section of transmission line would result in cutting several hundred stems over an area of a few hundred square feet that occur near the edge of the proposed ROW. However, the redesign of the transmission line route would avoid the vast majority of the Alabama snow-wreath population. Much of the occurrence occurs in vigorous patches along a field edge, and it is likely the Alabama snow-wreath plants that are cut during construction would resprout and colonize wooded areas along the edge of ROW after construction is complete. With the implementation of mitigation measures described below in Section 4.6.3, no adverse impacts to this state-listed plant occurrence are anticipated,

Small populations of limestone fameflower and Tennessee milk-vetch occur in an area of open woods and rock outcrops along the proposed Christiana Transmission Line. These populations each have less than five individuals of each species and would likely be impacted by the proposed construction activities. Elimination of these small populations, however, would not significantly impact the viability of either species in Tennessee. The limestone fameflower and Tennessee milk-vetch are known from 135 and 247 localities in Tennessee, respectively, and many of these documented populations consist of hundreds of individual plants.

A large cedar glade complex containing the state-listed species glade-cress, limestone fameflower, and Tennessee milk vetch occurs within the proposed transmission line route. Implementation of the mitigation measures described in Section 4.6.3 would minimize impacts to these occurrences of rare plant species.

The federally listed endangered Pyne's ground-plum occurs just outside the proposed Christiana Transmission Line ROW. The transmission line was rerouted to avoid crossing the population. TVA determined that the construction and maintenance of the transmission line near this population would not adversely impact the species. This determination is based on the known habitat preferences of Pyne's ground-plum (Section 3.6.2), and implementation of the mitigation measures described below in Section 4.6.3. Pyne's ground-plum prefers the edges of limestone glades and would not be adversely affected by openings created by transmission line ROW construction.

Botanical surveys of Christiana Transmission Line access roads conducted in February 2008 identified two new areas that contain gladelike habitat capable of supporting several different federally and state-listed plant species. Since the areas were surveyed during the winter when most plant species were not visible above ground, additional surveys would be conducted during the growing season before TVA would make any improvements to the access roads. If listed species are found, avoidance and/or implementation of the mitigation measures listed below in Section 4.6.3 would minimize impacts such that they would not be significant.

4.6.2.2.5. Cumulative Impacts

Central Tennessee is one of the faster growing areas in the United States. Between April 1, 2000, and July 1, 2006, the population in Rutherford, Williamson, and Maury counties has increased by 25.7 percent, 27.0 percent, and 12.7 percent, respectively (U.S. Census Bureau 2007). The average growth rate for the state as a whole during the same time period is 6.1 percent. This level of population growth is associated with large-scale development that converts natural areas to other land uses. Annual residential building permits have increased by over 53 percent in Rutherford and by more than 39 percent in Williamson County between 2000 and 2006 (U.S. Census Bureau 2006). Conversion of natural areas for development in Central Tennessee has had harmful effects on rare communities and species because habitat is permanently lost. Federally listed plants occurring in this area that have “development” cited as a risk to survival of the species include Braun’s rock-cress, leafy prairie-clover, Spring Creek bladderpod, and Tennessee coneflower (USFWS 2006, 1997, 1996, 1989).

TVA activities associated with construction and maintenance of transmission lines and the substation in Rutherford, Williamson, and Maury counties do occur in and around areas that contain federally and state-listed plant species. All transmission line ROW, substation, and access road areas with listed species, including the federally listed Pyne’s ground-plum and Braun’s rock-cress, have been thoroughly surveyed by TVA. Two areas of gladelike habitat along ROW access roads will undergo additional surveys to confirm that these species have not been missed. Protective measures in the form of BMPs and implementation of commitments have been put in place to minimize significant contributions to cumulative impacts for endangered and threatened plants in the region.

Construction of transmission lines through previously inaccessible natural areas may facilitate access to sensitive sites. Most sites containing rare limestone glade communities and listed plant species currently occur in areas where access is difficult. Transmission line ROWs frequently serve as off-road vehicle trails. Construction of ROWs along the proposed Maury, Almaville, and Christina routes could indirectly impact glades and glade species by increasing off-road vehicle damage and associated disturbances (dumping, invasive weed introduction, etc.). The additional impacts to glades would be relatively small and insignificant compared to conversion of limestone glade habitat spurred by foreseeable population growth in the region.

4.6.2.3. Terrestrial Animals

The proposed action has the potential to affect two federally listed terrestrial animals, the gray bat and the Indiana bat, and at least three state-listed species, the Tennessee cave salamander, the lark sparrow, and the Allegheny woodrat, as well as a species considered rare in Tennessee, the Echo Cave beetle. The anticipated impacts to each of these

species is described below for each of the major project components and then summarized for the total project.

The Tennessee cave salamander and the Echo Cave beetle both occur in the Snail Shell Cave System. The proposed Christiana Transmission Line and associated access roads would not affect habitat for these species in this cave system. Both species have specific habitat requirements, and although several other caves and numerous karst features and sinkholes occur within the project area, none provide suitable habitat for either species. The Action Alternative would not impact either species.

Although not recorded or observed in the project area, suitable habitat exists for both the Allegheny woodrat and the lark sparrow in areas along all three proposed transmission lines. The proposed actions would not prevent Allegheny woodrats from using the abundant karst features in and near the project area. Likewise, the proposed actions would not destroy cedar glade habitat preferred by lark sparrows in the vicinity and would likely provide more open and frequently disturbed habitat used by this species. Therefore, the proposed actions would not adversely impact populations of either species.

The gray bat is restricted to roosting in specific cave habitats, but forages over streams and rivers up to 22 miles from their roosts (La Val et al. 1977). Gray bats have been reported from three caves within 8, 13, and 14 miles from the project area. Several other caves occur in the vicinity, and numerous other karst features including sinkholes, were located in the project area. Although not previously reported from the Snail Shell Cave System, there is potential habitat for this species. The Snail Shell Cave System occurs near the Christiana Transmission Line. Potential foraging habitat for gray bats exists over several streams and rivers crossing the three transmission line routes. BMPs would be used during construction and maintenance activities at these aquatic features, and the proposed transmission line crossings of these streams and rivers would not affect this foraging habitat for gray bats. The Action Alternative would not significantly affect gray bats or their habitat.

Indiana bats use caves during hibernation and roost under the exfoliating bark of trees during the rest of the year. There are currently no caves used by Indiana bats near the proposed project area. One cave located 14 miles southwest of the proposed Maury Transmission Line route was previously thought to contain Indiana bats. Examination of the initial report and results of more recent surveys (Harvey and Britzke 2002) indicated that this cave was not previously and currently is not used by Indiana bats. However, six areas with moderately suitable forest habitat on all three transmission line routes provide potential roosting habitat for this bat. Because the removal of trees from areas of moderately suitable habitat would occur, this project would have the potential to impact Indiana bats. However, if timber harvesting of the six areas of moderately suitable habitat were restricted to October 15 through March 31, the season when Indiana bats are absent, this risk would be eliminated.

4.6.2.3.1. Rutherford 500-kV Substation

No suitable habitat for Indiana bat, gray bat, Tennessee cave salamander, Echo Cave beetle, or Allegheny woodrat exists within the proposed substation footprint, and no records are known from within 3 miles of the proposed substation. The construction and operation of the substation would not affect any of these species. The site may provide habitat of marginal quality for the lark sparrow, and any impacts to this species would be insignificant. No other federally or state-listed terrestrial animal species would be affected.

4.6.2.3.2. Maury Transmission Line

No suitable habitat for Tennessee cave salamander or Echo Cave beetle exists in the proposed Maury project area. Although a small cave was found within the proposed Maury Transmission Line ROW, the small size of the cave and certainty that it likely floods with each rain event make it unsuitable habitat for terrestrial cave-dwelling species such as bats and the Allegheny woodrat. All other caves are located greater than 1 mile away. Therefore, the construction and operation of the Maury Transmission Line would not affect these cave species. While there is no roosting habitat for gray bats in this section of the project area, foraging habitat occurs along several streams and rivers crossing the proposed line route. BMPs as described in Muncy (1999) would be used during construction and maintenance activities at these aquatic features. The proposed transmission line crossings of these streams and rivers would not affect foraging habitat for gray bats and thus no impacts to this species are anticipated.

Cave habitat for Indiana bats does not exist in the vicinity of the proposed Maury Transmission Line route or its associated access roads. Although the forests along the proposed route are highly fragmented, some forested habitat exists that could potentially offer summer roost sites to Indiana bats. As described in Section 3.6.3, most of the forested sites that were sampled to determine their quality as Indiana bat summer roost habitat ranked as of poor quality, and a few ranked as of moderate quality. With implementation of the mitigation measure listed below in Section 4.6.3 on the timing of timber harvesting, the Indiana bat would not be adversely affected.

The lark sparrow could occur in glades along this proposed transmission line. Because this species occupies glades with little to no tree cover, construction and operation of the transmission line would not adversely affect it and could have beneficial effects on it.

4.6.2.3.3. Almaville Transmission Line

All caves are 2.5 miles or greater from this proposed route, and no suitable habitat for Tennessee cave salamander, Echo Cave beetle, or Allegheny woodrat exists along or in the immediate vicinity of the proposed Almaville Transmission Line or its associated access roads. Therefore, the proposed actions on this section would not impact these species. There is also no cave roosting habitat for gray or Indiana bats in this section of the project area, but foraging habitat for gray bats occurs along several streams and rivers crossing the proposed ROW. BMPs as described in Muncy (1999) would be used during construction and maintenance activities at these sites, and the proposed transmission line crossings of these streams and rivers would not affect foraging habitat for gray bats. The proposed actions on this transmission line section would not impact gray bats or their habitat.

The proposed Almaville Transmission Line route contains more forest that the other major project components. Some of this forest ranked as moderate quality for Indiana bat summer roost habitat. With implementation of the mitigation measure listed below in Section 4.6.3 on the timing of timber harvesting, the Indiana bat would not be adversely affected.

As with the Maury Transmission Line, the construction and operation of the Almaville Transmission Line would not adversely affect lark sparrows and could have beneficial effects on the species.

4.6.2.3.4. Christiana Transmission Line

Suitable habitat for Tennessee cave salamander, the Echo Cave beetle, and the Allegheny woodrat exists in the Snail Shell Cave System located near the proposed Christiana Transmission Line route. Of the seven entrances to the Snail Shell Cave System, all but Nanna Cave are 0.2 mile or greater from the proposed actions and would not be disturbed by the proposed Action Alternative. The Nanna Cave entrance is located approximately 150 feet from the proposed ROW edge. Adverse impacts to this cave entrance and listed species inhabiting the cave would be avoided by implementation of the mitigation measure described in Section 4.5.2.5.

No roosting habitat for gray bats occurs within this section of the project area, but foraging habitat occurs along several streams and rivers crossing the proposed Christiana Transmission Line route. BMPs as described in Muncy (1999) would be used during construction and maintenance activities at these sites. The proposed Christiana Transmission Line crossings of these streams and rivers would not affect this foraging habitat for gray bats, and the proposed actions on this section would not impact gray bats or their habitat.

Cave habitat for Indiana bats does not exist in the vicinity of the proposed Christiana Transmission Line route. Although overall forests along the proposed Christiana route were highly fragmented, some of this forest ranked as of moderate quality for Indiana bat summer roost habitat. With implementation of the mitigation measure listed below in Section 4.6.3 on the timing of timber harvesting, the Indiana bat would not be adversely affected.

As with the Maury and Almaville transmission lines, the construction and operation of the Christiana Transmission Line would not adversely affect lark sparrows and could have beneficial effects on the species.

4.6.2.3.5. Cumulative Impacts

The Snail Shell Cave System contains the Tennessee cave salamander, the Echo Cave beetle, and other rare terrestrial cave organisms. This cave system was named one of the Top Ten Most Endangered Karst Communities by the Karst Waters Institute based upon “threats from trespassing, vandalism, logging, and factors related to encroaching sprawl and development from the nearby city of Murfreesboro” (Southeastern Cave Conservancy Inc. 2002). Although surrounding development may be leading to increased impacts to this cave system, the commitment for reducing impacts around the Nanna Cave entrance, combined with following standard TVA BMPs (Muncy 1999) in areas with karst features, would prevent project-related impacts to this cave system. The proposed project activities would not significantly add cumulative impacts to any terrestrial animal listed species or their habitats.

No gray bat caves would be impacted by the proposed actions. Many of the streams and rivers within the Rutherford project area occur within the foraging range (up to 22 miles) of gray bats that use three area caves (8, 13, and 14 miles away); however, similar foraging habitat exists throughout the landscape. The proposed actions would not significantly impact this foraging habitat.

Indiana bats have not been found in caves or others areas of the Maury, Rutherford, or Williamson counties. Although this finding may be due to lack of sampling in this area, central Tennessee occurs on the southern limit of the summer range for Indiana bats, and it

is unlikely that populations exist in this area. With implementation of the mitigation measure listed below in Section 4.6.3 on the timing of timber harvesting, the Indiana bat would not be adversely affected. The proposed project would not cumulatively impact Indiana bats.

4.6.3. Summary of Impacts and Proposed Mitigation Measures

Alternative 2, the Action Alternative, would result in the construction and operation of the proposed substation and 51 miles of associated transmission lines and use of 40 associated access roads. This could affect the birdwing pearly mussel, the Cumberland monkeyface, the orange-foot pimpleback, the tan riffleshell, Pyne's ground-plum, Braun's rock-cress, and the Indiana bat; all these species are listed as endangered under the ESA. Two candidate species for listing under the ESA, the rayed bean and the slabside pearlymussel, could also be affected. The proposed action would also affect DCH for Braun's rock-cress, and several species of state-listed plants and aquatic and terrestrial animals.

The listed aquatic species and DCH are all downstream of the proposed facilities and primarily in the main stem of the Duck River. With the implementation of the mitigation measures listed below, none of these species or DCH areas would be adversely affected.

The proposed action would impact small occurrences of limestone fameflower and Tennessee milk-vetch and could impact three occurrences of Canada lily. There are, however, numerous other populations of each of these species in Tennessee, and many of these populations are on areas managed to conserve them. Any adverse effects that could result from the proposed action would not adversely affect the species or their viability in Tennessee. With implementation of the mitigation measures listed below, impacts to other state-listed plants would not be adverse.

The proposed transmission line routes were modified during the planning process to reduce the potential impacts to Pyne's ground-plum, Braun's rock-cress, and critical habitat for Braun's rock-cress. TVA also proposed several mitigation measures listed below to further reduce these potential impacts. With the implementation of these mitigation measures, TVA has determined that Pyne's ground-plum and Braun's rock-cress would not be adversely affected and the critical habitat for Braun's rock-cress would not be adversely modified.

In order to minimize impacts to potential habitat for the Indiana bat, TVA would implement the mitigation measure listed below on the timing of timber harvesting. TVA has determined effects on the Indiana bat would not be adverse with implementation of this measure. With implementation of the mitigation measures for the protection of caves, impacts on state-listed animals would be insignificant.

Following are mitigation measures to reduce the potential impacts to endangered and threatened species.

- To minimize potential impacts to aquatic habitats and aquatic life, including federally or state-listed species, BMPs as outlined in Muncy (1999) would be applied to all construction and maintenance activities. Additionally, all intermittent and perennial streams were assigned a Category A protection level (Appendix J) that warrants additional protection measures as defined in Appendix H and Muncy (1999).

- Areas with state-listed plant species would be included in the transmission line and access road engineering design specification drawings used during the design, construction, and maintenance of the transmission line. During construction and maintenance, TVA would avoid the areas occupied by the state-listed plants. Unless there is no practical alternative, structures would be placed to avoid impacting these areas. Additionally, unless there is no practical alternative, access roads and the associated vehicle traffic would be excluded from these areas. These areas would be fenced during construction. Vegetation management in these areas would be accomplished through mechanical clearing and no herbicides would be applied in them.

- The location of the toothache tree population along the Maury Transmission Line ROW would be included on the engineering design specification drawings for use during the design, construction, and maintenance of the transmission line. TVA would clear the ROW between November and March when the plant is dormant; shear-clearing (bulldozing) methods would not be used. Vegetation management in the area would be accomplished by mechanical clearing (e.g., mowing). Herbicides would not be used in this area.

- The location of the Alabama snow-wreath population would be included on the engineering design specification drawings for use during the design, construction, and maintenance of the transmission line. All construction occurring within 200 feet of the Alabama snow-wreath population would be strictly confined to areas within the Christiana Transmission Line ROW. In addition, fencing would be erected along the edge of the ROW during construction to ensure impacts to Alabama snow-wreath are avoided. Vegetation management within 200 feet of the snow-wreath population would be accomplished by mechanical clearing and herbicides would not be used.

- Information regarding the location of Pyne's ground-plum would be included on the engineering design specification drawings for use during the design, construction, and maintenance of the transmission line. Vehicles, construction equipment, and unnecessary personnel would strictly be prohibited from disturbing the population. This would be accomplished by explicitly instructing construction crews to remain on the Christiana Transmission Line ROW in the immediate vicinity of the population and to avoid any activity in this area (felling trees, grading, inadvertently accessing the site with vehicles, etc.) that would alter the habitat. In addition, fencing would be erected along the edge of the ROW during construction to ensure impacts to Pyne's ground-plum are avoided. Vegetation management within 500 feet of the ground-plum population would be accomplished by mechanical clearing; herbicides would not be used.

- Prior to the transmission line construction clearing, TVA would treat all tree-of-heaven within the proposed Almaville Transmission Line ROW to reduce the risk of spreading within the DCH. This would be accomplished by using a basal bark application method with Garlon® 4 herbicide before trees are cleared from the proposed ROW. The tank mixture would consist of a 20 percent Garlon® 4/80 percent carrier solution; the solution would be a specially formulated vegetable oil. Using a backpack sprayer, herbicide would be applied to the trunk of each tree-of-heaven stem from ground level to 18 inches high. All areas of the trunk in this band

would be thoroughly wetted with herbicide. Herbicide does not need to be sprayed on the foliage of tree-of-heaven stems.

- Timber harvesting for ROW clearing in the six areas of moderately suitable habitat for the Indiana bat would take place between October 15 and March 31.

- To minimize potential impacts to the gray bat, a 500-foot-radius buffer at the entrance to Nanna Cave and standard BMPs at all stream crossings (Muncy 1999) would be implemented during the construction and maintenance of the transmission lines.

- Access roads that contain habitat for federally and state-listed species would be resurveyed during the growing season (March to May) prior to use for any ROW construction or clearing. Should an occurrence(s) be found within the area of any of the access roads as proposed, the occurrence(s) would be avoided by either rerouting the access road or not using that particular road for access to the ROW. Any new roads that would be considered as alternatives would also undergo surveys before their use.

TVA has concluded that the proposed actions with the implementation of the environmental commitments and mitigation measures described above and in Section 2.9 would not adversely affect any federally listed or state-listed species or critical habitat. In compliance with Section 7 of the Endangered Species Act, TVA consulted with the USFWS over the potential effects on endangered and threatened species and critical habitat. In a letter dated December 5, 2007 (Appendix B-1), the USFWS concurred with TVA's determination that the proposed actions are not likely to adversely affect any federally listed species or adversely modify critical habitat.

4.7. Wetlands

Activities in wetlands are regulated under Sections 401 and 404 of the Clean Water Act and EO 11990. Section 401 requires water quality certification by the state for projects permitted by the federal government (Strand 1997). Section 404 implementation requires activities in jurisdictional wetlands be authorized through a Nationwide General Permit or Individual Permit issued by the USACE. EO 11990 requires federal agencies to minimize wetland destruction, loss, or degradation and preserve and enhance natural and beneficial wetland values, while carrying out agency responsibilities. TVARAM is used to guide wetland mitigation decisions consistent with TVA's independent responsibilities under NEPA and EO 11990.

4.7.1. Alternative 1 – No Action

Under the No Action Alternative, no disturbance to wetlands within the proposed substation or transmission line ROWs and their associated access roads would occur. Therefore, no wetlands would be affected. Changes to wetlands would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.7.2. Alternative 2 – The Action Alternative

4.7.2.1. Rutherford 500-kV Substation

Under the Action Alternative, a 0.49-acre emergent wetland would be spanned by transmission lines, and the wetland functions would not change. This wetland on the substation site scored as a Category 2 wetland and is located within a heavily-impacted horse pasture; thus any potential impacts that could occur to this wetland would not be considered significant within the context of the approximately 9,248 acres of emergent wetlands present in the area. In addition, potential impacts to water stitchwort, a state-listed plant, would not be considered a significant impact due to the increase in water stitchwort records and the ability of the species to occupy a less specific habitat than previously thought.

4.7.2.2. Maury Transmission Line

The proposed Maury Transmission Line construction would affect wetland areas with the initial clearing and conversion of a total of 0.64 acre of forested wetland in W004M, W005M, and W006M. Consisting of 0.05 acre, W004M was classified as a Category 3 wetland, and both W005M and W006M (0.45 and 0.05 acre, respectively) were classified as Category 2 wetlands. The proposed transmission line would span these wetlands and the areas would then be maintained as emergent/scrub-shrub wetlands.

For W004M, the forested wetland acreage proposed for clearing is a part of a larger forested wetland complex, and the functions this larger wetland area provides would be maintained sufficiently post-conversion. Potential impacts to all other wetland areas resulting from possible access across these wetlands during the proposed transmission line construction would be minimized sufficiently through the use of BMPs (Muncy 1999). Similarly, BMPs would be implemented for all transmission line maintenance activities to ensure that wetland impacts are temporary and insignificant. Land use/land cover data indicated over 10,000 acres of forested/scrub-shrub wetlands are present in the overall project area. Therefore, the conversion of 0.64 acre of forested wetland to emergent/scrub-shrub and the use of BMPs to minimize impacts associated with vehicular access and long-term maintenance, collectively, would result in insignificant impacts to the wetland areas within the project sites. A Nationwide 12 permit has been issued to TVA by USACE for this proposed transmission line.

4.7.2.3. Almaville Transmission Line

The proposed Almaville Transmission Line construction would affect wetland areas with the initial clearing and conversion of a total of 0.02 acre of forested wetland in W001A. This wetland was classified as a Category 2. The proposed transmission line would span this wetland, and the area would then be maintained as an emergent/scrub-shrub wetland.

Because of the small area of forested wetland acreage proposed for clearing, the conversion of this area of forested wetland to scrub-shrub/emergent wetland and the associated change in function would be relatively minor within the context of the overall project area. Other impacts to these wetlands during the proposed transmission line construction would be minimized sufficiently through the implementation of BMPs (ibid). Similarly, BMPs would be implemented for all transmission line maintenance activities to ensure that wetland impacts are temporary and insignificant. Therefore, the conversion of 0.02 acre of forested wetland to emergent/scrub-shrub and the use of BMPs to minimize impacts associated with vehicular access and long-term maintenance, collectively, would

result in insignificant impacts to the wetland areas within the project sites. A Nationwide 12 permit has been issued to TVA by USACE for this proposed transmission line.

4.7.2.4. Christiana Transmission Line

The proposed Christiana Transmission Line construction and rebuild project would affect wetland areas with the initial clearing and conversion of a total of 1.63 acres of forested wetland in W001C, W002C, W003C, and W004C. W001C, W002C, and W003C (0.63, 0.06, and 0.89 acres, respectively) were classified as Category 2 wetlands, and W004C (0.05 acre) was classified as a Category 3 wetland. The proposed transmission line would span these wetlands, and the areas would then be maintained as emergent/scrub-shrub wetlands.

Because the majority of forested wetland acreage proposed for clearing is all part of a much larger forested wetland complex, the functions this larger wetland area provides would be maintained sufficiently post-conversion. As discussed in Section 2.5.2, land use/land cover data indicates over 10,000 acres of forested/scrub-shrub wetlands are present in the overall project area; the conversion of 1.63 acres of forested wetland to emergent/scrub-shrub would be insignificant within this context. Potential impacts resulting from possible access across these wetlands during the proposed transmission line construction would be minimized sufficiently through the implementation of BMPs (ibid). Similarly, BMPs would be implemented for all transmission line maintenance activities to ensure that wetland impacts are temporary and insignificant. Therefore, the conversion of 1.63 acres of forested wetland, with the use of BMPs to minimize impacts associated with vehicular access and long-term maintenance, would result in insignificant impacts to the wetland areas within the project sites. A Nationwide 12 permit has been issued to TVA by USACE for this proposed transmission line.

4.7.2.5. Cumulative Impacts

The proposed transmission lines would span wetlands located within the ROW area. As specified by the National Electrical Safety Code, TVA must maintain adequate clearance between conductors and tall-growing vegetation and other objects (Appendix I). Routine maintenance includes the removal of vegetation including trees that have the potential to grow tall enough to pass within 10 feet of a conductor or strike a structure should it fall toward the transmission line (Section 2.7.2.1). Before dredged or fill material is placed in wetlands and streams, a Nationwide 12 permit would be required from USACE in compliance with Section 404 of the Clean Water Act. TVA has been issued this permit.

Overall wetland impacts associated with this project would include the conversion of 2.29 acres of forested wetlands to emergent/scrub-shrub wetland habitat. Land use/land cover data indicated there are 10,629 acres of forested/scrub-shrub wetlands and 9,248 acres of emergent wetlands present in the watersheds within the project area. Analysis of these figures shows that the overall cumulative wetland impacts related to this project are insignificant.

4.8. Floodplains

4.8.1. Alternative 1 – No Action

Under the No Action Alternative, the Rutherford Substation and Maury, Almaville, and Christiana transmission lines would not be built and, therefore, no environmental impacts to floodplains would occur. Changes to these floodplains would nonetheless occur over time as other factors such as population trends, land use and development, quality of

air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.8.2. Alternative 2 – The Action Alternative

4.8.2.1. Maury, Almaville, and Christiana Transmission Lines

The proposed Maury, Almaville, and Christiana transmission line routes would cross several floodplain areas within Rutherford, Williamson, and Maury counties. Consistent with EO 11988, an overhead transmission line and related support structures are considered a repetitive action in the 100-year floodplain. The construction of the support structures for the transmission line would not be expected to result in any increase in flood hazard either as a result of increased flood elevations or changes in flow-carrying capacity of the streams being crossed. To minimize adverse impacts on natural and beneficial floodplain values, the ROWs would be revegetated where natural vegetation is removed, and the removal of unique vegetation would be avoided. BMPs would be used during construction activities. Some of the access roads would involve construction in the 100-year floodplain. Consistent with EO 11988, a road is considered as a repetitive action in the 100-year floodplain. To minimize adverse impacts, any road construction in the 100-year floodplain would be done in such a manner that upstream flood elevations would not be increased.

4.8.2.2. Cumulative Impacts

There would be no anticipated adverse floodplain impacts resulting from construction of the substation and the transmission lines. The substation would be located outside of the 100-year floodplain. As outlined above, efforts would be made to minimize adverse floodplain impacts resulting from construction of the transmission line support structures, and any road construction in the 100-year floodplain would be done in such a manner that upstream flood elevations would not be increased.

4.9. Managed Areas

4.9.1. Alternative 1 – No Action

Under the No Action Alternative, the proposed substation and transmission lines would not be constructed, and there would be no project-related impacts to managed areas, ecologically significant sites, or NRI streams. Changes to these features as well as their management objectives would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.9.2. Alternative 2 – The Action Alternative

4.9.2.1. Rutherford 500-kV Substation

The proposed 53.1-acre substation and its access road are of sufficient distance from Scales Mountain Knobs SNA (0.8 mile) and Indian Mountain SNA (1.0 mile) that no impacts to these natural areas are anticipated from the construction and operation of the proposed substation.

4.9.2.2. Maury Transmission Line

The proposed Maury Transmission Line would cross the Harpeth River, an NRI stream. Under applicable requirements, federal agencies must seek to avoid or mitigate actions that would adversely affect segments of streams recognized by the NPS for their outstanding

values. The portion of the Harpeth River that would be crossed by the 175-foot-wide 500-kV transmission line ROW in the College Grove area is narrow and shallow with easily accessed vegetated banks; it abuts agricultural lands. No significant impacts to this stream are anticipated for the following reasons. No structures would be located within the stream so there would be no material effect on its free flowing nature at this location.

This portion of the Harpeth River is several miles southeast of its more outstanding and publicly frequented scenic, recreational, geologic, cultural, and historical features, and the proposed transmission line at the point of crossing would not affect these downstream areas. The transmission line crossing would diminish the scenic integrity of this rural stream at the crossing site, as the overhead conductors would be visible from the river (Section 3.12); however, the 875-foot span of transmission line conductor across the narrow stream would reduce the likelihood of seeing the structures from the stream. Additionally, with the implementation of standard TVA BMPs for stream crossings, impacts to the river during construction would be insignificant (Section 4.3). Based on these factors, TVA determined that the proposed action would not have an adverse effect on the natural, cultural, and recreational values of this NRI stream nor would the proposed action foreclose options to list the river segment as “wild,” “scenic,” or “recreational” pursuant to the Wild and Scenic Rivers Act. Accordingly, this proposal was coordinated with the NPS’s regional NRI office, and in a letter dated January 2, 2007 (Appendix B-1), the NPS concurred with TVA’s determination.

No impacts to the Haley-Jaqueth WMA, Middle Tennessee Agricultural Experiment Station, Duck River State Mussel Sanctuary, Scales Mountain Knobs SNA, Indian Mountain SNA, or the NRI stream Overall Creek (in the Stones River drainage) are anticipated because the distance of the proposed route from their boundaries is sufficient.

The use of the proposed existing roads to access this transmission line is not anticipated to impact these natural areas.

4.9.2.3. Almaville Transmission Line

The proposed Almaville Transmission Line, a new 87.5-foot ROW to run adjacent to the existing Murfreesboro-East Franklin Transmission Line ROW on the southern side, would cross approximately 400 feet of the southwestern tip of Scales Mountain Knobs SNA. This crossing would be immediately adjacent or come just within the boundary of Indian Mountain SNA. The registered status of these natural areas acknowledges the state’s interest in protecting the tracts’ populations of Braun’s rock-cress. The areas of interest within the SNAs also are DCH for Braun’s rock-cress. TVA, in concurrence with USFWS (Appendix B-1) determined that the clearing of ROW and the construction of the 161-kV transmission line would not adversely modify Braun’s rock-cress habitat to the extent that the species would be reduced (Section 4.6.3). Based on this determination, the impacts from the proposed Almaville Transmission Line on the Scales Mountain Knobs SNA and Indian Mountain SNA would be minor and insignificant. Because of the areas’ status as Registered SNAs by TDEC, a copy of the draft EIS was sent to TDEC for review, and no adverse comments about these SNAs were received from TDEC.

No impacts to Overall Creek (in the Stones River drainage), an NRI stream, are anticipated because the distance from the proposed line to the creek is sufficient.

The use of the proposed existing roads to access this transmission line is not anticipated to impact these natural areas.

4.9.2.4. Christiana Transmission Line

The proposed Christiana Transmission Line would cross the West Fork of the Stones River, which is an NRI stream. This relatively short 10-mile segment would be crossed near Christiana at a newly cleared 100-foot ROW with a double-circuit, 161-kV transmission line. While the river's recreational, geologic, and fish and wildlife values would not likely be impacted by the presence of this transmission line, its scenic integrity would be diminished. Transmission line support structures would not be located in NRI streams. With the use of BMPs for stream crossings, impacts to the river during construction are anticipated to be temporary and insignificant. TVA determined that no significant impacts to this stream's NRI listing are anticipated because the proposed action would not affect the recreational value of this stream for which it is primarily recognized nor would the proposed action foreclose options to list this river segment as "wild," "scenic," or "recreational" pursuant to the Wild and Scenic Rivers Act. Accordingly, the proposed action was coordinated with the NPS's regional NRI office, and in a letter dated January 2, 2007 (Appendix B-1), the NPS concurred with TVA's determination.

With the implementation of mitigation measures as described in Section 4.1.2, no adverse impacts to the managed area, Snail Shell Cave Preserve, are anticipated.

No impacts to Overall Creek (in the Stones River drainage), Harpeth River, Scales Mountain Knobs SNA, or Indian Mountain SNA from the proposed work on this transmission line are anticipated because the distance from the proposed route to these natural areas and NRI streams is sufficient.

The use of the proposed existing roads to access this transmission line is not anticipated to impact these natural areas.

4.9.2.5. Cumulative Effects

The transmission lines within the project area would diminish the scenic integrity of the area's rivers that are nationally recognized for their scenic and pastoral character, along with other outstanding values. Two NRI-listed streams within the proposed project would be crossed by transmission lines, and would be visible from the rivers. While the visual impacts resulting from this proposal would be small and contained to the points of crossing, future crossings, if any, in other areas would eventually weaken the rivers' scenic value and pastoral character. TVA is unaware of any proposals for such crossings.

Cumulative impacts to the state-registered natural areas crossed by the proposed transmission lines are expected to be insignificant because the transmission lines would be sited and the ROW maintained to protect the populations of sensitive species found in these areas and their habitat.

4.10. Recreation

4.10.1. Alternative 1 – No Action

Under the No Action Alternative, the Rutherford Substation and the Maury, Almaville, and Christiana transmission lines and their associated access roads would not be built and, therefore, no environmental impacts to recreation would occur. Changes to recreation would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.10.2. Alternative 2 – The Action Alternative

There are no developed recreation facilities near the substation, transmission line routes, or associated access roads. Primary recreational activities are informal, dispersed, and occur on privately owned land. There would be insignificant effects on public recreation activities and resources.

4.11. Land Use and Prime Farmland

4.11.1. Alternative 1 – No Action

Under the No Action Alternative, the Rutherford Substation and the Maury, Almaville, and Christiana transmission lines and their associated access roads would not be built and, therefore, no environmental impacts to land use or prime farmland would occur. Changes to land use and prime farmland would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.11.2. Alternative 2 – The Action Alternative

Construction of the proposed substation and transmission lines in Rutherford, Williamson, and Davidson counties would impact land use. One occupied house, one unoccupied house, two occupied mobile homes, six barns, two well houses, four other sheds, and a diesel generator within the Maury and Christiana transmission line ROWs would be removed, and landowners would be prohibited from constructing buildings within the ROW. Forest, orchard, and plant nursery operations that would result in trees growing tall enough within the ROW to present a hazard would be prohibited. Most other agricultural activities could occur within the ROW. Other land uses allowable within the ROW include driveways, parking lots, lawns, and golf courses. The proposed access roads would generally utilize existing paved or gravel roads or farm roads through existing pasture or agricultural fields. No impact to land use or prime farmland is anticipated as a result of utilizing these access roads.

4.11.2.1. Rutherford 500-kV Substation

The 53.1-acre substation site in Rutherford County was evaluated to assess the quality of land impacted by construction activities. The substation location would be converted to industrial use. In accordance with the Farmland Protection Policy Act, this area was evaluated to determine its value as prime farmland. A Form AD 1006, “Farmland Conversion Impact Rating,” was completed with assistance from Jerry Prater, resource soil scientist, Natural Resources Conservation Service office in Sparta, Tennessee (Appendix N). The score assigned by Mr. Prater for the “Relative Value of the Farmland” for the substation site was 57 out of a possible maximum of 100 points. The “Total Site Assessment” score was 80 out of a possible maximum of 160 points. The reasons for the low site assessment score are as follows:

- The site is small relative to the average-sized farm in Rutherford County.
- The land is not protected by local or state governments.
- Conversion of the site would not impact farm support services.
- Conversion of the site would not cause adjacent farmland to also be converted to nonfarm use.
- The site has few well-maintained on-farm investments.

The total points for the site; i.e., the "Farmland Conversion Impact Rating" is 137. This is well below the threshold of 160, indicating that this site's relative value as prime farmland is not high enough to be considered for protection under the Federal Farmland Protection Policy Act.

4.11.2.2. Maury, Almaville, and Christiana Transmission Lines

The proposed transmission lines, regardless of the alternative and route alignment, would require the construction of transmission structures in prime farmland. The area disturbed by structure construction would be small, and permanent disturbances would be limited to the structure foundations.

4.12. Visual Resources

Consequences of the impacts to visual resources are examined based on visual changes between the existing landscape and the landscape as altered by the proposed actions, sensitivity of viewing points available to the general public, their viewing distances, and visibility of proposed changes. In this assessment, scenic character is described using a variety of terms. Scenic integrity, which relates to degree of intactness or wholeness of the landscape character, is also an important factor. These measures help identify changes in visual character based on commonly held perceptions of landscape beauty and the aesthetic sense of place. Scenic Value Class is determined by combining the levels of scenic attractiveness, scenic integrity, and visibility. The foreground, middleground, and background viewing distances were previously described in Section 3.12.

Visual impacts associated with the construction of a transmission line result from the construction of access roads and material laydown areas, removal of trees and most other vegetation from the ROW, erection of tall, silvery-gray laced-steel, single-pole, and double-pole transmission line structures, and installation of silvery-gray metal conductors between structures. The operation of construction equipment during this phase of the project results in an additional, short-term visual impact. The transmission line structures and conductors become essentially permanent features in the landscape. The long-term visibility of the cleared transmission line ROW depends on the surrounding landscape, and the cleared ROW can be more prominent in a forested landscape than in a cleared agricultural landscape. The potential visual impacts of the various alternatives and routes are described in the following sections.

4.12.1. Alternative 1 – No Action

Under the No Action Alternative, TVA would not build the substation or any new transmission lines. Visual resources would not be affected. Changes to the scenic quality of the area would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.12.2. Alternative 2 – The Action Alternative

4.12.2.1. Rutherford 500-kV Substation

Visual impacts as a result of substation construction would be minimal. The new substation, similar to Figure 2-12, would likely not be seen by the public from Patterson Road (Opossum Trot Road) to the south or Rehobeth Road to the west. Existing mature vegetation that would remain on the south and west sides of the substation, as well as undulating topography, would obscure most views. There may be some visual discord

during the construction period due to an increase in the number of commercial vehicles accessing the site from Patterson Road. However, this would be temporary until all activities are complete.

New substation lighting would comply with *TVA Substation Lighting Guidelines* (Appendix K) and these guidelines contain measures to reduce potential lighting impacts.

4.12.2.2. Maury Transmission Line

The proposed 500-kV Maury Transmission Line would begin at the existing TVA Maury Substation on North Point Drive in Maury County, Tennessee, and would be situated within an existing, TVA-owned 175-foot ROW along the approximate 27-mile route to the northeast. This area is mainly industrial to the immediate east and is characterized by numerous laced-steel transmission structures and industrial architecture, i.e., metal buildings. To the west is mainly agricultural and residential land with a few homes bound by open pastoral landscapes. The new transmission line in this area would be visually similar to poles, towers, lines, and other industrial features seen in the landscape now. Structures would be similar to Figure 2-13 and Figure 2-14.

Approximately 0.5 mile to the east, the new 500-kV transmission line would cross US 31, a major thoroughfare from Columbia to the south and Nashville to the north. Traffic along US 31 is extremely heavy. For motorists, the new 500-kV transmission line would add to the number of structures and lines seen crossing the roadway now. Most views, however, are brief due to roadway alignment and would be between structures and under lines.

Continuing east, the transmission line would cross Rutherford Creek three times. The creek is a narrow body of water suitable only for small watercraft along this section. Prior to the third creek crossing, the new line would bisect Double Branch Road. This area is mainly residential, characterized by open grasslands and existing service poles along road ROW. Motorists and residents in the area would view new transmission lines and structures in the foreground. However, the new line would disappear quickly to the southwest and northeast due to terrain, view positions, and heavy vegetation.

Farther northeast, the transmission line would cross Greens Mill Road, another local subdivision area that is typical of minor roads in the area. There are multiple homes in the foreground and middleground of the proposed line route. There are numerous wood poles along road ROW, and an existing transmission line route bisects Greens Mill Road from north to south. Residents have foreground views of existing single steel poles within this transmission line route. New structures and transmission lines would add to the number of discordantly contrasting elements seen in the landscape. The new transmission line and structures would be visually similar to poles seen in the landscape now. Views of new structures would be in the foreground to the northeast and southwest. Heavy vegetation and elevation changes in the middleground distances would minimize visual impacts, particularly for residents in the immediate foreground.

Just west of I-65, the line would cross Kedron Road. A new residential development is under construction to the northwest, and there are numerous existing homes in all directions. Residents have foreground views of an existing water treatment plant on the northeast side of Kedron Road, a minor industrial element that provides discordant contrast in this mainly rural setting. This area has been heavily affected by new residential development and has the capacity to absorb additional adverse visual change in the landscape. New structures and lines would likely not reduce the existing scenic class level.

Existing transmission line ROW that is currently utilized by transmission lines ends just west of I-65 The route for the new 500-kV transmission line would continue to the northeast on TVA-owned, vacant 175-foot ROW. Crossing I-65, the line traverses US 431, a major thoroughfare from Shelbyville to the south and Nashville to the north. There are numerous homes along this section of US 431 and additional residential properties under construction. Due to roadway alignment and topography, residents and motorists would have brief views of the new transmission line between structures. The new transmission line would be visually insignificant when viewed in context to human alterations in the area now.

Northeast of US 431, the landscape becomes a transition zone to pasture along roadways and an increase in woodland areas in the middleground distances. Views of the new transmission line would be mainly from road crossings by motorists and intermittently by local residents along secondary routes away from public views. Approximately 2 miles east of US 431, the transmission line would cross the 256-acre Smithson-McCall farm, an NRHP-listed property. The effects of the proposed transmission line route on this historic property are addressed in Section 4.13.

Near US 31A, two historic properties have been identified: the William Allison house to the south and the William Ogilvie house along the proposed route on US 31A. Both houses are located in sparsely developed areas adjacent to road ROW. Information regarding the environmental consequences of the proposed action on these two houses can be found in Section 4.13.

The line route would continue northeast over the Harpeth River, an NRI-designated stream. Views of the line from the water would be mainly of new lines between structures. These views would be brief for recreation users due to dense vegetation along the stream banks. Views would be mainly along new transmission line ROW. The route would continue from the Harpeth River past Talieaferro Road over steep terrain. This area is heavily wooded and is mostly inaccessible by automobile near Patterson-Windrow Road. Turning northwest, the proposed route would cross Patterson-Windrow Road and traverse mainly open pastureland before crossing Coleman Hill Road and entering the proposed Rutherford Substation site (Section 4.12.2.1). Traffic is extremely light along Coleman Hill Road. However, these motorists would have foreground views of the new line where it would cross open pastureland to the north and disappear in the middleground as a result of vegetation and topography. One resident to the south may have foreground views of the proposed line route to the north and south of Coleman Hill Road. Due to vegetation removal and new lines and structures, there would be discordant visual contrast in the landscape for this resident and a reduction of scenic class. However, the scenic class level is not expected to be lowered by two levels or more, the threshold of significance.

New access roads for this line route would not affect visual resources. There may be some minor visual discord during the access road construction period due to an increase in personnel and equipment. However, this would be temporary, ending when all construction activities have been completed. Therefore, there are no visual impacts anticipated as a result of access road constructions.

4.12.2.3. Almaville Transmission Line

The proposed Almaville/Murfreesboro-Triune-East Franklin 161-kV Transmission Line would begin at the existing Almaville Substation in Rutherford County, Tennessee. For residents and motorists in the immediate area, new structures (Figures 2-15 and 2-16) and transmission lines would add to the number of discordantly contrasting elements seen in

the landscape. However, as the line moves to the west, transmission structures would quickly disappear within heavy vegetation. In this area, the line route would be at obtuse angles and would be away from public views.

Crossing Stewart Creek Road, the proposed line would continue through heavy vegetation east of Persimmon Knob and Gibbs Knob. The line would cross Manson Pike and Shores Road to the south. There are few residents in the area. The new line would be seen mainly by motorists along these roads. However, most structures would be placed at distances away from road ROW that would help to mitigate minor visual impacts.

The proposed line would cross SR 96 near Hall Road. There are a few residents along SR 96 that would likely have foreground views of new transmission line and structures. The line would disappear quickly to the south in dense vegetation. Farther south, just west of Patterson Road (Opossum Trot Road), the line route would turn west and cross steep, heavily vegetated terrain at the southern base of Indian Mountain. The line would likely not be seen by the public except from middleground and background distances along higher peaks to the north and south. The influence of the natural landscape on the proposed transmission line greatly decreases negative impacts on scenic character. There would be a reduction in perceived details. Evergreen and deciduous vegetation, as well as gradient changes, obscures details, and the transmission line is seen as a broader, natural pattern as opposed to a focal point in the landscape.

Turning northwest, the route would traverse the western base of Indian Mountain at an obtuse angle. Turning west at the base of Scales Mountain, the route follows steep terrain across the westernmost peak of Scales Mountain before turning south and entering the proposed Rutherford 500-kV Substation. Effects of the new transmission line and associated access roads would be similar to those described in the previous paragraph for the area west of Patterson Road.

4.12.2.4. Christiana Transmission Line

The proposed Christiana 161-kV Transmission Line would begin at the existing Christiana Substation on US 231 in Rutherford County, Tennessee, just west of the town of Christiana. US 231 is a major thoroughfare from Alabama to major points in Tennessee northwest of Nashville. Traffic is extremely heavy, and the landscape is characterized by numerous service poles along the ROW, signage, and myriad residential development. For residents and motorists, the new structures (Figures 2-15 and 2-16) and 161-kV transmission line would add to the number of visual disruptions seen in the landscape. However, views along the roadway extend into the middleground to the north and south. Combined with open fields beyond the road ROW to the east and west, the existing landscape has the capacity to absorb visual change. The proposed line would not reduce scenic class by two levels or more, the threshold of significance.

Just west of US 231, the route would follow open pastureland and cross Stones Creek. Views for recreation users along Stones Creek would be brief and in the immediate foreground. At Walnut Grove Road and Panther Creek Road, there are several homes in the foreground of the proposed route. This area is characterized by open pastureland interspersed with undisturbed woodland thickets. There are numerous service poles seen in the landscape by area residents and motorists. New structures and lines would add to the number of visually contrasting elements seen in the rural landscape. However, most of these views would be intermittent and would be obscured by existing vegetation in the

foreground that would be outside the proposed transmission line ROW. Therefore, visual impacts in these areas would be minimal.

The line route would continue west over steep terrain. The route would traverse the base of Garrett Knob and cross SR 99 just north of the town of Rockvale. There are no homes in the immediate area. However, SR 99 is a main thoroughfare, and traffic is heavy. There is dense vegetation outside of the road ROW and numerous service poles can be seen along the road shoulders. Motorists would have brief views of new transmission lines between structures, mainly as a result of roadway and transmission line alignment. Views from nearby peaks to the north and south would likely be obscured for area residents due to steep terrain and heavy vegetation.

Continuing past Rockvale Road, the line route would turn north and then west at Rowling Hill, crossing Windrow Road. The proposed crossing would be on mostly level terrain. There are several homes in the foreground, and vegetation is heavy along the ROW, obscuring views of existing structures. Dyer Road to the north would be in the foreground of the route. Residents would have brief views, mainly of new lines. However, the route would quickly disappear to the southeast and northwest as a result of steep terrain and dense vegetation. Motorists in the area would likely not perceive a visual change in the landscape.

To the west along Morgan Road, the route would be in the immediate foreground of Hayes Cemetery. This area is typical of the region, heavily vegetated with views limited to the roadway itself. Visual impacts would likely be similar to those described for the Windrow Road area. The line would turn north just west of Morgan Road and follow steep terrain to Patterson-Windrow Road, Coleman Hill Road, and to the proposed Rutherford Substation. The ROW and potential visual impacts for this area have been previously described in Section 4.12.2.2.

New access roads for this line route would not affect visual resources. There may be some minor visual discord during the access road construction period due to an increase in personnel and equipment. However, this would be temporary, ending when all construction activities have been completed. Therefore, there are no visual impacts anticipated as a result of access road construction.

4.12.2.5. Cumulative Impacts

The new transmission line and structures would add to the number of discordantly contrasting elements seen in the landscape. Vegetation removal for new ROW would reduce scenic integrity in areas unaltered by human development. However, scenic class for any of the proposed sections and substation site would likely not be reduced by two levels or more, the threshold of significance.

4.13. Cultural Resources

4.13.1. Alternative 1 – No Action

Under the No Action Alternative, the Rutherford Substation and the Maury, Almaville, and Christiana transmission lines and their associated access roads would not be built and, therefore, no environmental impacts to cultural resources would occur. Changes to cultural resources would nonetheless occur over time as other factors such as population trends, land use and development, quality of air/water/soil, recreational patterns, and cultural, ecological, and educational interests change within the area.

4.13.2. Alternative 2 – The Action Alternative

4.13.2.1. Rutherford 500-kV Substation

The Phase I Survey (Deter-Wolf and Karpynec 2007) identified two previously recorded archaeological sites (40RD265 and 40RD266), 13 previously recorded architectural properties (RD-3136, 3149, 3150, 3151, 3154-3158, and 3161-3164), and six previously unrecorded architectural properties (HS-1–HS-6). All of these resources are considered ineligible for listing on the NRHP because the resource lacks integrity, has been destroyed, or is not in the visual line of sight to the substation footprint. Therefore, the construction and operation of the proposed substation would not affect historic properties listed on or eligible for listing on the NRHP.

4.13.2.2. Maury Transmission Line

Background research identified 10 previously recorded archaeological sites (40MU354, 40MU355, 40WM34-38, 40WM40-41, and 40WM324) within the proposed APE. Site 40WM35 is considered potentially eligible for listing on the NRHP and ground disturbance would be avoided during transmission line construction and maintenance. The remaining nine sites (40MU354, 40MU355, 40WM34, 40WM36-38, 40WM40-41, and 40WM324) are considered ineligible for listing on the NRHP.

Prior research also identified 70 previously recorded architectural resources (Table 3-16) within the APE. Of the 70, only 23 architectural resources (MU-59, 468, 469, 490, 491, 1960, 1961, 1975-1977, 1983, 2008, 2152, 2156, 4920, RD-3006, 3011, WM-231, 386, 1038, 1039, 1045, 1048) were located within the visual line of sight and had not been destroyed. All of these sites are considered ineligible for listing on the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage.

The archaeological survey identified six previously unrecorded sites (40MU581-585 and 40WM414). The portion of these sites located within the proposed APE are considered ineligible for listing on the NRHP due to their lack of intact deposits and lack of integrity.

The historic/architectural survey identified 31 previously unrecorded architectural resources (HS-1–HS-31) within the proposed APE. These resources are considered ineligible for the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage.

Three NRHP-listed properties (William Ogilvie house, William Allison house, and Smithson-McCall farm) are located within the proposed APE.

The William Ogilvie house has been severely altered through the construction of the rear two-story addition, the interior modification to the circa 1920 shed extension, and the loss of three contributing outbuildings since its initial recordation; therefore, it no longer retains sufficient integrity to remain listed on the NRHP and would not be adversely affected.

The proposed transmission line would have an adverse visual effect on the William Allison house. However, the project would not compromise the property's historic or architectural integrity for which it was listed on the NRHP, nor would it physically alter or disturb the historic property. The proposed line would be 0.39 mile northwest of the property's NRHP boundary in which the visual line of sight to the project area is unobstructed by tree growth or topography. Despite intensive development within Williamson County in recent years,

the surrounding viewshed of the William Allison house has remained relatively unchanged since its construction in 1832.

The proposed transmission line would have an adverse visual effect on the Smithson-McCall farm. Approximately 0.3 mile of the line would be on historic farm property and thus compromise the agricultural landscape, which is listed as a contributing site on the property's NRHP nomination form. TVA's easement rights to the transmission line route across this property date to the early 1930s when it acquired them from the Tennessee Electric Power Company. In fiscal year 1978-1979, TVA purchased an easement from the property owner for an additional 125 feet of ROW for the construction, operation, and maintenance of the then proposed Hartsville-Maury 500-kV Transmission Line and ROW. This easement agreement predates the nomination of the property to the NRHP, and, accordingly, the ROW and the likelihood of a transmission line being built on it should have been considered part of the existing landscape when NRHP designations were made. However, TVA recognizes that the construction of the transmission line would result in actual adverse impacts on the agricultural landscape that is important to this property. Alternative rerouting options were considered by TVA; however, these options proved cost prohibitive and would involve moving off the ROW that TVA already owns.

In an effort to mitigate the effects, TVA would minimize, to the extent practicable, the number and height of transmission line structures within the line-of-site of the William Allison house and the Smithson-McCall farm and use, where possible, vegetative screening measures at the landowners' request.

4.13.2.3. Almaville Transmission Line

Background research identified no previously recorded archaeological sites and 15 previously recorded architectural resources (RD-3029, 3049, 3050, 3052, 3053, 3059, 3067, 3068, 3095–3098, and 3130–3132) within the proposed APE. Of the 15, only two architectural resources (RD-3053 and 3095) were located within the visual line of sight and had not been destroyed. These sites are considered ineligible for listing on the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage.

The archaeological survey identified one previously unrecorded site (40RD282), which is considered ineligible for listing on the NRHP due to shallow and disturbed deposits.

The historic/architectural survey identified one previously unrecorded architectural resource (HS-47) within the proposed APE. This resource is considered ineligible for the NRHP due to the lack of architectural distinction and loss of integrity caused by modern alterations and/or damage.

4.13.2.4. Christiana Transmission Line

Background research identified no previously recorded archaeological sites and 34 previously recorded architectural resources (RD-1465–1471, 1491, 1492, 1495–1497, 1515, 1516, 3005, 3006, 3008–3014, 3019, 3053, 3095, 3154, 3155, 3157, 3158, and 3161–3164) within the proposed APE. Of the 34, only 13 architectural resources (RD-1465–1470, 1495, 3011–3013, 3053, 3095, and 3161) were located within the visual line of sight and had not been destroyed. These sites are ineligible for the NRHP due to their lack of architectural distinction and loss of integrity caused by modern alterations and/or damage.

In addition to the previously recorded architectural resources, one NRHP-listed property (RD-1494 [Rockvale Store]) was located within the proposed APE. Since the date of its listing, several alterations have occurred (Section 3.13.4). As a result, the Rockvale Store does not retain sufficient integrity to remain listed on the NRHP.

The archaeological survey identified two previously unrecorded sites (40RD280 and 40RD281). Site 40RD280 is a mid-19th to the early 20th century historic cemetery and brick scatter and is considered ineligible for listing on the NRHP. The cemetery would be avoided during construction and maintenance. TVA redesigned the proposed transmission line route moving it to the south to avoid impacting the historic cemetery. As a result, the proposed route would have no adverse effect on Site 40RD280. Site 40RD281 is a collection of stone features of indeterminate age and is considered potentially eligible for listing on the NRHP. The stone features should be avoided during construction and maintenance. TVA redesigned the proposed transmission line route moving it to the south to avoid impacting the site. As a result, the proposed route would have no adverse effect on Site 40RD281.

The historic/architectural survey identified 15 previously unrecorded architectural resources (HS-32-46) within the proposed APE. These resources are considered ineligible for the NRHP.

TVA determined that the proposed Christiana Transmission Line, with the additional alternate routes, would not have the potential to affect any historic properties that are potentially eligible or currently listed on the NRHP (Appendix B-1).

4.13.2.5. Summary of Impacts and Proposed Mitigation Measures

The construction and operation of the proposed substation would not affect historic properties. The construction and operation of the Maury Transmission Line would not affect any listed or eligible archaeological sites. The William Ogilvie house, which is listed on the NRHP, no longer retains sufficient integrity for such listing. Thus, it would not be adversely affected. The Maury Transmission Line would have adverse visual effects on two historic properties, the William Allison house and Smithson-McCall farm, listed on the NRHP. Neither the Almaville Transmission Line nor the Christiana Transmission Line would affect historic properties eligible for or listed on the NRHP. The construction of temporary access roads associated with the proposed transmission lines would not affect historic properties or archaeological sites. These determinations are based in part on the implementation of the following mitigation measures:

- In order to avoid adverse effects to archaeological site 40WM35, TVA would not place transmission line structures within the site or cause other ground disturbance of the site. If impacts to the site cannot be avoided in this manner, TVA would conduct further Phase II archaeological testing to identify locations for structure placement that would not adversely affect the site.
- Archaeological sites 40RD280 and 40RD281 would be avoided by the rerouting of a section of the Christiana Transmission Line.
- TVA would minimize, to the extent practicable, the number and height of transmission line structures within the line-of-site of the William Allison house and the Smithson-McCall farm and use, where possible, vegetative screening measures at the landowners' request.

The Tennessee SHPO has concurred with TVA's determinations for the substation, the Almaville Transmission Line, and the Christiana Transmission Line in letters dated August 16, 2007, and August 23, 2007 (Appendix B-1). In a letter dated June 29, 2007 (Appendix B-1), the SHPO concurred with TVA's finding of adverse effects on the William Allison house and Smithson-McCall farm, both located along the Maury Transmission Line. TVA developed an MOA with the SHPO and other interested parties that prescribes treatment measures to be undertaken by TVA to mitigate these adverse effects (Appendix B-1).

The MOA, executed and implemented between the Tennessee SHPO and TVA pursuant to 36 CFR § 800, which addresses multiple steps in §§ 800.3 through 800.6, evidences the agency (TVA) official's compliance with Section 106, and this part shall govern the undertaking and all of its parts. The agency official shall ensure that the undertaking is carried out in accordance with the memorandum of agreement. Stipulations in the MOA under parts 800.3 through 800.6 implement a phased approach for the identification, evaluation, and treatment of historic properties (archaeological sites, historic sites, and historic structures) eligible or listed to the NRHP. The access roads would be addressed under the MOA pursuant to §§ 800.3 through 800.6, prior to their construction.

4.14. Socioeconomics

4.14.1. Alternative 1 – No Action

Under the No Action Alternative, no new substation or transmission lines would be built and no other actions would be taken. However, due to rapid growth in population and electricity use in Murfreesboro, Franklin, and surrounding areas, substation and transmission line capacities are expected to be exceeded by 2010 (see Chapter 1). New substation and transmission capacity would be necessary to meet this increased demand. Failure to provide this capacity would add instability to electrical supplies and increase the likelihood of both planned and unplanned power outages (brownouts/blackouts) in the area as demand continues to grow. This could result in significant losses to businesses and industries in the area. Individuals living or working in the area could suffer income losses as a result. Loss of electrical supply, especially during extreme weather conditions such as very hot or very cold temperatures, could impact and threaten human health and life depending on the duration and circumstances. Such impacts would be significant.

4.14.2. Alternative 2 – The Action Alternative

This action would have no effect on population in the area; it is instead a response to growth already occurring and projected to continue in the Middle Tennessee area. Construction would involve a relatively small crew of workers for a few months. Due to the nature of the project, most workers probably would either move in temporarily or commute from their current homes, especially if they live within 50 or 60 miles. Consequently, there would be little or no change in employment of local workers. Little impact on housing is anticipated since many of the construction workers who move temporarily into the area likely would rent motel rooms or provide their own lodging using campers or trailers.

Some local business income and local government revenues would be generated during the construction period from purchases of items such as meals and from lodging or campground rental fees. The impacts of this additional revenue would be small. Some construction materials could be purchased locally, but due to their nature, most of the purchases would likely be outside the area. The increase in local tax revenues generally would not be noticeable.

While TVA, as a federal agency, does not pay local property taxes, it does make in lieu of tax payments to the state, much of which is redistributed to local governments. These payments are based, in part, on the value of TVA-owned assets in a county. Therefore, the completion of the proposed substation and transmission lines would result in a small increase in these payments to Rutherford and Maury counties.

4.14.2.1. Rutherford 500-kV Substation

The substation is not expected to have negative impacts on property values in the area. Except possibly during construction, there would be no noticeable impacts on road traffic, visual quality in the area, or other factors that might influence property values. Existing mature vegetation that would remain on the south and west sides of the substation, as well as undulating topography, would obscure most views.

4.14.2.2. Maury, Almaville, and Christiana Transmission Lines

Almost the entire proposed ROW for the Maury Transmission Line is already owned by TVA, as is 6 of 9 miles of the proposed ROW for the Almaville Transmission Line. Landowners for the parts of these lines where TVA already owns the ROW would not receive additional compensation from TVA for TVA's use of the ROW. If TVA damages their property during line construction, TVA would either repair the damage or compensate the landowners for the damage. For those sections of the transmission lines where TVA does not already own the ROW, TVA would purchase the necessary easements from landowners at fair market value.

Existing buildings or structures that are within TVA's vacant ROW or within the new ROW would have to be removed. These structures include one occupied house, one unoccupied house, two occupied mobile homes, six barns, two well houses, four other sheds, and a diesel generator. Houses or other buildings may have to be purchased by TVA and removed from the ROW. TVA would pay the owner an agreed purchase price; provide a minimum of 90 days to vacate the property; provide a comparable replacement dwelling; and provide the relocation benefits the owner is eligible to receive. TVA also provides counseling and other relocation advisory services, as needed. A comparable replacement dwelling must be:

- Decent, safe, and sanitary.
- Functionally equivalent to the dwelling being removed.
- Within the owner's financial means.

A property owner on newly acquired transmission line ROW would be reimbursed for the cost of moving personal property. In addition, the owner might be eligible for supplemental payments to help relocate into comparable decent, safe, and sanitary replacement housing.

Much of the route that the transmission lines would follow is in areas, including residential areas, with existing poles, towers, lines, and other industrial features. In most cases, views of the line from residential and recreation areas would be between structures or from a distance.

Results of research on transmission line impacts on property values vary, with some early studies finding little or no impact of transmission lines on property values. Some more recent studies, however, indicate that impacts in the range of a 5 to 10 percent decrease

are possible for properties adjacent to a transmission line. Additionally, depending on market conditions, no change or an increase is also possible. The size of the impact appears to be sensitive to distance, with little or no impact to properties not adjacent or very close. The magnitude of the impact is sensitive not only to distance but also to the appearance of the ROW and how it integrates into the neighborhood. The impacts on property value tend to diminish over time and some studies have found that they virtually disappear in about five years (Hamilton and Schwann 1995; Gregory and Winterfeldt 1996; Electric Power Research Institute 2003). Therefore, no significant adverse impacts on property values are expected.

4.15. Environmental Justice

4.15.1. Alternative A – No Action

Under the No Action Alternative, the proposed substation and transmission lines would not be built. As discussed in Section 4.14.1, failure to provide needed additional capacity would add instability to electrical supplies and increase the likelihood of both planned and unplanned power outages in the area as demand continues to grow. The resulting impacts on businesses, industries, and residences in the area however could occur anywhere in the area and are not likely to disproportionately affect minority or low-income populations. Therefore, no significant disproportionate environmental justice impacts would occur.

4.15.2. Alternative B – The Action Alternative

4.15.2.1. Rutherford 500-kV Substation

As discussed in Section 3.15.1, the area around the proposed substation site has a very small minority population. The poverty level is below both the county and state levels. Due to the location of the proposed facility and to the small share of minority and low-income residents, no environmental justice impacts are anticipated.

4.15.2.2. Maury Transmission Line

As discussed in Section 3.15.2, the area around the proposed 500-kV transmission line has a very small minority population. The largest minority population shares along the route are the areas in Maury County, all of which have minority population shares smaller than the county, state, and national averages, and one area in Williamson County, which is higher than the county average, but well below the state and national averages. Poverty levels are generally below the state and national levels. The proposed route is generally not densely populated, although there are occasional subdivisions in view. In Rutherford County, CT 408.04, BG 1, has a relatively high poverty level. However, the proposed line would pass through a sparsely populated area in this BG. CT 408.02, BG 2, has a low minority population, although some blocks near the line have high minority population shares. However, this area is also sparsely populated, and much of it is heavily wooded. Due to the location of the proposed route and to the overall small share of minority and low-income residents, no environmental justice impacts are anticipated.

4.15.2.3. Almaville Transmission Line

As discussed in Section 3.15.3, the area around the proposed Almaville Transmission Line has a very small minority population, well below the county level as well as the state and national levels. This area includes two census tracts, both in Rutherford County. In CT 408.03, the poverty level is well below the county, state, and national levels. In the other block group, CT 408.04, the poverty rate is also below the county, state, and national levels; however, one affected area, BG 1, has a poverty level of 14.4 percent, higher than

the county level and slightly higher than the state and national levels. None of the impacted blocks have a minority population share greater than the county average. Only one block group, CT 408.04, BG 1, has a higher poverty level, 14.4 percent, than the county. This poverty level population is somewhat removed from the proposed line route. As discussed in Section 4.12.2.3, this section of the line, south of SR 96, generally would be visible only at a distance and from higher locations. Overall, the proposed route is not densely populated, and the lines would generally be visible at a distance or in areas where other structures exist. Due to the location of the proposed route, the generally sparse population, the overall small share of minority residents, and the low poverty levels in most of the area, no environmental justice impacts are anticipated.

4.15.2.4. Christiana Transmission Line

As discussed in Section 3.15.4, the area around the proposed Christiana Transmission Line has a very small minority population, well below the county level as well as the state and national levels. Two blocks, however, have relatively high minority population shares. In CT 408.02, Block 1017 has a minority share of 25.8 percent. The proposed line would pass through the northern part of this block, where there are no nearby houses. The view of the line in this area is largely restricted to motorists on SR 99. In CT 407, Block 2002 has a minority share of 41.2 percent. This is a sparsely populated area with heavy vegetation that obscures views of the line (see Section 4.12.2.4). Poverty levels in all block groups except one are well below the county, state, and national levels. In CT 408.04, BG 1, the poverty rate is 14.4 percent, higher than the county average and slightly higher than the state and national averages. This block group is in a sparsely populated area, as discussed in Section 4.12.2.4, and the line would be seen only at a distance along higher peaks. In the other block groups, the poverty rate is lower than the county, state, and national levels. Overall, the proposed route is generally not densely populated, and the lines would generally be visible at a distance or in areas where other structures exist. Due to the location of the proposed route, the generally sparse population, the overall small share of minority residents, and the low poverty levels in much of the area, no environmental justice impacts are anticipated.

4.16. Post-Construction Impacts

4.16.1. Electric and Magnetic Fields

For the planning of new transmission line ROWs, TVA's transmission line route selection team uses a constraint model that places a 300-foot-radius buffer around occupied buildings, except schools, for which a 1,200-foot buffer is used. The purpose of these buffers is to reduce potential land use conflicts with yard trees, outbuildings, and ancillary facilities; reduce potential visual impacts; and reduce exposure to the magnetic field produced by the transmission line. Application of these constraints typically requires tradeoffs and balancing, and TVA can and does deviate from the constraints. These constraints are not applied to the use of existing transmission line ROWs. Property owners are free to build houses and other structures up to the edge of TVA's ROWs within these constraint distances.

Transmission lines, like all other types of electrical wiring, generate both electric and magnetic fields (EMF). The voltage on the conductors of the transmission line generates an electric field that occupies the space between the conductors and other conducting objects such as the ground, transmission line structures, or vegetation. A magnetic field is generated by the current (movement of electrons) in the conductors. The strength of the field depends on the current, design of the line, and distance from the line.

The fields from a transmission line are reduced by mutual interference of the electrons that flow around and along the conductors and between the conductors; the result is dissipation of the already low energy. Most of this energy is dissipated on the ROW and the residual very low amount is reduced to background levels near the ROW or energized equipment.

Magnetic fields can induce currents in conducting objects. Electric fields can create static charges in ungrounded, conducting materials. The strength of the induced current or charge under a transmission line varies with 1) the strength of the electric or magnetic field, 2) the size and shape of the conducting object, and 3) whether the conducting object is grounded. Induced currents and charges can cause shocks under certain conditions by making contact with objects in an electric or magnetic field.

The proposed transmission line, like other transmission lines, has been designed to minimize the potential for such shocks. This is done, in part, by maintaining sufficient clearance between the conductors and objects on the ground. Stationary conducting objects, such as metal fences, pipelines, and highway guard rails that are near enough to the transmission line to develop a charge would be grounded by TVA to prevent them from being a source of shocks.

The proposed transmission lines, like other transmission lines, have been designed to minimize the potential for such shocks. This is done, in part, by maintaining sufficient clearance between the conductors and objects on the ground. Stationary conducting objects, such as metal fences, pipelines, and highway guardrails, which are near enough to the transmission line to develop a charge (typically these would be objects located within the ROW), would be grounded by TVA to prevent them from being a source of shocks.

Under certain weather conditions, high-voltage transmission lines, such as the proposed 500-kV and 161-kV lines, may produce an audible low-volume hissing or crackling noise (Appendix O). This noise is generated by the corona resulting from the dissipation of energy and heat as high voltage is applied to a small area. Under normal conditions, corona-generated noise is not audible. The noise may be audible under some wet conditions, and the resulting noise level off the ROW would be well below the levels that can produce interference with speech. Corona is not associated with any adverse health effects in humans or livestock.

Other public interests and concerns have included potential interference with AM radio reception, television reception, satellite television, and implanted medical devices. If interference occurs with radio or television reception, it would be due to unusual failures of power line insulators or poor alignment of the radio or television antenna and the signal source. Both conditions are correctable and would be repaired if reported to TVA.

Implanted medical devices historically had a potential for power equipment strong-field interference when they came within the influence of low-frequency, high-energy workplace exposure. However, the older devices and designs (i.e., more than five to 10 years old) have been replaced with different designs and different shielding that eliminate the potential for interference from external field sources up to and including the most powerful magnetic resonance imaging medical scanners. Unlike high-energy radio frequency devices that can still interfere with implanted medical devices, low-frequency, and low-energy powered electric or magnetic devices no longer potentially interfere (Journal of the American Medical Association 2007).

Research has been done on the effects of EMF on animal and plant behavior, growth, breeding, development, reproduction, and production. This research has been conducted in the laboratory and under environmental conditions, and no adverse effects on health or the above considerations have been reported for the low-energy power frequency fields (World Health Organization [WHO] 2007a). Effects associated with ungrounded, metallic objects and static charge accumulation and discharge in dairy facilities have been found when the connections from a distribution line meter have not been properly installed on the farm side of a distribution circuit.

TVA substations and transmission lines are built with overhead ground wires that would lead a lightning strike into the ground for dissipation. Thus, a safety zone is created under the ground wires at the top of structures and along a line, for at least the width of the ROW or within a substation. The National Electrical Safety Code is strictly followed when installing, repairing, or upgrading TVA lines, substations, or equipment.

There is some public concern as to the potential for adverse health effects that may be related to long-term exposure to EMF. A few studies of this topic have raised questions about cancer and reproductive effects on the basis of biological responses observed in cells or in animals or on associations between surrogate measures of power line fields and certain types of cancer. Research has been ongoing for several decades.

The consensus of scientific panels reviewing this research is that the evidence does not support a cause-and-effect relationship between EMF and any adverse health outcomes (e.g., American Medical Association [AMA] 1994; National Research Council 1997; National Institute of Environmental Health Sciences [NIEHS] 2002). Some research continues of the statistical association between magnetic field exposure and a rare form of childhood leukemia known as acute lymphocytic leukemia. A recent review of this topic by the WHO (International Association for Research on Cancer 2002) concluded that this association is very weak, and there is inadequate evidence to support any other type of excess cancer risk associated with exposure to EMF.

TVA follows medical and health research related to EMF, along with media coverage and reports that may not have been peer reviewed by scientists or medical personnel. No controlled laboratory research has demonstrated a cause-and-effect relationship between low-frequency electric or magnetic fields and health effects or adverse health effects even when using field strengths many times higher than those generated by power transmission lines. Statistical studies of overall populations and increased use of low-frequency electric power have found no associations (WHO 2007b).

Neither medical specialists nor physicists have been able to form a testable concept of how these low-frequency, low-energy power fields could cause health effects in the human body where natural processes produce much higher fields. To date, there is no agreement in the scientific or medical research communities as to what, if any, electric or magnetic field parameters might be associated with a potential health effect in a human or animal. There are no scientifically or medically defined safe or unsafe field strengths for low-frequency, low-energy power substation or line fields.

The current and continuing scientific and medical communities' position regarding the research and any potential for health effects from low-frequency power equipment or line fields is that there are no reproducible or conclusive data demonstrating an effect or an adverse health effect from such fields (WHO 2007c). In the United States, national

organizations of scientists and medical personnel have recommended no further research on the potential for adverse health effects from such fields (AMA 1994; U.S. Department of Energy 1996; NIEHS 1998).

Although no federal standards exist for maximum EMF strengths for transmission lines, two states (New York and Florida) do have such regulations. Florida's regulation is the more restrictive of the two with field levels being limited to 150 milligauss (mG) at the edge of the ROW for lines of 230-kV and less. The expected magnetic field strengths at the edge of the proposed ROW would fall well within these standards.

In light of all of the above, the construction and operation of the proposed transmission line is not anticipated to cause any significant EMF-related impacts.

4.16.2. Lightning Strike Hazard

TVA transmission lines are built with overhead ground wires that lead a lightning strike into the ground for dissipation. Thus, a safety zone is created under the ground wires at the top of structures and along the line for at least the width of the ROW. The National Electrical Safety Code is strictly followed when installing, repairing, or upgrading TVA lines or equipment. Transmission line structures are well grounded, and the conductors are insulated from the structure. Therefore, touching a structure supporting a transmission line poses no inherent shock hazard.

4.16.3. Transmission Structure Stability

The laced-steel tower structures (Figures 2-13 and 2-14) that would be used on the proposed 500-kV transmission lines are the result of detailed engineering design and have been used by TVA for over 70 years with an exceptional safety record. Many structures of this type have been in service for more than 60 years with little maintenance necessary other than painting or minor repair of some of the steel members.

The pole structures (Figures 2-15 and 2-16) that would be used on the proposed 161-kV transmission lines have demonstrated a good safety record. They are not prone to rot or crack, like wooden poles, nor are they subject to substantial storm damage due to their low cross-section in the wind.

Additionally, all TVA transmission structures are examined visually at least once a year. Thus, the proposed structures do not pose any significant physical danger. For this reason, TVA does not typically construct barricades or fences around structures.

4.16.4. Noise and Odor

During construction of the proposed transmission line, equipment would generate noise above ambient levels. Because of the short construction period, noise-related effects are expected to be temporary and insignificant. In the more densely populated areas along the ROW, construction techniques would be used to limit noise as much as possible. For similar reasons, noise related to periodic line maintenance is also expected to be insignificant. In residential areas, the need for periodic ROW vegetation maintenance, i.e., mowing, would be limited or nonexistent. Construction and operation of the line is not expected to produce any noticeable odors.

Additionally, no significant long-term impacts related to noise are expected as a result of the operation of the substation or transmission lines (Appendix O). It is expected that circuit breakers at the substation could occasionally open to disconnect part of the transmission

system during incidents such as excessive current or voltage fluctuations. The resulting noise could startle people nearby; however, because of the infrequent occurrences, it would not result in a significant impact (Appendix O). As described in Section 4.16.1, 500-kV lines may also produce noise under certain atmospheric conditions. Off the ROW, this noise is below the level that would interfere with speech.

4.16.5. Other Impacts

As indicated in Section 4.14.2.2, a number of structures occur within both the TVA-owned, vacant ROW and the proposed new ROW. Due to restrictions regarding the existence of structures within the ROW, these would have to be removed or torn down prior to the construction of the transmission lines. Any materials from these structures that would be considered hazardous waste (i.e. lead paint, asbestos) would be properly disposed of according to TVA standard procedures.

No significant impacts are expected to result from the relatively short-term activities of construction, such as air quality and solid waste. Appendices E through G contain procedures for dealing with these issues.

4.16.6. Alternative 1 – No Action

Under the No Action Alternative, no new EMFs would be created from the construction of the proposed transmission line. The electrical loading on portions of TVA's existing transmission system would likely be increased, resulting in increases in EMF. However, this increase would not result in any significant impacts.

4.16.7. Alternative 2 – The Action Alternative

EMFs would be produced along the length of the proposed transmission lines. The strength of the fields within and near the ROW would vary with the electric load on the line as well as with the terrain. Public exposure to EMF would be determined by final routing decisions, and would change over time after the line is completed as adjacent land uses change. As described above, TVA would minimize public exposure to EMF through engineering features and line routing decisions. No significant impacts from EMF are anticipated.

Transmission line structures are well grounded, and the conductors are insulated from ground. Therefore, touching a structure supporting a 161-kV transmission line poses no inherent shock hazard. Additionally, TVA transmission lines are built with overhead ground wires that would lead a lightning strike into the ground for dissipation. Thus, a safety zone is created under the ground wires at the top of structures and along a line for at least the width of the ROW. The National Electrical Safety Code is strictly followed when installing, repairing, or upgrading TVA lines or equipment.

The structures that would be used on the proposed transmission line have demonstrated a good safety record. Unlike lattice-type structures, they are difficult to climb without special equipment. They are not prone to rot or crack, like wooden poles, nor are they subject to substantial storm damage due to their low cross-section in the wind. Thus, the proposed structures do not pose any significant physical danger. For this reason, TVA does not typically construct barricades or fences around structures.

During construction of the proposed transmission line, equipment would generate some noise above ambient levels. Because of the general lack of nearby sensitive receptors and the short construction period, noise-related effects are expected to be temporary and

insignificant. For similar reasons, noise related to periodic line maintenance is also expected to be insignificant. Construction and operation of the line is not expected to produce any noticeable odors.

4.17. Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources generally occur through the use of nonrenewable resources that have few or no alternative uses at the termination of the proposed action. Transmission line and substation construction would require the irreversible commitment of fossil fuels (diesel and gasoline), oils, lubricants, and other consumables used by construction equipment and by workers commuting to the site. Other materials used for construction of the proposed facilities would be committed for the life of the facilities. Some of these materials, such as ceramic insulators and concrete foundations, may be irreversibly committed, while the metals used in conductors, supporting structures, and other equipment could be recycled. The useful life of the transmission structures is expected to be at least 60 years. Operation and maintenance of the facilities would use small amounts of fuels, lubricants, and other nonrenewable consumables.

Irretrievable commitments of resources result in the lost production or use of renewable resources such as timber, agricultural land, or wildlife habitat. Land utilized by the substation would be committed to industrial use for the life of these facilities; however, it is possible that a full range of uses could be restored with the retirement of these facilities. The range of available land uses for the transmission line ROW would be restricted during the life of the transmission line, but the full range of uses could be restored upon retirement of the line. In the interim, compatible uses of the ROW, such as farming and providing early successional wildlife habitat, could continue. Forest products and related late-successional wildlife, which might have grown in the ROW, would be irretrievably lost for the life of the project. Lands used only during initial construction activities, such as temporary access roads and construction assembly areas, would be restored according to the landowner's needs and become available for other uses soon after construction is completed. No locally or regionally significant lost forest or agricultural production would be expected.

4.18. Unavoidable Adverse Effects

The construction and operation of the proposed transmission line would result in unavoidable adverse effects to several resources. Many adverse effects associated with the Maury, Almaville, and Christiana transmission line routes were reduced to acceptable levels via avoidance during the transmission line routing process. Some other potentially adverse effects could be minimized by mitigation and monitoring procedures specified in Section 2.9 of this EIS. As previously stated, clearing for the Rutherford Substation and the associated transmission line connections would result in the removal of approximately 370 acres of forest.

Adverse effects resulting from the Action Alternative that cannot be avoided include the following:

- The substation location would be graveled. Trees would not be permitted to grow within the transmission line ROW or to a determined height adjacent to the ROW that would endanger the transmission line.
- Clearing and construction would result in the disruption of some wildlife, but no long-term habitat changes would occur except in the wooded areas previously described and on the substation site.

- There would be increased forest fragmentation, loss of forest area, and their associated wildlife populations.
- Any burning of cleared material would result in some short-term air pollution.
- Clearing, tree removal, and excavation for structure/pole erection and substation construction would result in a small amount of localized siltation.
- The tree canopy at stream crossings would be removed.
- Localized increases in noise would occur during construction and some later maintenance activities.
- Existing buildings would be removed from the new ROW and the TVA-owned ROW, including one occupied house, one unoccupied house, two occupied mobile homes, six barns, two well houses, four other sheds, and a diesel generator.
- Future land use restrictions would apply within the ROW.
- Changes would occur to scenery along the ROW, both short term from construction equipment and ground-disturbing activities, later during periodic removal of vegetation from the ROW, and long term from the cleared ROW and the addition of metal structures and conductors. Transmission line and substation visibility has been minimized through the siting process; however, there would be long-term effects on the landscape in the project area.

Houses or other buildings may have to be purchased by TVA and removed from the ROW. TVA would pay the owner an agreed purchase price; provide a minimum of 90 days to vacate the property; provide a comparable replacement dwelling; and provide the relocation benefits the owner is eligible to receive. TVA also provides counseling and other relocation advisory services, as needed. A comparable replacement dwelling must be:

- Decent, safe, and sanitary.
- Functionally equivalent to the dwelling being removed.
- Within the owner's financial means.

A property owner on newly acquired transmission line ROW would be reimbursed for the cost of moving personal property. In addition, the owner might be eligible for supplemental payments to help relocate into comparable decent, safe, and sanitary replacement housing.

4.19. Relationship of Short-Term Uses and Long-Term Productivity

The construction and operation of the proposed substation and associated transmission lines would increase the short-term and long-term capacity and reliability of the power supply in TVA's service area. This would help support the economic and population growth that is presently occurring, and is forecast to continue to occur, in the Middle Tennessee area and the quality of life that depends on adequate and reliable supplies of electric energy.

The proposed action would result in both short-term and long-term effects on vegetation and wildlife, especially in forested areas where potential forest productivity, including timber and associated wildlife production, would be lost from within the ROW where these resources now exist. The principal change in short-term use of the ROW would be the exclusion of trees and permanent structures. The amount of forest being lost is approximately 370

acres within the ROW area, and areas removed from production are dispersed along the length of the transmission line. A small amount of agricultural productivity would be lost from new transmission structure foundations and access roads.

There would be long-term effects on land use within the ROW due to restrictions on building construction. The ROW cannot support building construction for the life of the project, but the social and economic benefits of the project should outweigh this small loss. Additional long-term effects would occur on scenery in the project area due to the visual intrusions of the transmission structures and conductors. These short-term and long-term effects have been, to the extent possible, minimized during project planning.

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