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FINAL ENVIRONMENTAL ASSESSMENT

MURFREESBORO-EAST FRANKLIN AND PINHOOK-RADNOR 161-KV TRANSMISSION LINES

Rutherford, Williamson, and Davidson Counties, Tennessee

TENNESSEE VALLEY AUTHORITY

MARCH 2007

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ACRONYMS, ABBREVIATIONS, AND SYMBOLS

°F	Degree Fahrenheit
#	Number
AP	Access point (refers to permanent access roads that would allow vehicle access to structures and other points along the proposed right-of-way)
APE	Area of Potential Effect
BC	Before Christ
BMP	Best Management Practice
CFR	Code of Federal Regulations
DCH	Designated Critical Habitat
e.g.	Latin term, *exempli gratia*, meaning "for example"
EMF	Electric and Magnetic Fields
EO	Executive Order
et al.	Latin term, *et alii* (masculine), *et aliae* (feminine), or *et alia* (neutral), meaning "and others"
etc.	Latin term *et cetera,* meaning "and other things" "and so forth"
I -	Interstate Highway
ibid	Abbreviation for the Latin term, *ibidem*, meaning "in the same place;" refers to the immediately preceding author or work cited
i.e.	Latin term, *id est,* meaning "that is"
kV	Kilovolt
MS4	Municipal Separate Storm Sewer System
MTEMC	Middle Tennessee Electric Membership Corporation
MW	Megawatt
n.d.	No date (indicates date of access undetermined on Web sites listed under Literature Cited)
NEPA	National Environmental Policy Act
NNL	National Natural Landmark
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
OSHA	Occupational Safety and Health Administration
RM	River Mile
SMZ	Streamside Management Zone
SNA	State Natural Area
spp.	Species
SR	State Route
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority
TVARAM	TVA-developed modification of the Ohio Rapid Assessment Method (Mack 2001) specific to the TVA region
US	U.S. Highway
U.S.	United States
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USNPS	U.S. National Park Service

CHAPTER 1

1. PURPOSE OF AND NEED FOR ACTION

1.1. Proposed Action: Improve Power Supply

Tennessee Valley Authority's (TVA) proposed action is to relieve the potential for transmission line overloading on the TVA transmission line system by building an approximately 23-mile, 161-kilovolt (kV) transmission line connection from the existing Murfreesboro Substation to the existing East Franklin Substation by May 2008. Most of this new transmission line would be on transmission line right-of-way owned by TVA, where the existing transmission lines would be removed and rebuilt. About 1.75 miles of new right-of-way would be required to avoid environmentally sensitive areas on the existing right-of-way. The new transmission line would tie to the existing transmission system near the Cason Lane Substation before continuing west to the Triune Substation and finally the East Franklin Substation (Figure 1-1). The transmission line would be constructed as two circuits on a single set of structures located on mostly existing TVA 100-foot-wide right-of-way. The two circuits would be tied together electrically to allow a higher electric capacity.

In addition to the transmission line construction, TVA would install one 161-kV circuit breaker and bay at the Murfreesboro Substation and add jumpers in another bay; reconductor the approximate 10 mile Pinhook-Radnor 161-kV Transmission Line and add another conductor to the vacant side of the existing Pinhook-Radnor Transmission Line structures thus creating a second Pinhook-Radnor circuit (Figure 1-1). TVA would also rearrange existing transmission line connections at existing substations to create a Pinhook-Radnor 161-kV Transmission Line and a Pinhook-South Nashville 161-kV Transmission Line, and install two new 161-kV breakers at the Pinhook Substation. Communication and relay modifications would be made at several existing TVA facilities.

1.2. Need

Reliability is a concern in providing adequate electric service to the area. TVA's transmission system studies have identified several different contingencies, or unexpected event scenarios, that each predict that seven separate 161-kV transmission lines in the Middle Tennessee power service area in Rutherford and Williamson counties are likely to overload by 2008. The worst of these seven transmission line overloads would occur on the North Tullahoma-Wartrace and Hurricane Creek-Interchange City 161-kV transmission lines. In the event of the loss of the Franklin-Wartrace 161-kV Transmission Line, the North Tullahoma-Wartrace 161-kV Transmission Line is projected to overload to 121 percent of capacity. The Hurricane Creek-Interchange City 161-kV Transmission Line would overload to 113 percent in the event of the loss of the Pinhook-Smyrna 161-kV Transmission Line. To prevent the transmission line overloading scenarios on these transmission line segments, service of approximately 266 megawatts (MW) would have to be suspended.

In addition to the overload concerns, a maintenance outage predicament at the Murfreesboro Substation could result in a voltage collapse in the Middle Tennessee area. The Smyrna-Murfreesboro and Gallatin-Murfreesboro transmission lines provide strong power sources into Murfreesboro. Maintenance operations are typically done at moderate load levels, but even at this level, the disconnection of one of these transmission lines combined with the subsequent loss of the other would result in a blackout in the city of Murfreesboro.

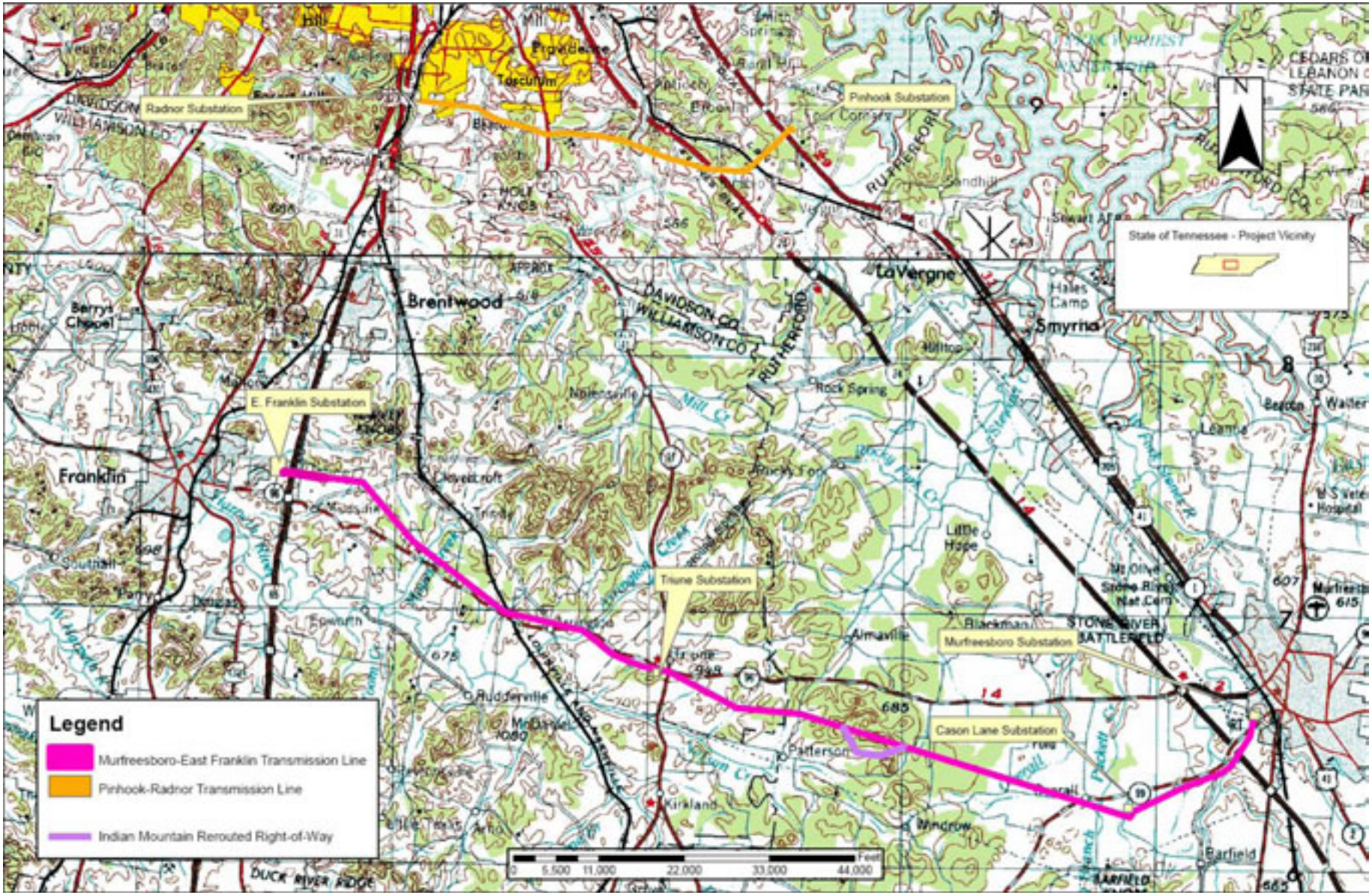


Figure 1-1. The Preferred Route for the Proposed Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Line in Rutherford, Williamson, and Davidson Counties, Tennessee

Two additional transmission projects are in some stage of development in the same general area as the Murfreesboro-East Franklin and Pinhook-Radnor Transmission Line project; the Clovercroft delivery point project (TVA, 2006) and the Rutherford-Williamson-Davidson Power Supply Improvement Project.

The Clovercroft project will provide a connection to the existing TVA transmission system for a new Middle Tennessee Electric Membership Corporation (MTEMC) delivery point near Nolensville, Tennessee. This project addresses the growing residential and commercial load in the Nolensville area, which requires MTEMC to have additional electric load capacity by November 2007. The Clovercroft project was the subject of an environmental assessment for which a finding of no significant impact was issued November 14, 2006.

The Rutherford-Williamson-Davidson Power Supply Improvement Project addresses the projected overloading of key components of TVA's 500-kV transmission system in 2010 in the Middle Tennessee area and the overloading of multiple 161-kV transmission lines in the area in the 2009-2010 time frame. TVA issued a Notice of Intent to prepare an environmental impact statement for this project in July 2005 and is presently conducting engineering and environmental studies of it.

Although these two projects and the subject Murfreesboro-East Franklin and Pinhook - Radnor Transmission Line project are in the same area and address overloading and capacity problems, they each have independent utility and are separate actions.

1.3. Objectives of the Proposed Action

To increase the reliability of the TVA transmission line system in the Middle Tennessee power service area, TVA proposes to construct approximately 23 miles of new 161-kV transmission line from the existing Murfreesboro Substation to the existing East Franklin Substation. This transmission line would provide a third strong power source into the Murfreesboro area and would provide voltage support for the Murfreesboro power service area that would prevent overloading of the transmission lines based on the contingency situations identified in the TVA transmission system studies.

1.4. Decisions

The primary decisions before TVA are whether to build a new 161-kV transmission line connecting the Murfreesboro Substation and the East Franklin Substation; to install improvements at the Murfreesboro Substation; to reconductor the Maury-Henpeck 161-kV Transmission Line; to reconductor the Pinhook-Radnor 161-kV Transmission Line; to add a conductor on the vacant side of the existing Pinhook-Radnor Transmission Line structures to create a second Pinhook-Radnor Transmission Line circuit; rearrange connections to create a Pinhook-Radnor 161-kV Transmission Line and a Pinhook-South Nashville 161-kV Transmission Line; and to install two new 161-kV breakers at the Pinhook Substation.

If these actions are implemented, other secondary decisions are involved. These include the following considerations:

- The timing of improvements
- The best route for a transmission line

- Determining any necessary mitigation and/or monitoring measures to implement to meet TVA standards and minimize potential damages to resources

1.5. Public Involvement

The following federal, state, and local agencies and tribes have been contacted to date by TVA concerning this project:

- Eastern Band of the Cherokee Indians, Cherokee, North Carolina
- The Muscogee (Creek) Nation of Oklahoma
- Tennessee Department of Environment and Conservation
- Tennessee Historical Commission
- U.S. Fish and Wildlife Service

This proposal was reviewed in accordance with Executive Order (EO) 11988 (Floodplain Management), EO 11990 (Protection of Wetlands), Farmland Protection Policy Act, National Historic Preservation Act, Endangered Species Act, Section 404 of the Clean Water Act, and EO 12372 (Intergovernmental Review). Correspondence received related to this coordination is contained in Appendix I.

1.6. Necessary Permits or Licenses

A permit would be required from the State of Tennessee for construction site storm water discharge for the transmission line construction. Permits required by Municipal Separate Storm Sewer System (MS4) regulations would be needed in the City of Murfreesboro, the City of Franklin, Rutherford County, and Williamson County. TVA's Transmission Line Construction organization would prepare the required erosion and sedimentation control plans and coordinate them with the appropriate state and local authorities. A permit would also be required for burning trees and other combustible materials removed during transmission line construction.

CHAPTER 2

2. ALTERNATIVES INCLUDING THE PROPOSED ACTION

2.1. Introduction

A description of the various alternatives considered is provided in this chapter. Additional background information about transmission line construction, operation, and maintenance is also provided. This chapter has the following five major sections:

- Description of Alternatives
- Alternative Eliminated From Detailed Study
- Description of Construction, Operation, and Maintenance of the Existing and Proposed 161-kV Transmission Line
- Project and Siting Alternatives
- Identification of the Preferred Alternative

This chapter describes all of the alternatives explored and provides a detailed description of the necessary steps in constructing a transmission line.

2.2. Description of Alternatives

2.2.1. Alternative 1 – Do Not Construct the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Lines (No Action)

Under the No Action Alternative, TVA would not construct approximately 23 miles of new transmission line on the existing Murfreesboro-East Franklin Transmission Line right-of-way. Additionally, TVA would not implement any substation improvements, the Pinhook-Radnor Transmission Line would not be reconductored, and a second Pinhook-Radnor circuit would not be added. As a result of implementing the No Action Alternative, the TVA transmission system in Rutherford and Williamson counties would continue to operate with a high-risk level of interruption in certain situations. This risk would likely increase over time as the electrical loads in the area continue to grow. With these considerations, it was determined that this alternative would not address the reliability concerns in TVA's Middle Tennessee power service area.

2.2.2. Alternative 2 – Construct and Operate the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Lines (Action)

Under the Action Alternative, TVA would construct and operate approximately 23 miles of new 161-kV transmission line that would connect the existing Murfreesboro and East Franklin substations. The newly constructed line would begin near the Cason Lane Substation and continue west to the Triune Substation before then continuing toward East Franklin (Figure 1-1). This section of transmission line would be about 21 miles in length and would be constructed as two circuits on a single set of structures on an existing 100-foot-wide right-of-way. The two circuits would be tied together electrically to allow a higher electric capacity. Most of the 12-mile section between the Cason Lane and Triune substations would be built on existing right-of-way which is presently occupied by a de-energized 46-kV transmission line built using wood poles. The de-energized line would be

removed and the materials would be recycled or disposed as appropriate. This section of right-of-way would require reclearing in some areas as it has not been maintained for several years. About 1.75 miles of this portion of the line would be on new right-of-way a short distance south of the existing right-of-way (Figure 1-1).

About nine miles of the proposed Murfreesboro-East Franklin Transmission Line, between the Triune and East Franklin substations, would be built on existing right-of-way which is presently occupied by an operating 161-kV transmission line built using wood poles. This section of transmission line would be taken out of service and removed, and the materials would be recycled or disposed as appropriate. This right-of-way section would require little or no reclearing.

Under the Action Alternative, TVA would also install one 161-kV circuit breaker and bay at Murfreesboro Substation and add jumpers in another bay; reconductor approximately 10 miles of the Pinhook-Radnor 161-kV Transmission Line and add another conductor to the vacant side of the existing Pinhook-Radnor Transmission Line structures thus creating a second Pinhook-Radnor circuit (Figure 1-1). Additionally, TVA would rearrange existing transmission line connections at existing substations to create a Pinhook-Radnor 161-kV Transmission Line and a Pinhook-South Nashville 161-kV Transmission Line and would install two new 161-kV breakers at the Pinhook Substation. Communication and relays' modifications would be made at several existing TVA facilities.

2.3. Alternative Eliminated From Detailed Study – Reconductor TVA's Existing 161-kV Transmission Lines in the Project Area

Under this alternative, TVA would reconductor seven of TVA's existing 161-kV transmission lines in Middle Tennessee to improve reliability. The transmission lines under consideration include the following:

- Pinhook-Hurricane Creek Transmission Line
- Hurricane Creek-Interchange City Transmission Line
- Interchange City-Murfreesboro Transmission Line
- Maury-Henpeck Transmission Line
- Davidson-Radnor #1 Transmission Line
- Davidson-Radnor #2 Transmission Line
- Gallatin-Murfreesboro Transmission Line

Two significant problems were identified with the implementation of this alternative. First, this alternative would not provide a third strong electrical source into the Murfreesboro area and thus would not solve the maintenance outage problem experienced at the Murfreesboro Substation that could result in a voltage collapse in the Middle Tennessee area in the event of the loss of one of these seven transmission lines.

The second identified problem is that three of the transmission lines that would require reconductoring under this option (Pinhook-Hurricane Creek, Davidson-Radnor #1 and Davidson-Radnor #2 transmission lines) are already composed of the largest conductor

available on the TVA transmission line system. No reasonable means are available to uprate these transmission lines in their present locations.

Based on these factors, this alternative was deemed unreasonable and eliminated from further study.

2.4. Description of Construction, Operation, and Maintenance of the Existing and Proposed 161-kV Transmission Line

2.4.1. Transmission Line Construction

2.4.1.1. Right-of-Way Acquisition and Clearing

Approximately 21 miles of existing and 1.75 miles of new right-of-way 100 feet wide would be needed for the proposed transmission line that would connect TVA's existing East Franklin and Murfreesboro substations.

TVA would purchase easements from landowners for the new right-of-way on private land. These easements would give TVA the right to construct, operate, and maintain the transmission line, as well as remove danger trees off the right-of-way. Danger trees are those trees that are located away from the cleared right-of-way, but are tall enough to pass within 5 feet of a conductor or strike a structure should it fall toward the transmission line. Fee title, i.e., ownership, for the land within the right-of-way remains with the landowner, and a number of activities may be continued on the property by the landowner. However, the easement agreement prohibits certain activities such as the construction of buildings and any other activities within the right-of-way that could interfere with the transmission line or create a hazardous situation.

Because of the need to maintain adequate clearance between tall vegetation and transmission line conductors, as well as to provide access for construction equipment, most trees and shrubs would be initially removed from the entire width of the right-of-way. Equipment used during this right-of-way clearing would include chain saws, skidders, bulldozers, tractors, and/or low ground-pressure feller-bunchers. Marketable timber would be salvaged where feasible; otherwise, woody debris and other vegetation would be piled and burned, chipped, or taken off site. In some instances, vegetation may be windrowed along the edge of the right-of-way to serve as sediment barriers.

Streamside management zones (SMZs) would be established along intermittent and perennial streams; their width would be based on stream characteristics, slope, soil types, and other factors (Muncy 1999). Vegetation removal in SMZs and wetlands would be restricted to trees tall enough, or with the potential soon to grow tall enough, to interfere with conductors. Clearing in SMZs would be accomplished using hand-held equipment or remote-handling equipment, such as a feller-buncher, in order to limit ground disturbance. *TVA Right-of-Way Clearing Specifications, Environmental Quality Protection Specifications for Transmission Line Construction, and Transmission Construction Guidelines Near Streams* (Appendices II, III, and IV) would be followed in clearing and construction activities.

Subsequent to clearing and construction, the right-of-way would be restored as much as is possible to its state prior to construction. Pasture areas would be reseeded with suitable grasses. Wooded areas would be restored using native grass and other low-growing

species. Erosion controls such as silt fences would remain in place until adequate plant cover is established. Streamside areas would be revegetated as described in Appendices II through IV.

2.4.1.2. Access Roads

Permanent access roads would be needed to allow vehicle access to each structure and other points along the new right-of-way. Seventy-three access roads were included in the environmental field review. Of these, 46 were identified along the proposed Murfreesboro-East Franklin Transmission Line and 27 along the proposed Pinhook-Radnor Transmission Line. These access roads are primarily existing roads that include privately built, farm and field roads, some of which may need upgrading with minor grading and the placement of gravel.

Typically, the access roads are located on the right-of-way wherever possible and designed to avoid areas with steep slopes and to minimize stream crossings. The roads are typically about 20 feet wide and surfaced with dirt or gravel. Along the new transmission line, TVA would obtain the necessary rights for these access roads from landowners.

Culverts and other drainage devices, fences, and gates would be installed as necessary. Culverts installed in any permanent streams would be removed following construction. However, in wet-weather conveyances (i.e., streams that run only following a rainfall), they would be left or removed, depending on the wishes of the landowner or on any permit conditions that might apply. If desired by the property owner, new temporary access roads would be restored to previous conditions. Additional applicable right-of-way clearing and environmental quality protection specifications are listed in Appendices II and III.

2.4.1.3. Construction Assembly Areas

A construction assembly (laydown) area would be required for worker assembly, vehicle parking, and material storage. The site identified for this project is located between Franklin and Murfreesboro, approximately 750 feet south of the State Route (SR) 96 and SR 11 intersection (Figure 2-1). The construction assembly area for this project is approximately 4.2 acres in size, relatively flat, previously cleared, and is located adjacent to an existing paved road near the existing transmission line right-of-way. The areas would be graveled and fenced, and trailers used for material storage and office space would be parked on the areas. Following the completion of construction activities, all trailers, unused materials, and construction debris would be removed from the site.

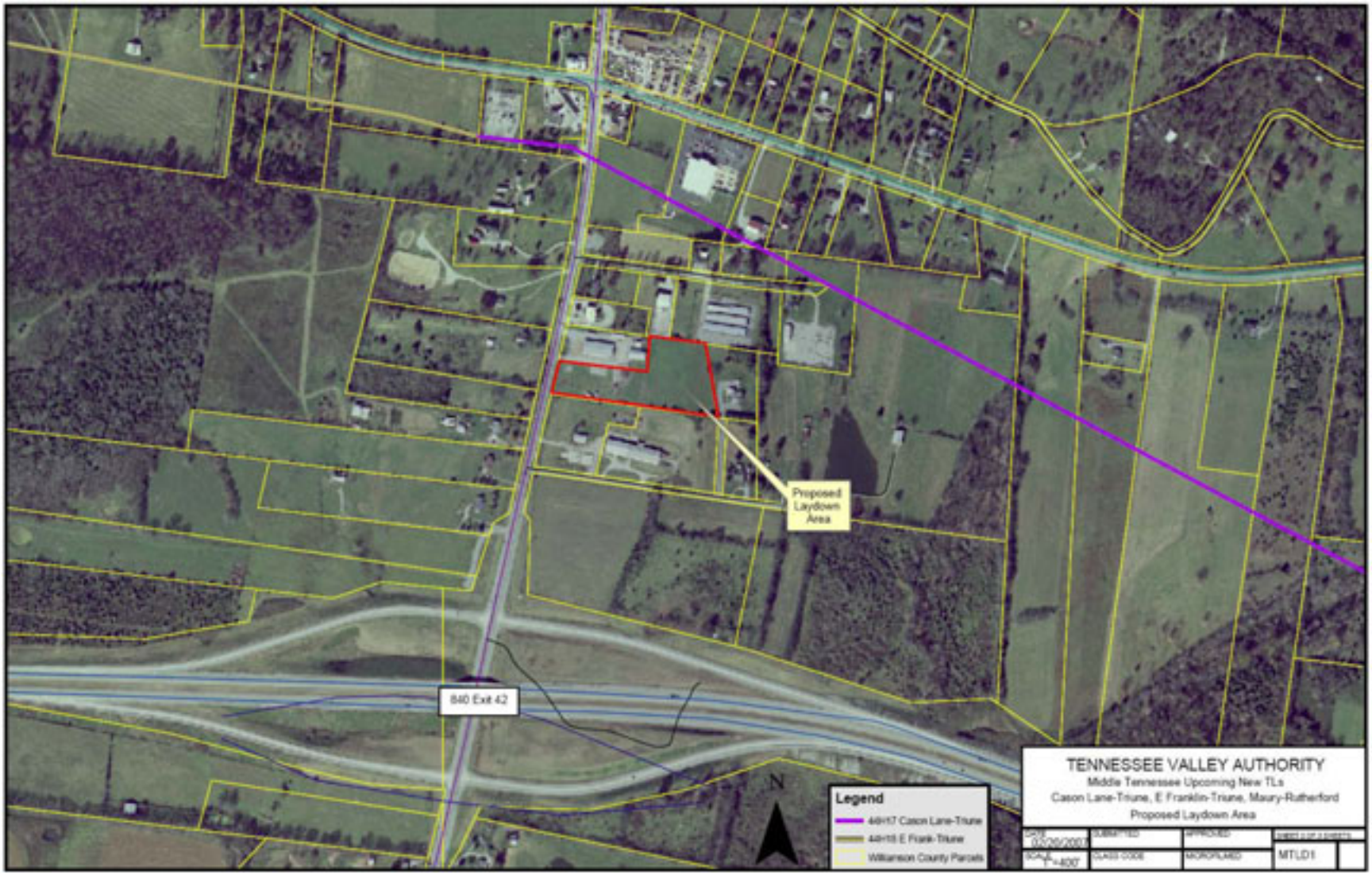
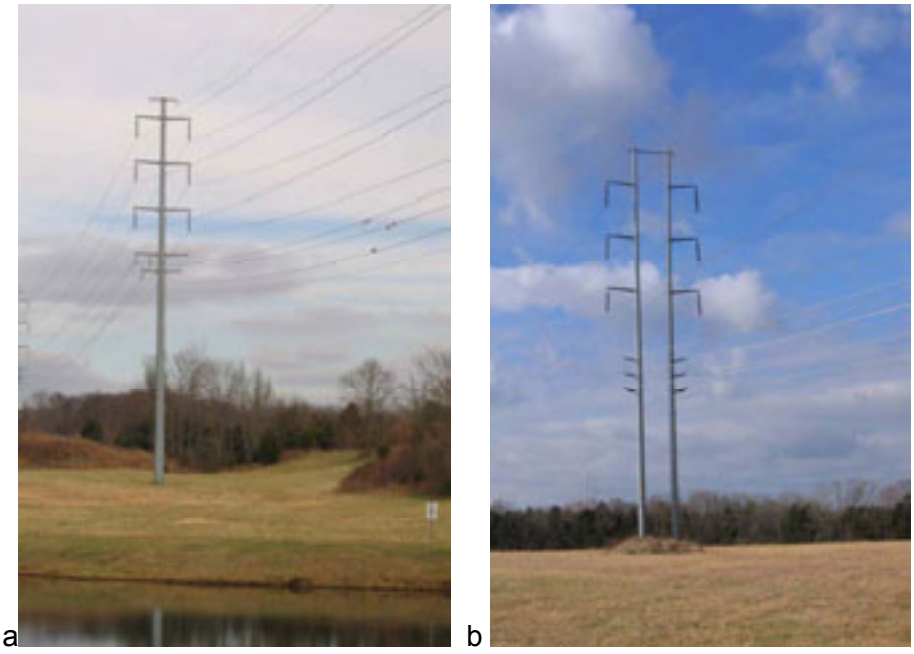


Figure 2-1. Construction Laydown Area for the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Line Project

2.4.1.4. Structures and Conductors

The proposed 161-kV transmission line between the Murfreesboro and East Franklin substations would be built using either single steel-pole structures or H-frame steel-pole structures (Figures 2-2 and 2-3). Structure type and heights would vary according to the terrain and would range between 80 and 110 feet.

Figure 2-2. Single-Pole 161-kV Transmission Structures



a b

Figure 2-3. Single-Pole (a) and H-Frame Pole (b) 161-kV Transmission Structures With a Lower Voltage Under-Built Circuit

Three conductors (the cables that carry the electrical current) are required to make up a circuit in alternating current transmission lines. For 161-kV transmission lines, each conductor is made up of a single cable. The conductors are attached to fiberglass or ceramic insulators suspended from the structure cross arms. A smaller overhead ground wire(s) is attached to the top of the structures. This ground wire may contain fiber optic communication cables.

Poles at angles in the transmission line may require supporting guy wires. Some structures for larger angles could require two or three poles. Most poles would be imbedded directly in holes augured into the ground to a depth equal to 10 percent of the pole's length plus an additional 2 feet. The holes would normally be backfilled with the excavated material. In some cases, gravel or a cement and gravel mixture might be necessary. Some structures may be self-supporting (non-guyed) poles fastened to a concrete foundation that is formed and poured into an excavated hole.

Equipment used during the construction phase would include trucks, truck-mounted augers and drills, as well as tracked cranes and bulldozers. Low ground-pressure-type equipment would be used in specified locations (e.g., areas with soft ground) to reduce the potential for environmental impacts.

2.4.1.5. Conductor and Ground Wire Installation

Reels of conductor and ground wire would be delivered to various staging areas along the right-of-way. Temporary clearance poles would be installed at road and railroad crossings to reduce interference with traffic. Installation of conductors would begin with a small rope being pulled from structure to structure. This rope would then be connected to the conductor and ground wire and used to pull them down the line through pulleys suspended from the insulators mounted on the structures. A bulldozer and specialized tensioning equipment would be used to pull conductors and ground wires to the proper tension. Finally, the wires would be clamped to the insulators and the pulleys removed.

2.4.2. Operation and Maintenance

2.4.2.1. Inspection

Periodic inspections of TVA's transmission lines are performed from the ground and by aerial surveillance using a helicopter. These inspections, which occur on approximately two- to three-year cycles after operation begins, are conducted to locate damaged conductors, insulators, or structures, and to report any abnormal conditions that might hamper the normal operation of the line or adversely impact the surrounding area. During these inspections, the condition of vegetation within the right-of-way, as well as immediately adjoining the right-of-way, is noted. These observations are then used to plan corrective maintenance or routine vegetation management.

2.4.2.2. Vegetation Management

Management of vegetation along the right-of-way would be necessary to ensure access to structures and to maintain an adequate distance between transmission line conductors and vegetation. The transmission line would be designed to meet a 24-foot minimum clearance for a 161-kV transmission line.

Management of vegetation along the right-of-way would consist of two different activities: namely, the felling of danger trees adjacent to the cleared right-of-way, as described in Section 2.4.1.1, and the control of vegetation within the cleared right-of-way.

Management of vegetation within the cleared right-of-way would use an integrated vegetation management approach designed to encourage the low-growing plant species and discourage tall-growing plant species. A vegetation-reclearing plan would be developed for each transmission line segment based on the results of the periodic inspections described above. Given the land use in the area of this project, right-of-way maintenance is expected to be minimal. The two principal management techniques are mechanical mowing, using tractor-mounted rotary mowers, and herbicide application. Herbicides are normally applied in areas where heavy growth of woody vegetation is occurring on the right-of-way and mechanical mowing is not practical. Herbicides would be selectively applied by helicopter or from the ground with backpack sprayers or vehicle-mounted sprayers.

Any herbicides used would be applied in accordance with applicable state and federal laws and regulations and the commitments listed in this document. Only herbicides registered with the U.S. Environmental Protection Agency (USEPA) would be used. A list of the herbicides currently used by TVA in right-of-way management is presented in Appendix V. This list may change over time as new herbicides are developed or new information on presently approved herbicides becomes available.

Other than vegetation management, little other maintenance work would normally be required. The transmission line structures and other components typically last several decades. In the event that a structure must be replaced, the structure would normally be lifted out of the ground by crane-like equipment and the replacement structure would be inserted into the same hole or an immediately adjacent hole. Access to the structures would be on existing roads where possible. Replacement of structures may require leveling the area surrounding the replaced structures, but there would be little, if any, additional area disturbance when compared to the initial installation of the structure.

2.5. Project and Siting Alternatives

TVA has long employed a set of evaluation criteria that represent opportunities and constraints for development of transmission line routes. The criteria are oriented toward factors such as existing land use, ownership patterns, environmental features, cultural resources, and visual quality. Cost is also an important factor, with engineering considerations, property, and right-of-way acquisition cost being the most important elements. Routing opportunities also considered include the use of existing utility corridors, co-use of transportation corridors, and the upgrading of existing transmission lines to create a circuit with higher electrical capacity or the installation of multiple circuits.

The first task in defining the study area was to identify a power source that could supply the identified objective. Within the proposed project area, TVA has an existing transmission line right-of-way between the Cason Lane 161-kV Substation, which is a connection point to an existing transmission line into the Murfreesboro Substation and the East Franklin 161-kV Substation. There is also a 10-mile transmission line segment from the Triune Substation to the East Franklin Substation that is occupied by an operating 161-kV transmission line. This transmission line segment is presently cleared and its use as part of this project would

eliminate the environmental impacts associated with clearing and construction on new right-of-way.

The overall review of the project area revealed that there are an increasing number of developments in the vicinity of both Franklin and Murfreesboro. Additional existing development occurs in the area along SR 96 and around Triune near the intersection of Highway 431 and SR 96. A proposed new transmission line route through any of these areas would have resulted in considerable conflict as a result of both the existing and planned development in the project study area. This conflict would have resulted in substantially greater costs than those associated with use of TVA's existing transmission line right-of-way, and could have resulted in a longer project schedule potentially impacting TVA's electric system reliability in the project area.

Based on these considerations, TVA did not identify any additional specific transmission line route alternatives that would have required all or substantial amounts of new right-of-way. TVA's existing transmission line right-of-way was then examined in detail to gather information on constraints and opportunities related to its use for a Murfreesboro-East Franklin 161-kV Transmission Line.

Given that TVA had an existing right-of-way that could be used to meet the needs and objectives of the proposed project, a broad study area was not developed nor were any additional routes considered that would require significant amounts of new right-of-way. Rather, TVA's existing transmission line right-of-way was examined to gather information on constraints and opportunities related to its use for a Murfreesboro-East Franklin 161-kV Transmission Line.

During this examination, TVA identified historic rock cairn structures in the existing right-of-way on Indian Mountain (Section 3.13). This site was deemed potentially eligible for listing on the National Register of Historic Places (NRHP), and TVA made the decision to avoid it during the siting process for the proposed project. Additionally, a plant listed under the Endangered Species Act, as well as its' Designated Critical Habitat (DCH), occur in this same area (Section 3.4).

TVA archaeologists, biologists, and transmission line siting staff worked to identify a route relocation that would avoid impacts to these resources. As a result, a segment of the proposed transmission line is located outside of the existing right-of-way, necessitating about 1.75 miles of new 100-foot-wide right-of-way (Figure 1-1). This relocated segment is part of the preferred route for the Murfreesboro-East Franklin Transmission Line.

Since the proposed activities along the Pinhook-Radnor 161-kV Transmission Line would involve existing facilities, no alternative locations were considered for this portion of the project.

2.6. Identification of the Preferred Alternative

Alternative 2 - Construct and Operate the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Lines (Action) is TVA's preferred alternative. TVA would construct approximately 23 miles of 161-kV transmission line, mostly within TVA's existing transmission line right-of-way between the Murfreesboro and East Franklin substations (Figure 1-1). TVA would also install one 161-kV circuit breaker and bay at Murfreesboro Substation and add jumpers in another bay; reconductor an approximate 10 miles segment

of the Pinhook-Radnor 161-kV Transmission Line and add another conductor to the vacant side of the existing Pinhook-Radnor Transmission Line structures thus creating a second Pinhook-Radnor circuit (Figure 1-1). Additionally, TVA would rearrange existing transmission line connections at existing substations to create a Pinhook-Radnor 161-kV Transmission Line and a Pinhook-South Nashville 161-kV Transmission Line and would install two new 161-kV breakers at the Pinhook Substation. Communication and relays' modifications would be made at several existing TVA facilities. The proposed project would require approximately 1.75 acres of new right-of-way.

CHAPTER 3

3. AFFECTED ENVIRONMENT

3.1. Introduction

This chapter describes the existing condition of the environmental resources and factors of the proposed project area that would affect or that would be affected by implementing the proposed action. The affected environment descriptions below are based on field surveys conducted from 2006 through 2007, on published and unpublished reports, and on personal communications with resource experts. This information establishes the baseline conditions against which the decision maker and the public can compare the potential effects of the alternatives under consideration.

3.2. Vegetation

In Tennessee, the Nashville Basin is within the Interior Plateau Ecoregion and consists of two distinctive sections: the Inner Nashville Basin and the Outer Nashville Basin (USEPA 2006a). The proposed Murfreesboro-East Franklin Transmission Line occurs primarily within the Inner Nashville Basin while the proposed Pinhook-Radnor Transmission Line occurs within the western portion of the Outer Nashville Basin.

Murfreesboro-East Franklin Transmission Line

The Inner Nashville Basin is an area generally consisting of relatively flat and fertile lowlands with few rolling hills and knobs. Outcrops of limestone are common, and the soils are generally shallow. The limestone cedar glades of Tennessee are a unique mixed grassland/forest cedar glades vegetation type with many endemic species and are located primarily within the Inner Nashville Basin. Oak-hickory stands are the most common forest type, although mixed stands of eastern red cedar, winged elm, sugar maple, and blue ash grow on many of the rockier sites and limestone glades. The Nashville Basin was once characterized by rich, fertile farm country. Urban, suburban, and industrial land use in the region is on the rise (ibid).

Forests of the Nashville Basin vary considerably depending upon topography and moisture. The elevations within the project area range from approximately 800 feet to 1,100 feet. Plant communities observed within the proposed Murfreesboro-East Franklin Transmission Line right-of-way include deciduous forests (9 percent), deciduous woodlands with small pockets of limestone xeric prairies/cedar glades (6 percent), and herbaceous vegetation with a few scattered glade complexes (84 percent). There are approximately 3 acres of scattered wetlands that occur within the herbaceous vegetation type, and 0.01 acre of wetlands within the deciduous woodlands. The remaining project area (1 percent) consists of road crossings, stream crossings, and other nonvegetated areas.

Deciduous forests are wooded areas where the trees' crowns are overlapping, generally forming 60 to 100 percent cover. This forest is a dry/mesic type and typically includes numerous plant species associated with limestone. The forests are scattered with limestone outcrops that occur along gentle slopes that typically developed into steeper slopes. The knob summits or ridge tops are scattered with limestone outcrops. Limestone rock ledges occur along the steep slopes. Common trees observed are black cherry, blue

ash, bur oak, eastern red cedar, red bud, Ohio buckeye, shagbark hickory, Shumard's oak, and sugar maple. Coralberry is abundant in the understory with Japanese honeysuckle and spicebush. Herbaceous species include crane's fly orchid, cut-leaf toothwort, putty-root orchid, rue anemone, toadshade, and wild ginger.

Deciduous woodlands include open stands of trees with crowns not usually touching, generally forming 25 to 60 percent cover. These areas surround the margins of the deciduous forests and also occur as fragments between pastures or other open areas. Small peripheral portions of the deciduous woodlands appear to be grazed. Deciduous woodlands occur as either dry limestone woodlands or mesic woodlands. The dry limestone woodland dominant species include chinkapin oak, eastern red cedar, osage orange, post oak, red bud, shagbark hickory, sugar maple, and winged elm. The understory contains blackberry, coralberry, fragrant sumac, and Japanese honeysuckle. Herbaceous species include blazing star, ebony spleenwort, goldenrod, prickly pear cactus, and toothwort. Mesic woodlands occur in low areas and are typically associated with streams. Common woody species observed include bitternut hickory, black cherry, hackberry, paw paw, Shumard's oak, sugar maple, sycamore, and tulip poplar. The understory contains coralberry, crossvine, ebony spleenwort, spicebush, toothwort, and trillium.

Several small scattered limestone xeric prairies/cedar glades occur within the deciduous woodlands. Common woody species observed within these areas include coralberry, eastern red cedar, fragrant sumac, honey locust, and winged elm. Herbaceous plant species observed include cinquefoil, glade St. John's wort, prickly pear cactus, rough button-weed, scaly blazing star, tall thoroughwort, wood mint, and the nonvascular reindeer lichen.

Herbaceous vegetation is dominated by forbs and other species having less than 25 percent cover. The existing transmission line right-of-way is maintained as mostly herbaceous vegetation, and the remaining areas of the proposed transmission line are almost entirely herbaceous vegetation including hayfields, managed pastures, residential lawns, and scattered small limestone cedar glades. Common right-of-way and pasture species are composed of broomsedge, cat greenbriar, coralberry, eastern red cedar, goldenrod, Japanese honeysuckle, nodding fescue, orchard grass, and sericea lespedeza.

Middle Tennessee cedar glades are one of Tennessee's rarest ecosystems. They support three species federally listed as endangered (Tennessee coneflower, leafy prairie-clover, and Pyne's ground plum) and more than 25 state-listed species. Distinctive in appearance, these regions in the Central Basin are characterized by a mosaic of limestone outcroppings. Cedar glades occur within these outcrops and are surrounded by gravel and/or very thin soil. Some glades have scattered eastern red cedar and hardwood trees in deeper soils. Most glades are wet in the winter and very dry in the summer. The Tennessee Department of Environment and Conservation (TDEC) estimated that cedar glades make up approximately 5 percent of the Central Basin region.

A few small, seasonally wet herbaceous limestone cedar glade complexes totaling less than 1.5 acres occur in the project area. The NatureServe Community Classification System describes this seasonally wet glade complex as the Interior Limestone Glade Ephemeral Pool and designates it as G3 – Vulnerable (NatureServe 2006a). The limestone glade species observed include beaded glade cress, beaked corn salad, flowering spurge, glade sandwort, pink stonecrop, round leaf ragwort, small glade cress, tall thoroughwort,

and white beardtongue. The cyanobacterium, *Nostoc commune,* and a moss, *Pleurochaete squarrosa,* were abundant.

Invasive exotic plant species encountered along the proposed route include Japanese honeysuckle, multiflora rose, princess tree, tree of heaven, and sericea lespedeza.

Pinhook-Radnor Transmission Line
As previously stated, the Pinhook-Radnor Transmission Line occurs primarily within the Outer Nashville Basin, a region that generally has a more hilly landscape with slightly higher elevations than the Inner Nashville Basin. This region encompasses most all of the outer areas of the limestone bedrock of the Inner Basin. The higher hills and knobs are slightly cherty and exhibit remnants of the Highland Rim. The region's limestone rocks and soils are high in phosphorus. Deciduous woods with pasture and cropland are the dominant land covers in the Outer Nashville Basin, though the region is experiencing rapid suburban and industrial growth (USEPA 2006a).

Herbaceous vegetation occurring on transmission line rights-of-way, hayfields, pastures, lawns, scattered xeric prairies/cedar glades, and other open areas account for 56 percent of the proposed transmission line route. Common species observed include blackberry, broomsedge, cat greenbriar, coralberry, eastern red cedar, giant ironweed, goldenrod, Japanese honeysuckle, nodding fescue, orchard grass, and sericea lespedeza.

The western portion of the proposed transmission line route is almost entirely developed for industrial, urban, and suburban uses. These areas, accounting for 42 percent of the proposed route, are sparsely vegetated or have been landscaped with grasses, trees, and shrubs leaving few or no native plants or native plant communities.

Areas of fragmented deciduous woodlands and woodland edges compose the remaining 2 percent of the proposed transmission line route. These dry or moderately dry woodlands include coralberry, eastern red cedar, hackberry, Japanese honeysuckle, persimmon, princess tree, post oak, shagbark hickory, and smooth sumac.

Invasive exotic plant species encountered along the proposed project route include Japanese honeysuckle, multiflora rose, princess tree, tree of heaven, and sericea lespedeza.

3.3. Wildlife

Murfreesboro-East Franklin Transmission Line
Wildlife habitats observed within the proposed Murfreesboro-East Franklin Transmission Line route have been heavily impacted by previous agricultural practices and development and are predominately early successional with sections of deciduous forests. Early successional or herbaceous habitats make up 84 percent of the project area, with the remaining habitat consisting of 9 percent deciduous forest, 6 percent deciduous woodland, and 1 percent road crossings, stream crossings, and other nonvegetated areas (Section 3.2). Within the deciduous woodlands along the route are occasional occurrences of limestone cedar glades. Additionally, there are approximately 3 acres of early successional wetland habitat, and 0.01 acre of wetland habitat within the deciduous woodlands.

Early successional habitats observed along the transmission line route include hayfields, managed pastures, and residential lawns. Birds observed in these areas include Carolina wren, eastern bluebird, American robin, brown thrasher, northern cardinal, American kestrel, and mourning dove. Indigo bunting, white-eyed vireo, and gray catbird would also be expected. Common mammals include striped skunk, eastern cottontail rabbit, white-tailed deer, Virginia opossum, and various rodents. Reptiles often found in early successional habitats include racers, black rat snake, milksnake, and common garter snake. Wetlands within early successional habitats provide habitats for amphibians including American and Fowler's toads, green frog, northern cricket frog, southeastern chorus frog, and red-spotted newts.

Deciduous forest habitats consist of both older forests dominated by various oak and hickory species, and younger, woodland deciduous forests containing a red cedar component. These forested areas provide habitat for wild turkey, downy woodpecker, pileated woodpecker, white-breasted nuthatch, and American crow, as well as numerous Neotropical migrants such as wood thrush, red-eyed vireo, ovenbird, hooded warbler, and black-and-white warbler. White-tailed deer and eastern gray squirrel are mammals frequently found in deciduous forests, and scattered rock outcrops within these forests provides habitat for woodrats and other small mammals. Northern zigzag and slimy salamanders may be abundant in deciduous forests, and common reptiles include eastern box turtle, ring-necked snake, black rat snake, and copperhead. Wetlands within deciduous woodlands provide habitat for amphibians such as American and Fowler's toads, northern cricket frog, spotted salamanders, red salamanders, and red-spotted newts.

Limestone cedar glades occur periodically throughout the proposed transmission line route in the younger forested habitats. These glades are used by several reptiles and amphibians. A study done in Cedars of Lebanon State Park, Wilson County, Tennessee, indicated that 16 amphibians and 19 reptiles occur within or near the limestone cedar glade communities that are found in the park (Jordan 1986). Reptiles occurring in limestone cedar glades include eastern box turtle; northern fence lizard; five-lined, southeastern five-lined, and broad-headed skinks; six-lined racerunners, common garter snake, and eastern hognose snakes.

Unique and important terrestrial habitats, such as heronries and caves, were also searched for during field investigations in the proposed project area. Several small sinkholes were observed near the proposed transmission line route. All of these except one were at least 300 feet from the existing transmission line right-of-way. One sinkhole within the existing right-of-way was located just east of Rehobeth Road (Section 3.11). However, the access road at this location would avoid the sinkhole, and the transmission line would be constructed so that no structures were located near or within the sinkhole. The TVA Natural Heritage database has records of six caves within 3 miles of the proposed transmission line route; all are greater than 1 mile away. No heron colonies or other unique habitats, aside from the previously mentioned cedar glades, have been reported from the project area.

Pinhook-Radnor Transmission Line

The Pinhook-Radnor Transmission Line right-of-way consists of habitats that have been heavily affected by previous maintenance activities. Ninety-eight percent of the project area contains early successional or herbaceous habitats and includes managed rights-of-way, hayfields, and managed lawns (Section 3.2 Vegetation). Almost half of this habitat consists

of urban/suburban and industrial sites, which have limited value to wildlife. Approximately 2 percent of deciduous forest also occurs within the project area.

Common birds, mammals, and reptiles in the early successional habitats of the Pinhook-Radnor Transmission Line are expected to be similar to those found along the Murfreesboro-East Franklin Transmission Line.

Deciduous forest habitats consisted of younger, woodland deciduous forests. These forested areas provide habitat for wild turkey, Carolina chickadee, and tufted titmouse. Other animals occurring in this habitat include white-tailed deer, white-footed mouse, northern zigzag salamander, slimy salamander, eastern box turtle, black rat snake, and copperhead. Wetlands within deciduous woodlands provide habitat for amphibians such as American and Fowler's toads, northern cricket frog, spotted salamanders, and red-spotted newts.

The TVA Natural Heritage database has records of four caves within 3 miles of the proposed transmission line route, but greater than 1 mile away. No heron colonies or other unique habitats have been recorded from the project area. No unique and important terrestrial habitats, such as heronries and caves were identified during field investigations in the proposed project area.

3.4. Threatened and Endangered Species

Murfreesboro-East Franklin Transmission Line
The TVA Natural Heritage database indicated that five federally listed plant species and 55 state-listed plant species are known from Rutherford and Williamson counties. Of these, four federally listed plant species (Braun's rock-cress, leafy prairie clover, Pyne's ground plum, Tennessee coneflower) and 23 state-listed plant species are known to occur within a 5-mile radius of the proposed Murfreesboro-East Franklin Transmission Line project area (Table 3-1). DCH for Braun's rock-cress also occurs in the project area. Most occurrences of listed plants in the project area counties are associated with the rock shelves surrounding Scales and Indian mountains, the rare limestone cedar glade communities, and floodplain areas near Percy Priest Reservoir in Davidson and Rutherford counties.

Scales Mountain botanical surveys were conducted in February and December 2006 and January 2007. Based upon habitat requirements of Braun's rock-cress and the primary constituent elements of its critical habitat, field surveys indicated the proposed transmission line route does not have the appropriate habitat to support this rare species (U.S. Fish and Wildlife Service [USFWS] 2004). Though the site on Scales Mountain has the rocky habitat aspect, it is not mesic or fully shaded. Braun's rock-cress is not known to survive in dry, part-sun to sunny sites.

Botanical surveys of the Indian Mountain area were conducted in February, April, May, and December 2006 and January 2007. Braun's rock-cress was observed within the existing right-of-way on Indian Mountain, and this area is also DCH for this endangered species. In order to avoid impacting this species and its critical habitat, as well as important cultural resources, a 1.75-mile segment of the proposed transmission line was rerouted on Indian Mountain, as shown on Figure 1-1. No other listed plants were observed along this segment of the proposed line.

The TVA Natural Heritage database indicated that one federally listed animal species has been reported from Rutherford and Williamson counties, Tennessee, and three state-listed animal species have been reported from within 3 miles of the proposed Murfreesboro-East Franklin Transmission Line route (Table 3-1). No federally or state-listed terrestrial animal species were observed during field investigations in 2006.

The TVA Natural Heritage database indicated that one federally listed endangered crayfish, seven state-listed fish, and one state-listed mussel are known to occur within Rutherford and Williamson counties (Table 3-1.). Of these, three fish species (bedrock shiner, slenderhead darter, smallscale darter) are known to occur within the affected watersheds of the Harpeth, West Fork Stones, and Stones rivers.

Pinhook-Radnor Transmission Line

The TVA Natural Heritage database indicated that five federally listed plant species, one federal candidate species, and 48 state-listed plant species are known from Davidson County. Of these, four federally listed plant species (Braun's rock-cress, Leafy prairie clover, Pyne's ground plum, and Tennessee coneflower) and 22 state-listed plant species are known to occur within a 5-mile radius of the proposed Pinhook-Radnor Transmission Line project area (Table 3-1). No federally listed plant species or state-listed plant species are known to occur along the proposed transmission line route. Furthermore, field inspections conducted in February 2006 did not reveal any populations of rare plant species or rare plant habitat along the proposed transmission line route.

No records for federally listed animal species occur in Davidson County, Tennessee, but one state-listed animal species has been reported from within 3 miles of the proposed Pinhook-Radnor Transmission Line route. No federally or state-listed terrestrial animal species were observed during field investigations in 2006.

The TVA Natural Heritage database indicated that one federally listed as endangered crayfish and six state-listed fish are known to occur within Davidson County (Table 3-1). The federally listed as endangered Nashville crayfish is known to occur in the Mill Creek drainage within 10 miles of the project area. Field surveys identified potential Nashville crayfish habitat in several streams that would be crossed by the Pinhook-Radnor Transmission Line.

Table 3-1. Federally and State-Listed Species Reported From the Proposed Project Area

Common name	Scientific name	Status[1]	
		Federal	State
Terrestrial Plants			
A blue-star	*Amsonia tabernaemontana var gattingeri*	-	SPCO (S3)
Alabama snow-wreath	*Neviusia alabamensis*	-	THR (S2)
American ginseng	*Panax quinquefolius*	-	S-CE (S3S4)
Blackfoot quillwort	*Isoetes melanopoda*	-	END (S1S2)
Boykin's milkwort	*Polygala boykinii*	-	SPCO (S2)
Braun's rock-cress	*Arabis perstellata*	END	END (S1)
Butternut	*Juglans cinerea*	-	THR (S3)

Common name	Scientific name	Status[1]	
		Federal	State
Carolina anemone	*Anemone caroliniana*	-	END (S1S2)
Cleft phlox	*Phlox bifida ssp stellaria*	-	THR (S3)
Creeping spot-flower	*Acmella oppositifolia*	-	SPCO (S2)
Duck River bladderpod	*Lesquerella densipila*	-	THR (S3)
Evolvulus	*Evolvulus nuttallianus*	-	SPCO (S3)
Fen Indian-plantain	*Arnoglossum plantagineum*	-	SPCO (S2)
Flat-stemmed spike-rush	*Eleocharis compressa*	-	SPCO (S1)
Glade onion	*Allium stellatum*	-	END (S1)
Glade-cress	*Leavenworthia exigua* var. *exigua*	-	THR (S3)
Goldenseal	*Hydrastis canadensis*	-	S-CE (S3)
Hairy fimbristylis	*Fimbristylis puberula*	-	THR (S1S2)
Hairy rock-cress	*Arabis hirsuta var adpressipilis*	-	THR (S1)
Leafy prairie-clover	*Dalea foliosa*	END	END (S2S3)
Limestone fame-flower	*Talinum calcaricum*	-	SPCO (S3)
Liverwort	*Cololejeunea ornata*	-	THR (S1)
Longbeak buttercup	*Ranunculus aquatilis var. diffusus*	-	END (S1)
Missouri evening-primrose	*Oenothera macrocarpa ssp macrocarpa*	-	THR (S2)
Northern prickly-ash	*Zanthoxylum americanum*	-	SPCO (S2)
Ovate-leaved arrowhead	*Sagittaria platyphylla*	-	SPCO (S2S3)
Perideridia	*Perideridia americana*	-	END (S2)
Pope sand-parsley	*Ammoselinum popei*	-	THR(S2)
Prairie-dock	*Silphium pinnatifidum*	-	THR (S2)
Price's potato-bean	*Apios priceana*	THR	END (S2)
Pyne's ground plum	*Astragalus bibullatus*	END	END (S1)
Sessile water-speedwell	*Veronica catenata*	-	END (S1)
Sharp's lejeunea	*Lejeunea sharpii*	-	END (S1S2)
Short's bladderpod	*Lesquerella globosa*	CAND	END (S2)
Stones River bladderpod	*Lesquerella stonensis*	-	END (S1)
Sunnybell	*Schoenolirion croceum*	-	THR (S3)
Tennessee coneflower	*Echinacea tennesseensis*	END	END (S2)
Tennessee milk-vetch	*Astragalus tennesseensis*	-	SPCO (S3)
Water stitchwort	*Stellaria fontinalis*	-	THR (S3)
Wavy-leaf purple-coneflower	*Echinacea simulata*	-	THR (S2)
White prairie-clover	*Dalea candida*	-	SPCO (S2)
Amphibians			
Streamside salamander[-]	*Ambystoma barbouri*	-	NMGT (S2)
Tennessee cave salamander[-]	*Gyrinophilus palleucus*	-	THR (S2)
Birds			
Barn owl[-]	*Tyto alba*	-	NMGT (S3)

Common name	Scientific name	Status[1]	
		Federal	State
Bewick's wren[-]	*Thryomanes bewickii bewickii*	-	END (S1)
Mammal			
Gray bat[-]	*Myotis grisescens*	END	END (S2)
Crayfish			
Nashville crayfish[2]	*Orconectes shoupi*	END	END (S1)
Mussel			
Rabbitsfoot	*Quadrula cylindrica cylindrica*	-	NOST (S3)
Fish			
Ashy darter	*Etheostoma cinereum*	-	THR (S2S3)
Bedrock shiner[3]	*Notropis rupestris*	-	NMGT (S2)
Blue sucker	*Cycleptus elongatus*	-	THR (S2)
Lake sturgeon	*Acipenser fulvescens*	-	END (S1)
Redband darter	*Etheostoma luteovinctum*	-	NMGT (S4)
Silver lamprey	*Ichthyomyzon unicupsis*	-	NMGT (S2)
Slenderhead darter[3]	*Percina phoxocephala*	-	NMGT (S3)
Smallscale darter[3]	*Etheostoma microlepidum*	-	NMGT (S2)
Southern cavefish	*Typylichthys subterraneus*	-	NMGT (S3)
Tippecanoe darter	*Etheostoma tippecanoe*	-	NMGT (S1S2)

- = Not applicable

[1] Status codes: **CAND** = Federal listing Candidate species; **END** = Endangered; **NMGT** = In Need of Management; **NOST** = No legal status, but tracked by the Tennessee Natural Heritage Program; **SPCO** = Special Concern; **THR** = Threatened; **S1** = Extremely rare and critically imperiled in the state with 5 or fewer occurrences; or very few remaining individuals; or because of some special condition, where the species of some factor(s) make it vulnerable to extinction; **S2** = Very rare and imperiled within the state, 6 to 20 occurrences; **S3** = Rare or uncommon with 21 to 100 occurrences; **S4** = Widespread, abundant, and apparently secure in the state, but with cause for long-term concern (more than 101 occurrences)

[2] Aquatic species known to occur in the potentially affected drainage within 10 miles of the Pinhook-Radnor 161-kV Transmission Line

[3] Aquatic species known to occur in the potentially affected drainage within 10 miles of the Murfreesboro-East Franklin Transmission Line

Discussion of Federally and State-Listed Species Reported From the Project Area

The 23 state-listed plant species known from within 5 miles of the proposed Murfreesboro-East Franklin Transmission Line occur in limestone cedar glades, humid limestone sinks, slow flowing streams, upland limestone woods, wet cultivated fields, wetlands, or wet prairies. Though some forms of these habitats occur within the proposed project area, no state-listed plant species were found during rare plant surveys conducted in February, April, May, and December 2006 and January 2007. The 22 state-listed plant species known from within 5 miles of the Pinhook-Radnor Transmission Line occur in limestone cedar glades, barrens, cultivated fields, rich woods, ponds, cedar barrens and cedar thickets. The areas that would be affected by the proposed transmission line do not meet the habitat requirements of these species.

Braun's rock-cress is recorded from 15 localities within Rutherford County and four localities within Davidson County. This species typically occurs on shaded, north-facing limestone rock shelves (NatureServe 2006a). Several localities of Braun's rock-cress are

known from within 2 miles of the proposed project area. During field surveys in April 2006, Braun's rock-cress was found on Indian Mountain within TVA's existing right-of-way that was the initial proposed Murfreesboro-East Franklin Transmission Line route. A population of Braun's rock-cress occurs about 260 feet north of the existing right-of-way on Scales Mountain on a north facing, shaded, moist rock shelf. Rare plant surveys on Scales Mountain conducted in February and December 2006 and January 2007 indicated suitable habitat does not occur within the proposed Murfreesboro-East Franklin Transmission Line project area. Additional surveys in the vicinity of the Pinhook-Radnor Transmission Line found no occurrences or the appropriate habitat for the species within the proposed project area.

Leafy prairie clover has been recorded from 19 localities in Rutherford County, seven localities in Davidson County, and two localities in Williamson County. This species is typically found in close association to seasonally wet limestone cedar glades and calcareous barrens, typically in the deeper soil along the boundaries of and within rocky glades (NatureServe 2006a). No occurrences of leafy prairie clover were encountered during surveys of the proposed project area.

Price's potato bean has been recorded from five localities in western Williamson County and one locality in Davidson County. It is usually associated with openings in the forest canopy or along woods' edges where rocky, limestone ravine slopes grade into creek or stream bottoms (ibid). No populations or appropriate habitat of Price's potato bean were found during surveys of the proposed project area.

Pyne's ground plum is a limestone cedar glade endemic known globally from 14 localities within Rutherford County. The populations are associated with seasonally wet glades in the deeper soiled glade margins or in areas within glades with partial shade (ibid). No populations of Pyne's ground plum were found during surveys of the proposed project area.

Short's bladderpod has been recorded from nine localities within Davidson County. This species is typically found on rocky, limestone cliffs and river bluffs (ibid). No populations of Short's bladderpod or favorable habitat were found during surveys of the proposed project area.

Tennessee coneflower has been recorded from 14 localities within Rutherford County, as well as sites in Davidson County. This species is found in mostly sunny limestone cedar glades within the gravel crevices or the thin soils along the periphery of glades (ibid). No populations of Tennessee coneflower or its appropriate habitat were found during rare plant surveys.

Streamside salamanders occupy upland deciduous forests, particularly within limestone regions. They breed in streams typically 6 to 15 feet wide with a moderate gradient and a substrate containing large flat limestone rocks (Petranka 1998) and occasionally in ponds (Craddock and Minckley 1964; Petranka 1982). Populations are rarely found in stream sections where the surrounding forest has been eliminated (Petranka 1998). Their range in Tennessee includes sites in Davidson, Lincoln, Rutherford, and Williamson counties and is disjunct from northern populations in Ohio, Kentucky, and Indiana where the streamside salamander is relatively common.

Streamside salamanders are known from Puckett Creek, which would be crossed by the proposed Murfreesboro-East Franklin Transmission Line route. The habitat surrounding

this section of Puckett Creek has changed from forested when the salamander was first found, to open, grassy habitats with isolated trees. This species is affected by deforestation and has declined throughout its range due to loss of habitat (ibid). However, the area that the transmission line would cross on Puckett Creek is primarily in pasture and does not provide suitable streamside salamander habitat. Minimal habitat requirements for streamside salamanders does exist in Wilson Creek, an unnamed stream 0.4 mile west of Rehobeth Road, an unnamed stream in the valley between Indian and Scales mountains, and an unnamed stream located where the transmission line route would cross Newman Road.

Tennessee cave salamanders occur in caves with water and have been found in quiet pools with both rocky and sandy substrates (McCrady 1954; Simmons 1975). Local populations in Tennessee are usually found in cave systems below the water table, especially in the vicinity of sinkholes. This salamander has been reported from a cave approximately 2.5 miles from the proposed route, but no caves or other suitable habitat for this salamander were found along the proposed Murfreesboro-East Franklin Transmission Line route during field investigations.

Barn owls nest in cavities including caves, bluffs, hollow trees, barns, and other abandoned structures. They forage over open landscape such as abandoned farmland, but also forage in urban areas such as vacant lots, cemeteries, and parks (Nicholson 1997). No nests are known from the area, but foraging areas are plentiful near and within the proposed Murfreesboro-East Franklin Transmission Line route.

Bewick's wrens occur in open habitats containing brush, thickets, and scrub, within both rural and suburban areas. Their populations have significantly decreased in Tennessee since the 1940s due to unknown reasons. Suitable habitat for Bewick's wren habitat is sparse and scattered throughout the proposed Pinhook-Radnor Transmission Line route.

Gray bats roost in caves year-round and typically forage over the open water of streams, rivers, and reservoirs. No caves used by gray bats occur near the project area, but numerous stream crossings along the proposed Murfreesboro-East Franklin Transmission Line route provide foraging habitat for gray bats.

The Nashville crayfish is found in the main stem of Mill Creek, numerous large tributaries to Mill Creek, and some small second-order streams that eventually flow into Mill Creek in southern Davidson and northern Williamson counties, Tennessee (Withers 2001). This species lives primarily under slabrock in areas with relatively little sediment in moderately flowing streams. It breeds during spring and is active during the summer (Miller and Hartfield 1985). Though this animal seems to be fairly tolerant of adverse conditions, its limited range renders it vulnerable to catastrophic events, and continuing urbanization may exceed the limits of the species' tolerance (O'Bara et al. 1985).

Portions of the existing Pinhook-Radnor Transmission Line cross Mill Creek and five tributaries of Mill Creek. This transmission line is currently operated and maintained by TVA. The Mill Creek drainage originates in mixed forest and agricultural lands; however, a large portion of it lies in urban/suburban environments in southeast Davidson County. Field surveys during February 2006 identified habitat preferred by the Nashville crayfish within several streams that would be crossed by the proposed project.

The bedrock shiner is a common species restricted to the Nashville Basin in Cannon, Rutherford, Smith, and Wilson counties, Tennessee. This species is found in bedrock pools of some low-gradient streams in the Stones and lower Caney Fork rivers' systems and direct Cumberland River tributaries between these systems (Etnier and Starnes 1993). Records of the bedrock shiner also occur in the Duck River in Bedford County, but are attributed to bait bucket introductions. The species' restricted range, as well as sedimentation and habitat loss, threatens the bedrock shiner.

The southeastern edge of the known range for slenderhead darter is in Tennessee. In recent years, the slenderhead darter was collected primarily from drainages of the Duck, Stones, Harpeth, and Red rivers, with sporadic samples taken from the Tennessee and Cumberland rivers. The slenderhead darter is commonly found in gravel shoal areas of medium to large rivers with moderate to swift current (ibid). The most likely threats to the species are siltation, impoundment, and channelization (NatureServe 2006b).

The smallscale darter is known to occur in large streams and rivers in the Stones, Harpeth, Red, and Little rivers' systems in the Cumberland River drainage (Etnier and Starnes 1993). This species prefers deep riffles with boulder and coarse rubble substrate and, therefore, impoundments of larger streams and river are a threat to this species.

3.5. Wetlands

Wetlands are areas inundated by surface water or groundwater such that vegetation (hydrophytes) adapted to saturated soil conditions are prevalent. Wetland substrates consist predominantly of undrained hydric soil—soils that are saturated with water and usually deprived of oxygen. Wetland examples include palustrine areas (described as lacking flowing water including marshes and swamps, as well as bogs, fens, wet meadows, and floodplains) and lacustrine areas (described as lake-associated including freshwater marshes, aquatic beds, as well as lakeshores).

Wetland determinations along the proposed transmission line rights-of-way, construction material laydown area, and access roads were conducted according to U.S. Army Corps of Engineers' (USACE) standards that require documentation of hydrophytic vegetation, hydric soil, and wetland hydrology (Environmental Laboratory 1987; Reed 1997, U.S. Department of Defense and USEPA 2003). Broader classification definitions of wetlands, such as the ones used by the USFWS (Cowardin et al. 1979), the State of Tennessee (Tennessee Code 11-14- 401), and the TVA Environmental Review Procedures definition (TVA 1983), were also considered in this review. Using a TVA-developed modification of the Ohio Rapid Assessment Method (Mack 2001) specific to the TVA region (TVARAM), wetlands were categorized by their functions, sensitivity to disturbance, rarity, and irreplaceability. The categorization was used to evaluate impacts and to determine the appropriate levels of mitigation for wetland impacts.

For wetlands crossed more than once by a proposed transmission line route or access road, a separate USACE wetland determination form was completed for each crossing. However, for the entire wetland, a single TVARAM form was completed. The TVARAM is designed to distinguish between three categories of wetlands.

Category 1 wetlands are described as "limited quality waters." They are considered to be a resource that has been degraded, has limited potential for restoration, or is of such low functionality, that lower standards for avoidance, minimization, and mitigation can be

applied. Category 2 includes wetlands of moderate quality and also wetlands that are degraded but exhibit reasonable potential for restoration. Category 3 generally includes wetlands of very high quality and wetlands of concern regionally and/or statewide, such as wetlands that provide habitat for species listed as threatened or endangered.

The Murfreesboro-East Franklin Transmission Line right-of-way corridor is located in four subwatersheds of the Harpeth River and Stones River watersheds: Nelson Creek, Stewart Creek, Overall Creek, and West Fork Stones River. The existing Pinhook-Radnor Transmission Line right-of-way is located in three subwatersheds of Mill Creek and Stones River: Upper Mill Creek, Lower Mill Creek, and Percy Priest Lake. The Mill Creek, Harpeth River, and Stones River watersheds eventually drain into the Cumberland River, a tributary of the Ohio River. A total of 10 wetlands were located during a ground survey conducted in February 2006 to identify all jurisdictional wetlands within the two proposed project transmission line corridors (Tables 3-2 and 3-3).

Murfreesboro-East Franklin Transmission Line

The proposed approximate 23-mile transmission line would traverse a landscape dominated by cropland and pasture, with portions of the transmission line crossing upland forest, residential areas, creeks, drainage ways, and eight wetland areas (Table 3-2).

Table 3-2. Wetlands Located Along the Proposed Murfreesboro-East Franklin Transmission Line Right-of-Way

Wetland ID	Wetland Classification[1]	Estimated Wetland Acreage Within Right-of-Way	Estimated Acreage of Forested Wetland	Structure #	TVARAM	
					Score	Category
W001	PEM2Cd	0.03	-	509-510	23	1
W002	PEM1C	0.12	-	539-540	37	2
W003	PEM1C/PSS1C	1.48	-	600	46.5	2
W004	PEM1C/PSS1C	0.46	-	601-602	38.5	2
W005	PEM1E	0.48	-	603-604	57.5	2
W006	PEM1E	0.38	-	604-605	57.5	2
W007	PEM1C/PSS1C	0.30	-	162-161	58.5	2
W008	PFO1C	0.34	0.34	162-161	54.5	2
TOTAL		3.59 acres	0.34			

[1] Classification codes as defined in Cowardin et al. 1979: PEM = Palustrine emergent; PFO = Palustrine forested; PSS = Palustrine scrub-shrub

Wetland W001 is a small emergent wetland formed in the drainage of a man-made pond, located completely within the right-of-way. W001 exhibits hydric soils and eventually drains into an unnamed tributary of Watson Creek. W001 is dominated by flat sedge, black willow saplings, and Nepalese browntop grass.

Wetland W002 is a small emergent spring-fed wetland approximately 0.3 acre in size with 0.12 acre located within the right-of-way. W002 exhibits hydric soils and is hydrologically connected to an unnamed tributary of Mayes Creek. This wetland is located approximately 10 feet from Structure 539 of the existing transmission line. W002 is dominated by pathrush, sedge species, box elder saplings, and tall fescue.

Wetland W003 consists of approximately 50 acres of emergent/scrub-shrub wetland of which 1.48 acres is located within the transmission line right-of-way. W003 exhibits hydric soils and is connected hydrologically to Wilson Creek. Dominant vegetation includes green ash, sweetgum, and black willow saplings, silky dogwood, path rush, panic grass, and flatsedge. Existing transmission line Structure 600 is located within this wetland.

Wetland W004 is an approximate 2-acre emergent/scrub-shrub wetland of which 0.46 acre is located within the transmission line right-of-way. W004 exhibits hydric soils and is connected hydrologically to Wilson Creek. Dominant vegetation includes sweetgum, sycamore, and honey locust saplings, pathrush, sedges, and flatsedge species.

Wetland W005 is an approximate 5-acre emergent wetland within the floodplain of Wilson Creek of which 0.48 acre is located within the right-of-way. W005 exhibits hydric soils and is dominated by pathrush, boneset, panic grass, and moss.

Wetland W006 is part of the same floodplain wetland system adjacent to Wilson Creek as W005. Approximately 0.38 acre of this wetland is located within the right-of-way. W006 exhibits hydric soils and is dominated by pathrush, bulrush, panic grass, sedges, and spikerush species.

Wetland W007 is a 0.30-acre emergent/scrub-shrub wetland located entirely within the right-of-way. W007 exhibits hydric soils and is spring fed connecting hydrologically to Nelson Creek. This wetland is located approximately 2 feet from existing transmission line Structure 162. Dominant vegetation includes green ash, sugarberry, and honey locust saplings, path rush, and clubmoss.

Wetland W008 is a 0.34-acre forested wetland entirely located within the right-of-way. W008 exhibits hydric soils and contains a seep. This wetland is hydrologically connected to Nelson Creek. Dominant vegetation includes green ash, sycamore, and honey locust.

Pinhook-Radnor Transmission Line

The proposed Pinhook-Radnor Transmission Line project area consists of an existing transmission line route that traverses a landscape divided by residential areas and upland forest, with portions of the transmission line crossing agricultural land, creeks, drainage ways, and two wetlands (Table 3-3).

Table 3-3. Wetlands Located Along the Proposed Pinhook-Radnor Transmission Line Right-of-Way

Wetland ID	Wetland Classification[1]	Estimated Wetland Acreage Within Right-of-Way	Estimated Acreage of Forested Wetland	Structure #	TVARAM	
					Score	Category
W009	PUBH/PFO1C	0.22	0.10	137-136	39	2
W010	PUBH/PEM1A	0.02	-	121-120	22.5	1
TOTAL		0.24 acres	0.10			

[1] Classification codes as defined in Cowardin et al. 1979: PEM = Palustrine emergent; PFO = Palustrine forested; PUB=pond

Wetland W009 is an approximate 0.5-acre ponded wetland with a forested wetland fringe. Of this, 0.22 acre is located within the right-of-way consisting of a 0.10-acre forested

section. W009 exhibits hydric soils and eventually drains into an unnamed tributary of Mill Creek. W009 is dominated by sycamore, box elder, green ash, and sycamore.

Wetland W010 is a ponded wetland with a developing emergent fringe. This wetland totals approximately 0.1 acre, with 0.02 acre located within the right-of-way. W010 exhibits hydric soils and wetland hydrology, but does not appear to have a significant hydrologic connection to a flowing waterway. W010 is dominated by tall fescue and other wetland species whose condition at the time of the field survey did not allow for species identification.

3.6. Surface Water

Precipitation in the proposed project area averages about 54 inches per year with the wettest month in March at 5.7 inches and the driest month in October at 3.3 inches. The average annual air temperature is 57 degrees Fahrenheit (°F), ranging from a monthly average of 35°F in January to 77°F in July. Stream flow varies with rainfall and averages about 21 inches of runoff per year or approximately 1.5 cubic feet per second per square mile of drainage area.

Murfreesboro-East Franklin Transmission Line

The Murfreesboro-East Franklin Transmission Line project area drains to the Harpeth River (via Watson Branch, Mayes Creek, Arrington Creek, and Nelson Creek and its tributary Wilson Branch) and to the Stones River (via Stewart Creek, West Fork Stones River, and its tributaries Overall Creek and Puckett Creek) in the Cumberland River Basin. The Harpeth, Stones, and West Fork Stones rivers are classified by TDEC for domestic and industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife (TDEC 2004a). The remaining streams are classified for fish and aquatic life, recreation, irrigation, and livestock watering and wildlife (ibid). The Harpeth River in Davidson County (about 50 miles downstream of the project area) is a State Scenic River because of its outstanding scenic and recreational value. It is threatened by rapid development in Franklin and Bellevue.

The Harpeth River downstream of the project is on the state 303(d) list as impaired (i.e., not fully supporting its designated uses) due to organic enrichment and low dissolved oxygen from municipal point source and discharges from MS4. Watson Branch is listed due to siltation from land development. Stewart Creek is listed due to nitrates and siltation municipal point source and MS4. The West Fork Stones River is listed due to siltation and low dissolved oxygen from land development and pasture grazing (TDEC 2006).

Pinhook-Radnor Transmission Line

The Pinhook-Radnor Transmission Line project area drains to the Stones River and to Mill Creek and its tributaries Sevenmile Creek (and its tributary Brentwood Branch), Whittemore Branch, and Collins Creek. The Stones River is classified by the state for domestic and industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. Mill Creek is classified for industrial water supply, fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. The remaining streams are classified for fish and aquatic life, recreation, irrigation, and livestock watering and wildlife. Mill Creek is on the state 303(d) list due to nutrients, siltation, and organic enrichment/low dissolved oxygen from collection system failure and discharges from MS4 area. Sevenmile Creek is on the state 303(d) list due to nutrients, *Escherichia coli,* and habitat alterations

from hydromodifications and discharges from MS4 area. Whittemore Branch is on the state 303(d) list due to habitat alterations and discharges from MS4 area. Collins Creek is on the state 303(d) list due to siltation resulting from land development (TDEC 2006).

3.7. Aquatic Ecology

Located in the Nashville Basin, the proposed transmission lines would cross within drainages of the Stones, Harpeth, and Cumberland rivers in Rutherford, Williamson, and Davidson counties, Tennessee. Streams of the Nashville Basin are characterized by low to moderate gradient and virtually paved in some areas with expanses of limestone bedrock interspersed with rock rubble riffle areas, silty basins, and some sand and gravel reaches (Etnier and Starnes 1993). Many streams are dry, reduced to isolated pools or are subterranean during the late summer and fall (TDEC 2003). The limestones freely leach nutrients and, consequently, waters are very productive, and algae and rooted vegetation are abundant in streams. Representative fish and mussels occupying streams in the drainage are described in Etnier and Starnes (1993) and Parmalee and Bogan (1998).

About 50 species of native freshwater mussels have historically been reported as occurring within the drainages occurring in the affected area of Rutherford, Williamson, and Davidson counties, Tennessee (Parmalee and Bogan 1998). Modification of the drainage systems and subsequent water quality changes due to dam construction, stream channelization, domestic and agricultural pollution, and effluents from strip mining, have extensively modified the aquatic environment that once supported numerous mollusks (Parmalee and Bogan 1998). Many of these mollusks have been unable to adjust to such environmental changes and are therefore either struggling to maintain viable populations, or have been extirpated.

The Nashville Basin has a distinctive fish fauna which is perhaps as much notable for elements that avoid the region as those that are present (Etnier and Starnes 1993). Fish communities have long been recognized to be indicators of water quality because they are relatively long-lived aquatic creatures, and because many species require precise habitat and water quality conditions and therefore, their patterns of abundance and occurrence indicate the health of the streams in which they live (Mettee et al. 1996). According to Etnier and Starnes (1993), 96 species of fish have been identified within streams in the Nashville Basin drainage, and all of these species have been reported to occur within streams located within the project area counties. Specific species found within streams crossed by the proposed transmission lines would depend on a number of factors including stream size, existing habitat in the vicinity of these stream segments, ecological requirements of the individual species, and the condition of the stream water quality (i.e., dissolved oxygen, temperature, dissolved solids, pollutants).

TDEC monitors various reference streams in watersheds in part using a Biological Reconnaissance. Activities that take place include benthic (bottom dwelling) macroinvertebrate biological stream surveys, physical habitat determinations and/or chemical monitoring. Macroinvertebrates have also been used as a screening tool to describe the condition of water quality, in general, by determining the absence or presence of clean water indicator organisms, such as EPT (Ephemeroptera [mayfly], Plecoptera [stonefly], Trichoptera [caddisfly]) (TDEC 2003). These surveys in part contribute to TDEC's water quality assessments of streams (303(d) listings) in Tennessee (TDEC 2006).

Murfreesboro-East Franklin Transmission Line
The larger named streams that would be crossed by the proposed Murfreesboro-East Franklin Transmission Line include Watson Branch and Arrington, Overall, Puckett, and Mayes Creeks.

Field surveys conducted within the proposed Murfreesboro-East Franklin Transmission Line right-of-way during February 2006 identified 75 watercourses including 33 perennial streams, 12 intermittent streams, 30 wet-weather conveyances, and three ponds (Appendix VI). Additionally, three springs were identified within the right-of-way that drains into either a perennial or intermittent streams that would be crossed by the proposed transmission line.

Tennessee Rivers Assessment Project rated Arrington Creek as having regionally significant natural scenic qualities with water quality fully supporting its designated uses. Overall and Puckett creeks were on also assessed, however, no rating was given for their fishery status and water quality for both supported their designated uses, but was threatened (TDEC 1998).

Pinhook-Radnor Transmission Line
The larger named streams that would be crossed by the proposed Pinhook-Radnor Transmission Line are Whittemore Branch and Mill, Collins, and Sevenmile creeks.

Field surveys conducted within the proposed Pinhook-Radnor Transmission Line right-of-way during February 2006 identified 29 watercourses including 10 perennial streams, 7 intermittent streams, and 12 wet-weather conveyances (Appendix VI). Additionally, one spring was identified within the right of way. Tennessee Rivers Assessment Project rated Mill Creek as having an excellent fishery, but indicated that its water quality does not support its designated uses (TDEC 1998).

3.8. Managed Areas

Murfreesboro-East Franklin Transmission Line
The proposed Murfreesboro-East Franklin Transmission Line would cross one managed area. The proposed route would bisect the southwestern knob of the Scales Mountain Knobs Registered State Natural Area (SNA), a privately owned forested area of approximately 270 acres consisting of three knobs. The middle knob is known habitat for the state-listed Alabama snow-wreath and the northeastern knob has approximately 90 acres of federally DCH for Braun's rock-cress (Scales Mountain DCH Unit 18).

Four additional natural areas are located within 3 miles of the proposed Murfreesboro-East Franklin Transmission Line. These areas are northeast of the transmission line terminus near Murfreesboro at distances of 0.8 mile, 1.7 miles, 2.2 miles, and 2.2 miles, respectively.

Radio Tower Marsh is a 20-acre area in Murfreesboro owned and maintained by the City of Murfreesboro. The site includes a large marsh where the state's largest population of sessile water-speedwell and other marsh-related herbs and shrubs are found. WGNS Radio Tower stands in the middle of the marsh, and the site includes The Discovery Center at Murfree Spring, a children's museum.

Oaklands Spring Wetland is located in Murfreesboro on site of the Civil War-era Oaklands Historic House. Managed by the Oaklands Association, the home is maintained as a public museum. The small wetlands area near this home is fed by a nearby spring.

Stones River National Battlefield, a 350-acre area, commemorates a Civil War battle. The area is managed by the U.S. National Park Service (USNPS) to provide a quality recreational experience for visitors and to preserve significant natural and heritage resources.

Overlapping the Stones River National Battlefield site is the 185-acre Stones River Cedar Glade and Barrens SNA. It is also managed by the USNPS in cooperation with Tennessee's Division of Natural Areas to protect the site's unique cedar glade ecosystem including the recovery of two federally listed as endangered plant species, Pyne's ground plum and Tennessee coneflower.

No Wild and Scenic Rivers are in the proposed project area. However, Nationwide Rivers Inventory (NRI) streams in the project area include Overall Creek, Harpeth River, and the Middle and West forks of the Stones River.

The proposed rebuild would cross Overall Creek between existing transmission line Structures 94 and 95 at approximately river mile (RM) 14. Overall Creek, from RM 0 at the confluence with West Fork, Stones River (north of Murfreesboro segment) to RM 17 at the headwaters 1 mile southeast of Windrow, is recognized by the USNPS for its recreational, fish, and wildlife values.

Middle Fork and West Fork of the Stones River are approximately 0.4 mile from the proposed action. Middle Fork of the Stones River, from RM 0 at its confluence with West Fork of the Stones River to RM 14, is recognized by the USNPS for its scenic, recreational, fish, wildlife, and historic values. West Fork of the Stones River, from RM 17 to RM 27, is recognized by the USNPS for its scenic, recreational, geologic, fish, and historic values.

The proposed transmission line would come within 1.1 miles of the Harpeth River at existing transmission line Structure 560 on the Triune-East Franklin Transmission Line. The Harpeth River is listed on the NRI between RM 6 near Jackie Branch on the Cheatham/Dickson county line and RM 121 at the confluence with Puckett Branch and Concord Creek. The USNPS recognizes this stream for its scenic, recreational, geologic, fish and wildlife, historic, and cultural values. It is noted as a stream rich in history and of archaeological significance with impressive, carved bluffs.

Pinhook-Radnor Transmission Line

The Pinhook-Radnor Transmission Line is not within or immediately adjacent to any natural areas. Eight natural areas are located within 3 miles of the proposed action.

Mount View Glade Designated SNA is a 9-acre area managed by the state's Division of Natural Areas. This small area is fenced and gated for limited public access. Its natural area designation helps protect the federally listed as endangered Tennessee coneflower and other state rare cedar glade-related species. It is located approximately 1.3 miles north of the proposed action.

Hobson Pike Glade, approximately 2.1 miles northeast of the proposed action, is a limestone glade, open with cedar islands. Tennessee coneflower and limestone fame-flower occur on this ecologically significant site.

Mount View Glade Potential National Natural Landmark (NNL) is an open cedar glade of approximately 15 acres and bordered by cedar glade endemics. Although privately owned, The Nature Conservancy monitors the area. The NNL program was established in the 1970s by the USNPS to identify nationally significant examples of ecologically pristine or near pristine landscapes. This tract, approximately 2.2 miles northeast of the proposed action, meets the criteria for listing, but has not yet been registered.

Cane Ridge Park, approximately 2.4 miles south of the proposed project, is managed by Metro Parks and Recreation Department. It contains baseball fields and a paved runway for miniature aircraft.

Elsie Quarterman Cedar Glade Designated SNA, approximately 2.7 miles from the proposed action, is a 185-acre limestone cedar glade important as a reintroduction site for federally listed as endangered plants. It is owned by the USACE and managed in cooperation with TDEC.

Nashville Zoo at Grassmere is the City of Nashville's 183-acre zoo featuring wildlife exhibits, an aviary, and an historic plantation farmhouse. It is approximately 2.2 miles north of the proposed action.

Radnor Lake Designated SNA, Tennessee's first official SNA, is a 957-acre area including an 80-acre lake. Managed by Radnor Lake State Park for TDEC, the area also is a State Wildlife Observation Area. Bird watching and other nature study, trail hiking, photography, and research are the primary uses of this environmental preserve and sanctuary. It is approximately 0.6 mile west of the proposed action.

Dyer Observatory, located approximately 10 miles south of Nashville near Brentwood, is the principal astronomical facility of Vanderbilt University. It is approximately 1.8 miles west of the proposed action.

No Wild and Scenic Rivers are in the area of this proposed action. One NRI stream, Stones River, is located approximately 3 miles from the proposed action. Stones River, from RM 8 above Percy Priest Dam to RM 38 at the confluence with the East Fork Stones and West Fork Stones, is recognized by the USNPS for its scenic, recreational, fish, wildlife, historic, and cultural values.

3.9. Recreation

Murfreesboro-East Franklin Transmission Line
Public recreation activities in the project corridors are largely informal and dispersed and include hunting, walking, horseback riding, off-road vehicle use, and nature viewing. There are developed public recreational facilities located within the proposed project area including the Judge Fly and Cecil Lewis parks operated by the Williamson County Parks and Recreation Department. These parks offer ball fields, walking trails, and picnic facilities and receive heavy seasonal use.

Pinhook-Radnor Transmission Line
The section is characterized as urban and heavily developed with commercial and residential structures. Public recreation activities in the project corridors are largely informal and dispersed and include walking and nature viewing. There are no developed public recreational facilities directly in the corridor.

3.10. Floodplains

The proposed Murfreesboro-East Franklin Transmission Line would cross the identified floodplains of Mayes Creek and Arrington Creek in Williamson County, Tennessee, and the identified floodplains of Overall Creek, Puckett Creek, Armstrong Creek, unnamed tributary of West Fork Stones River, and the West Fork Stones River in Rutherford County, Tennessee, along with several minor floodplain areas in these counties. The proposed Pinhook-Radnor Transmission Line would cross the identified floodplains of Sevenmile Creek, Whittemore Branch, and Mill Creek in Davidson County, Tennessee, along with several minor floodplain areas in these counties. The existing East Franklin, Radnor, and Pinhook substations are not located within the 100-year floodplain.

3.11. Groundwater

The project area is underlain by Ordovician-aged aquifers in the Interior Low Plateaus Physiographic Province. These carbonate rocks are the principal aquifers in large areas of central Tennessee and are part of the Central Basin aquifer system. The carbonate rock aquifers consist of almost pure limestone and minor dolostone and are interlayered with confining units of shale and shaly limestone. Limestone is susceptible to erosion, which produces fissures, sinkholes, underground streams, and caverns forming vast underground karst areas.

The middle Ordovician Stones River Group contains the most important carbonate-rock aquifers in the project area. The calcareous siltstones of the middle Ordovician Nashville Group yield small volumes of water, but these units are not considered to be principal aquifers. The lower Ordovician Knox Group is a major aquifer where dolostone contains freshwater. In a large area in central Tennessee, the upper parts of these aquifers contain freshwater and underlie a thin layer of Mississippian limestone and/or the Chattanooga Shale of Mississippian and Devonian age (Lloyd and Lyke 1995).

Precipitation is the primary source of recharge in the Interior Low Plateaus Province. Most of the precipitation becomes overland runoff to streams, but some percolates downward through soil to the underlying bedrock. In the consolidated rocks, however, most of the water moves through and is discharged from secondary openings, such as joints, fractures, bedding planes, and solution openings. As a result, groundwater discharge from springs is common throughout the Interior Low Plateaus Province. However, the volume of solution openings in the Ordovician limestones is estimated to be less than 0.5 percent of the total rock volume (ibid).

The quality of the water in the carbonate aquifers in the Ordovician rocks is considered hard and contains high concentrations of dissolved solids, chlorine, and iron. These concentrations, however, are equal to or less than USEPA's secondary maximum contaminant levels for drinking water. The quality of the water generally is adequate for domestic use, or it can be treated and made adequate for most uses. Contaminated and

turbid waters are common problems for the users of water from the carbonate aquifers in Ordovician rocks. The thin soil and residuum and the presence of solution features, such as sinkholes, swallow holes, and solution-enlarged fractures, allow water from the land surface to recharge the aquifer directly and rapidly. Contaminated and sediment-laden waters can then spread through a system of interconnected solution openings that can eventually reach wells and springs (ibid).

The proposed project is located within karst terrain. Karst systems are readily susceptible to contamination as the waters can travel long distances through conduits with no chance for the natural filtering processes of soil or bacterial action to diminish the contamination. In unconfined conditions, karst aquifers have very high flow and contaminant transport rates under rapid recharge conditions such as storm events (TDEC 2002a). Consequently, the groundwater sources in karst aquifers considered most vulnerable to contamination are those that are under the direct influence of surface water.

Murfreesboro-East Franklin Transmission Line

Many sinkholes and other karst features occur within the Murfreesboro-East Franklin Transmission Line project area. Several are located within the proposed transmission line right-of-way or very close to the proposed access roads.

A cluster of small sinkholes is located along the proposed right-of-way between access roads AP 61 and AP 60 in Williamson County. A large sinkhole occurs in Rutherford County between the Rutherford-Williamson county line and Rehobeth Road. The right-of-way and an original access road (AP 28) would cross the sinkhole in that location. However, construction of the access road would be such that the sinkhole would be avoided. Another sinkhole occurs along the same proposed access road. A proposed access road (AR RR1) has been sited through the center of a very large sinkhole (approximately 800 feet by 400 feet) that is located near the new rerouted transmission line section that would go around Indian Mountain. The access road as proposed is positioned along an existing road that runs through a stream that feeds a collapsed section of the sinkhole where groundwater contact occurs several feet from the proposed road.

A group of sinkholes occurs between Windrow Road and AP 24. A small sinkhole is located just off of AP 22 and another one occurs along the right-of-way at the east end of AP 16. Four groundwater springs were found within Murfreesboro-East Franklin Transmission Line project right-of-way during a field survey (Appendix VI).

Public drinking water for Williamson County is supplied by both surface water and groundwater sources. Public drinking water for Rutherford County is not supplied by groundwater sources (TDEC 2002b). The Murfreesboro-East Franklin Transmission Line right-of-way is not within a state-designated source water protection area. Privately owned wells supply water to area restaurants, schools, and marinas in both counties (USEPA 2006b). Residential wells may also occur near the project area.

Pinhook-Radnor Transmission Line

Although the Pinhook-Radnor Transmission Line project area is within the same geologic setting as the Murfreesboro-East Franklin Transmission Line right-of-way, sinkholes are not as prevalent along the Pinhook-Radnor Transmission Line right-of-way. One pond that may be a sinkhole occurs near existing transmission line Structure 136. Additionally, one groundwater spring was found during a field survey (Appendix VI).

Groundwater does not supply public water for Davidson County (TDEC 2002b). The Pinhook-Radnor Transmission Line right-of-way is not within a state-designated source water protection area. Privately owned wells supply water to a marina (USEPA 2006b). Residential wells may occur near the project area.

3.12. Visual Resources

The physical, biological, and cultural features of an area combine to make the visual landscape character both identifiable and unique. Scenic integrity indicates the degree of unity or wholeness of the visual character. Scenic attractiveness is the evaluation of outstanding or unique natural features, scenic variety, seasonal change, and strategic location. Where and how the landscape is viewed would affect the more subjective perceptions of its aesthetic quality and sense of place. Views of a landscape are described in terms of what is seen in foreground, middleground, and background distances. In the foreground, an area within 0.5 mile of the observer, details of objects are easily distinguished in the landscape. In the middleground, normally between 1 and 4 miles from the observer, objects may be distinguishable but their details are weak and they tend to merge into larger patterns. Details and colors of objects in the background, the distant part of the landscape, are not normally discernible unless they are especially large and standing alone. The impressions of an area's visual character can have a significant influence on how it is appreciated, protected, and used. The general landscape character of the study area is described in this section with additional details in Chapter 4.

Murfreesboro-East Franklin Transmission Line

The proposed Murfreesboro-East Franklin Transmission Line would begin at the existing TVA Murfreesboro Substation. New construction for the proposed route would begin at Cason Lane approximately 2 miles southwest along SR 99 (Eagleville Pike). This area is being developed for residential use, and natural landforms have been extensively modified by the construction of new buildings, utilities, and roads. New transmission line construction would be seen in the foreground along SR 99 to approximately Armstrong Valley Road to the west. Topography is mainly flat and vegetation is sparse.

Farther west, along Windrow Road, residential development is mainly confined to single-family homes situated on large tracts of open, agricultural land. Traffic is light and topography ranges from flat along roadsides to slightly rolling to the north and south in middleground distances. Continuing west, the transmission line route crosses Rockvale Road and disappears from motorists' views, crossing steep topography and heavily vegetated ridgelines. The existing right-of-way crosses Newman Road and Coleman Hill Road to the west, continuing across steep topography north of Nelson Creek. At Indian Mountain the transmission line route turns southwest, avoiding higher ridgelines to the north, before turning north just west of Indian Mountain and continuing west across steep terrain.

The existing right-of-way turns northwest at Haley Lane north of New Road, crossing US 31/41 and enters the existing Triune Substation. Traffic is moderate to heavy, and motorists and nearby residents have foreground views of the substation and existing transmission lines and structures. Scenic attractiveness is minimal. Scenic integrity is low.

Continuing west from the Triune Substation, the existing transmission line route parallels the right-of-way of SR 96, remaining in the foreground views of area residents and

motorists. Topography ranges from slightly rolling near SR 96 to moderately steep at Benhill near SR 252 (Wilson Pike). The landscape in these areas alternates between open pastures and dense woodlands to the north and south, providing sporadic views of existing transmission structures. South of Clovercroft Road, the route crosses North Chapel Road and the Judge Jerry Fly Girls' Softball Complex as well as near the Trinity School. There are numerous poles, transmission lines, and lighting structures in the area, providing discordant vertical contrast in the open, flat terrain. West of the softball complex, near Nolen Cemetery and Clovercroft Road, the areas adjacent to the transmission line route becomes intensive residential development. The existing route ends at the East Franklin Switching Station just west of John Williams Road.

Pinhook-Radnor Transmission Line

Construction for the new Pinhook-Radnor Transmission Line uprate would begin at the existing Pinhook Substation just north of La Vergne, Tennessee, east of U.S. Highway (US) 41 on Hickory Boulevard. Motorists along US 41 do not have discernible views of the substation due to existing vegetation and topographic conditions along the road right-of-way. However, residents northwest of the substation along US 41 have foreground views of the north and west sides of the substation. Motorists along Hickory Boulevard have foreground views of the southern edge of the substation.

The existing Pinhook-Radnor Transmission Line route crosses US 41 to the southwest and disappears quickly from public views. The transmission line crosses Interstate (I-) 24 and turns slightly northwest toward Old Hickory Boulevard/Bell Road. Visual congestion along Bell Road includes numerous service and light poles, signs, and other vertical and broadly horizontal elements in the landscape. Motorists and residents near Whittemore Branch along Old Hickory Boulevard have foreground views of the route parallel to structures. At the intersection of Nolensville Pike and Old Hickory Boulevard, motorists have views of existing transmission structures to the south.

The transmission line turns northwest at Huntington Parkway and traverses dense residential developments. Residents have foreground views of existing structures, particularly along local roads and open space areas. The route terminates at the existing Radnor Substation. The substation is located in a residential area and can be seen by area residents in the foreground from the south and west.

3.13. Cultural Resources

The Central Basin of Middle Tennessee has been an area of human occupation for the last 12,000 years. Human occupation of the area is generally described in five broad cultural periods: Paleo-Indian (11,000-8000 BC), Archaic (8000-1600 BC), Woodland (1600 BC-AD 1000), Mississippian (AD 1000-1700), and Historic (AD 1700-to present). Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on floodplains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands.

Williamson County was created from part of Davidson County in 1799. Like the other counties in the fertile Central Basin, Williamson County thrived on an agricultural economy. Phosphate mining became a profitable pursuit during the early 1890s. The county remained mostly agrarian through the 1960s, but during the late-20th century, urban sprawl from nearby Nashville forever changed the landscape of the area (Crutchfield 1998).

Rutherford County was created from Davidson, Wilson, Williamson, and Sumner counties in 1803. In 1811, Murfreesboro became the county seat and served as the state capitol from 1818 to 1826. Due to its location between Nashville and Chattanooga, Rutherford County underwent numerous Civil War actions. The county's chief agricultural products continue to be livestock and grains (Hankins 1998).

TVA proposes to construct an approximate 23-mile, 161-kV transmission line between the East Franklin Switching Station in Williamson County, Tennessee, and the Murfreesboro Substation in Rutherford County. The eastern 3.2 miles of transmission line right-of-way for the proposed Murfreesboro-East Franklin Transmission Line correspond exactly with the footprint of the TVA Cason Lane 69-kV Transmission Line replacement corridor and related substation. Cultural resources along this segment were described by McKee and Karpynec (2005).

Murfreesboro-East Franklin Transmission Line

The area of potential effect (APE) for archeological resources was determined as all areas in which land-disturbing activities would take place, which include the approximate 23-mile-long by 100-foot-wide transmission line right-of-way. The APE for architectural resources include a 0.5-mile area surrounding the proposed transmission line route, as well as any areas where the project would alter existing topography or vegetation in view of an historic resource.

Prior to any field survey, background research was conducted and identified no archaeological resources, 34 architectural resources (RD-1938, RD-1998, RD-2014, RD-2015, RD-2018, RD-2019, RD-2021 through 2024, RD-2033, RD-2035 through 2039, RD-3026, RD-3029, RD-3165 through 3167, WM-161, WM-173/921, WM-246, WM-808, WM-919, WM-920, WM-922 through 924, WM-926, WM-929, WM-930, and WM-939), which are considered ineligible for listing on the NRHP due to loss of integrity, and one NRHP-listed property (Bostick Female Academy) within the proposed APE (Karpynec and Deter-Wolf 2006). The Bostick Female Academy's historic setting has been compromised by modern development.

The archaeological field survey identified two previously unrecorded archaeological resources, 40RD278 and 40WM408 (Karpynec and Deter-Wolf 2006). Site 40RD278 is a collection of historic stoneworks located on the crest of Indian Mountain. It is possible that this site can contribute significant new data regarding historic period settlement and land use of this portion of the Nashville Basin, as well as shedding new light on the identification and treatment of similar stone features throughout the Southeast; however, no specific cultural affiliation was determined for the site. Site 40RD278 is recommended potentially eligible for listing on the NRHP. Site 40WM408 is an historic-period cemetery located 0.3 mile west of Rehobeth Road and 0.75 mile south of SR 96 along the Williamson/Rutherford county line. This site does not fulfill the criteria to be eligible for listing on the NRHP.

The architectural survey identified 10 previously unrecorded architectural resources (HS-1 through HS-10) within the APE (Karpynec and Deter-Wolf 2006). HS-1 and HS-3 are late 19th century hall-and-parlor houses. HS-2 is an example of a late 19th century pyramidal roof house. HS-4 is an early 20th century center-hall plan house. HS-5 is an early 20th century massed-plan, side-gable house. HS-6 is an early 20th century minimal traditional style house. HS-7 is an early 20th century gable-front-and-wing house. HS-8 and HS-9 are early 20th century double-plan houses. HS-10 is an early 20th century piano box style

house. All of these structures failed to exhibit unique features of architectural style or workmanship and thus are considered ineligible for listing on the NRHP.

Pinhook-Radnor Transmission Line

The APE for archeological resources was determined as all areas in which land-disturbing activities would take place, which include the 100-foot-wide, 10-mile-long existing transmission line corridor and 25 access roads. The APE for architectural resources includes a 0.5-mile area surrounding the proposed transmission line route, as well as any areas where the project would alter existing topography or vegetation in view of an historic resource.

Prior to any field survey, background research was conducted and identified one previously recorded archaeological site (40DV571), the Northern Route of the Trail of Tears, located within the transmission line corridor (Wampler 2006). The NRHP eligibility of the site has not been assessed.

The survey did not identify any archaeological or architectural resources other than the previously mentioned Site 40DV571. This site crosses the APE near the Pinhook Substation and is now occupied by SR 41 (Murfreesboro Pike); therefore, any original remains located within the APE and several miles north and south of the APE have been completely destroyed.

CHAPTER 4

4. ENVIRONMENTAL CONSEQUENCES

4.1. Introduction

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 2.2 contains by alternative the predicted attainment and nonattainment of the purpose and need defined in Chapter 1. Chapter 4 presents the detailed predicted effects of implementing Alternative 1 – Do Not Construct the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Lines (No Action) and Alternative 2 - Construct and Operate the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Lines (Action).

4.1.1. Alternative 1 – Do Not Construct the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Lines (No Action)

Under this alternative, TVA would not construct and operate the proposed transmission lines, or take other actions to improve the TVA power supply situation in the Middle Tennessee power service area. None of the impacts resulting from the construction and upgrades of the proposed facilities described below would occur as a result of TVA's actions. TVA would, however, continue to operate and maintain the existing Triune-East Franklin Transmission Line, the Pinhook-Radnor Transmission Line, and their associated rights-of-way.

The implementation of Alternative 1 as discussed in Section 2.2.1 would not address the reliability or capacity concerns in the Middle Tennessee power service area. TVA would continue at this time to operate with a high risk level of interruption in certain situations. However, at some point in the future, the power supply would have to be addressed, and it would be likely that the impacts encountered at that time would be similar to those addressed under the Action Alternative presented in this environmental assessment.

4.1.2. Alternative 2 - Construct and Operate the Murfreesboro-East Franklin and Pinhook-Radnor 161-kV Transmission Lines (Action)

Under this alternative, TVA would implement the proposed project. The predicted effects of the construction, operation, and maintenance of the proposed 23-mile transmission line, and the upgrades to the 10-mile Pinhook-Radnor Transmission Line are described in this chapter.

4.2. Vegetation

Murfreesboro-East Franklin Transmission Line

With the exception of limestone cedar glades, the proposed Murfreesboro-East Franklin Transmission Line route and access roads would pass through vegetation types that are mostly common and representative of the region. A seasonally wet glade complex occurs

along a proposed access road on the Bill Rice Ranch. This glade community, described as the Interior Limestone Glade Ephemeral Pool, is designated G3 – Vulnerable. Disturbance of these small, scattered glades would be a direct effect of the proposed action. Although areas of potential habitat for listed species is present, no federally or state-listed plant species were found within the glade complex. The area has been marked and impacts to this vulnerable G3 plant community would be minimized as described in Section 4.18. Construction in this area would take place during the dry season (June to December), and restrictions would be placed on how the area would be used.

Invasive plant species have the potential to adversely impact the native plant communities because of their potential to spread rapidly and displace native vegetation. Impacts to native plant communities from the introduction and spread of exotic or invasive plant species are anticipated as a result of the proposed action. To minimize impacts to these communities, suitable non-native, non-invasive species would be planted (James 2002). Although many of the invasive plant species observed within the proposed project area are listed as high priority - severe threat plant species (James 2002), the plant species and the size of the populations observed within the proposed project area are typical of the area and are not likely to become a serious problem.

The forested areas within the proposed Murfreesboro-East Franklin Transmission Line right-of-way, totaling approximately 77 acres, would be converted to, and maintained as, early successional habitat. Other direct impacts anticipated to such communities include the potential introduction and spread of invasive terrestrial plant species. To minimize the potential impacts to these forest communities, nonnative, noninvasive and/or native plant species would be planted following the completion of construction to reduce or eliminate the introduction and spread of exotic nonnative invasive species along the proposed transmission line right-of-way (James 2002).

Pinhook-Radnor Transmission Line
The proposed transmission line route would pass through vegetation types that are common and representative of the region. The Action Alternative would not likely result in significant direct, indirect, or cumulative adverse effects on terrestrial ecology.

Although the proposed Pinhook-Radnor Transmission Line route is mostly existing right-of-way and pasture, direct impacts to herbaceous communities from the potential introduction and spread of invasive terrestrial plant species are anticipated as a result of the proposed project. However, to minimize the potential impacts to the plant communities in the project area, nonnative, noninvasive, and/or native plant species would be planted following construction to reduce or eliminate the introduction and spread of exotic nonnative invasive species along the proposed transmission line right-of-way (ibid).

4.3. Wildlife

Murfreesboro-East Franklin Transmission Line
The clearing of 77 acres of forested habitat along the route would increase forest edge habitat and fragmentation. In particular, the Indian and Scales Mountain area contain some of the larger unfragmented forests in the area. Some species, including several Neotropical migrant songbirds, are dependent on large forested areas and are negatively affected by forest conversion. However, few of these types of birds occur in this part of the state. Conversely, several species require early successional habitats and would benefit from the

increase in this habitat type along the proposed route. Most species that would be affected by these changes, however, are locally and regionally common, and would not be significantly impacted. Increased fragmentation of these habitats would be insignificant.

Of the eight wetlands located along the proposed route, six are in the existing right-of-way and one is an emergent wetland outside of the existing right-of-way. Wetland habitat would not be converted in these locations, and impacts to wildlife using these areas are not anticipated. A 0.3 acre forested wetland would be converted to an emergent wetland. Because wetland habitat would not be lost and the size of the conversion is small, impacts to wildlife using wetlands would be minimal. Within glades, the proposed actions would clear woody vegetation from these areas. This would create drier conditions and sun-exposed rock surfaces which would benefit reptiles and decrease the numbers of the few amphibians expected in glades.

Six caves are known to occur within 3 miles of the proposed transmission line route. All of these caves are greater than 1 mile from the project area, and are at adequate distances from the proposed route. Several sinkholes found in the vicinity of the proposed route are all greater than 300 feet from the right-of-way and would not be impacted by the proposed actions. The proposed Murfreesboro-East Franklin Transmission Line is not expected to result in significant direct or indirect impacts to terrestrial animals or habitats.

Pinhook-Radnor Transmission Line
The Pinhook-Radnor Transmission Line is within a landscape heavily disturbed by previous development and agricultural activities and is of limited value to wildlife. The right-of-way is currently maintained in an early successional state and there would be no long-term change in its management. Terrestrial animal species that would be affected by the construction of the proposed transmission line are locally and regionally common, and impacts to them are not expected to be significant.

Four caves are known from the project area. All of these caves are greater than 1.5 miles from the project area, and are at adequate distances from the proposed route. The Pinhook-Radnor Transmission Line would not adversely affect terrestrial animals or their habitats.

4.4. Threatened and Endangered Species

Murfreesboro-East Franklin Transmission Line
Populations of Braun's rock-cress and DCH for this endangered plant occur within TVA's existing right-of-way that crossed Indian Mountain. To avoid impacts to these populations and the critical habitat, as well as cultural resources, a segment of the proposed transmission line was rerouted south of Indian Mountain. No federally or state-listed plant species occur within the proposed rerouted transmission line section or access roads near Indian Mountain. One small population of Braun's rock-cress is known to occur on Scales Mountain approximately 260 feet outside the proposed transmission line route. The location of this population, which has been marked, would not be disturbed during the proposed construction or maintenance activities. Additionally, the right-of-way in this area, between proposed Structures 148, 149, and 150 would be maintained by hand clearing only, and no herbicides would be used in With these protection measures, no adverse impacts to this population are anticipated, and no direct or indirect impacts to other federally or state-listed plant species are expected as a result of the proposed action.

Streamside salamanders are known from Puckett Creek within the Murfreesboro-East Franklin Transmission Line project area. However, the area crossed on Puckett Creek is primarily in pasture and does not provide suitable streamside salamander habitat. A few other streams crossing the proposed route provide marginal habitat, but this salamander has not been recorded in these streams, and no streams containing high-quality habitat were found during field investigations. Due to the current landscape, the construction and maintenance of the proposed Murfreesboro-East Franklin Transmission Line is not expected to cause significant direct or indirect adverse effects to streamside salamanders or their habitat.

Tennessee cave salamanders are known from a cave approximately 2.5 miles from the proposed route. The proposed action alternative would not adversely affect this cave. No other caves were located along the proposed route and, therefore, no adverse effects to Tennessee cave salamanders are anticipated.

The Action Alternative would not eliminate barn owl foraging habitat or potential nest sites. Additionally, future maintained rights-of-way resulting from this alternative may provide additional foraging habitat. Therefore, barn owls may minimally benefit and would not be adversely affected by the Murfreesboro-East Franklin Transmission Line.

One gray bat cave exists in Rutherford County, but no caves are located near the proposed transmission line route. Numerous streams occur within the project area and provide foraging habitat for gray bats. Most of the proposed and/or existing stream crossings have little to no riparian vegetation and there would be little change to gray bat foraging habitat. Consequently, the proposed action is not expected to affect gray bats.

The slenderhead darter and the smallscale darter have been collected in the Harpeth River. While the surveyed Murfreesboro-East Franklin Transmission Line route would not cross the Harpeth River, it would cross several of its tributaries less than 2 miles from the Harpeth River including Arrington Creek, Wilson Creek, Nelson Creek, and Mayes Creek. The Murfreesboro-East Franklin Transmission Line route would also cross Puckett Creek, a tributary to the Stones River, where bedrock shiner, also listed as “In Need of Management” and smallscale darter have been collected. Sections of the Harpeth River downstream of the confluence with Arrington Creek are on the 303(d) list due to excessive siltation. Soil-disturbing activities and removal of riparian vegetation adjacent to tributaries of Arrington Creek and to Puckett Creek could have a direct effect on populations of slenderhead darters and bedrock shiners. However, with proper implementation of appropriate stream protection requirements, use of best management practices (BMPs), and adherence to the recommended commitments, there would be no adverse effects to state-listed aquatic species and no effects to federally-listed species as a result of the proposed project.

Pinhook-Radnor Transmission Line

No federally or state-listed plant species or their appropriate habitats occur along the Pinhook-Radnor Transmission Line. No direct or indirect impacts to federally or state-listed plant species are expected as a result of the proposed upgrades of this line.

Bewick’s wren uses open, early successional habitats with brush, thickets, and scrub. This habitat exists in the project area, but the proposed actions would not eliminate or reduce this habitat. Therefore, Bewick’s wrens would not be adversely affected by the alternative action. No other protected terrestrial animal species are known from the project area, and

the Action Alternative would not affect any protected terrestrial animal species or their habitats.

Portions of the existing, maintained Pinhook-Radnor Transmission Line right-of-way cross Mill Creek and five tributaries of Mill Creek. The Nashville crayfish, federally listed as endangered, is found in the Mill Creek drainage. Given the descriptions of the preferred habitat for Nashville crayfish presented by Miller and Hartfield (1985) and results of site inspections, several of these watercourses are likely to support populations of the Nashville crayfish. Soil-disturbing activities and vegetation removal adjacent to Mill Creek and its tributaries could further degrade water quality within the Mill Creek drainage. Due to the likely presence of Nashville crayfish in these streams and their impaired water quality, all intermittent and perennial stream crossings in the Mill Creek system would be protected using Category B, Protection of Important Permanent Streams, as outlined in Muncy (1999) and Appendix VI. This designation is more protective of these stream crossings than is in place under existing maintenance procedures. With proper implementation of the appropriate stream protection measures and BMPs, siltation would be minimized and the Nashville crayfish would not be adversely affected.

Williamson County, Rutherford County, and the southeastern region of Davidson County are currently undergoing rapid growth and urbanization. As a result, siltation and channel modification have become major concerns in this area. Siltation has a detrimental effect on many 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 part of the U.S. Moreover, it is believed that in streams carrying heavy silt loads, the welfare of crayfishes is seriously threatened. Silt in suspension is not necessarily detrimental to crayfish populations; it is the effect of the destruction of the habitat (obliteration of retreats under rocks and debris and smothering of burrows) rather than the direct effect on the crayfish itself (Hobbs and Hall 1974).

Cumulative effects to the Nashville crayfish, the slenderhead darter, the bedrock shiner, and the smallscale darter could result from these impacts to aquatic habitat in Mill Creek, its tributaries, tributaries to the Harpeth River, and Puckett Creek due to runoff from soil-disturbing activities during construction, or from subsequent maintenance activities. However, ground disturbance would be minimized during construction, and all construction and maintenance activities would be conducted according to BMPs as outlined in Muncy (1999). With proper implementation of these practices and adherence to the commitments when constructing and maintaining these transmission lines, cumulative impacts to the Nashville crayfish, slenderhead darter, smallscale darter, and the bedrock shiner or their habitats would be insignificant.

TVA has concluded that the proposed actions, with the implementation of the environmental commitments and mitigation measures described above and in Section 4.18, would not adversely affect the endangered Braun's rock-cress or Nashville crayfish, would not affect other federally listed species, and would not have significant impacts on any state-listed species. In compliance with Section 7 of the Endangered Species Act, TVA consulted with the USFWS over the potential effects on Braun's rock-cress and Nashville crayfish. In a letter dated February 23, 2007 (Appendix I), The USFWS concurred with TVA's determination that the proposed actions would not adversely affect these species.

4.5. Wetlands

Activities in wetlands are regulated under Section 404 of the Clean Water Act, as well as EO 11990. Under Section 404, the USACE established a permit system to regulate activities in "Waters of the United States," including wetlands. This requires that authorization under either a nationwide general permit or an individual permit be obtained to conduct specific activities in wetlands. Additionally, Section 401 requires water quality certification by the state for projects permitted by the federal government (Strand 1997). EO 11990 requires agencies to minimize wetland destruction, loss, or degradation, and preserve and enhance natural and beneficial wetland values, while carrying out agency responsibilities. The use of TVARAM aids TVA in guiding wetland mitigation decisions consistent with TVA's independent responsibilities under the National Environmental Policy Act (NEPA) and EO 11990.

All of the wetlands identified within the proposed project areas function in storm water retention, erosion control, toxicant absorption, flood control and offer wildlife habitat. Wetlands W002 through W009 scored as Category 2 using the TVARAM, which indicates these wetlands are of good condition and therefore provide these beneficial wetland functions to a moderate extent. W001 and W010 scored in Category 1, which typically exhibit low species diversity (often invasive dominants), minimal wildlife habitat, and minimal hydrological function due to the degraded condition of the wetland (Mack 2001).

Wetlands W002, W003, and W007 contain or are very close to existing transmission line structures that would be removed. Wetlands W008 and W009 contain forested wetland areas. All of the identified wetland areas appear to be jurisdictional except W010, which is located along the Pinhook-Radnor Transmission Line and would not be affected by the proposed upgrades to this line. With the exception of W010, all other wetland areas are situated at locations where construction access across the wetland may be necessary. The total wetland area identified along both of the transmission line routes is 3.83 acres. Of this, approximately 3.81 acres are located on potential access routes within the right-of-way. The total forested wetland area identified along both of the transmission line routes is 0.44 acre.

The proposed Murfreesboro-East Franklin and Pinhook-Radnor Transmission Line project would require: (1) work activities within Wetland W003, (2) clearing forested wetland areas of 0.34 acre in W008 and 0.10 acre in W009, (3) potential construction access across all other wetlands located along the proposed transmission line route, and (4) long-term maintenance of the transmission lines.

Murfreesboro-East Franklin Transmission Line

Existing transmission line Structure 600 is located within Wetland W003. With appropriate BMPs, impacts resulting from work activities at this structure are anticipated to be minimal and insignificant. All of W008, a forested wetland, is located within the Murfreesboro-East Franklin Transmission Line right-of-way and would, consequently, be converted from a forested wetland to an emergent/scrub-shrub wetland area. The wetland functions that are currently provided by W008 could incrementally be reduced as a result of the conversion. However, these functions should continue sufficiently at the currently rated moderate level post conversion such that a TVARAM Category 2 score would be sustained. Therefore, due to the small size of this wetland (0.34 acre), and the current high score within TVARAM Category 2 (currently 54.5 within the 30 to 59 point range with higher being better), the

conversion of this wetland from forested to emergent/scrub-shrub is anticipated to be insignificant.

Pinhook-Radnor Transmission Line
The proposed Pinhook-Radnor Transmission Line construction/upgrade would require the clearing of 0.10 acre of a forested wetland (W009) and its conversion to an emergent/scrub-shrub. The forested portion of W009 currently extends outside the right-of-way and would continue to provide the current moderate functions. Thus, with no loss of wetland area, the conversion of 0.10 acre would have an insignificant impact on the wetlands functionality. W010 would be avoided by the proposed transmission line construction/upgrade activities.

Potential impacts resulting from vegetation clearing and potential vehicular access during construction/upgrade and long-term maintenance activities of the transmission lines to all other wetland areas would be minimized sufficiently through the use of BMPs (Muncy 1999).

Therefore, the conversion along both of the proposed transmission lines of a total of 0.44 acre of forested wetland areas to emergent/scrub-shrub wetland areas, the use of BMPs to minimize impacts associated with work activities at Structure 600, and access to all other structures for construction/upgrade and long-term maintenance, collectively, would result in insignificant impacts to the wetland area within the project area.

4.6. Surface Water

Soil disturbances associated with access roads or other construction activities can potentially result in adverse water quality impacts. Soil 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.

However, TVA routinely includes precautions in the design, construction, and maintenance of its transmission line projects to minimize these potential impacts. Permanent stream crossings 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). Canopies in all SMZs would be left undisturbed unless there were no practicable alternative. Right-of-way 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 surface water impacts are anticipated.

4.7. Aquatic Ecology

Aquatic life could be affected by the proposed action either directly by the alteration of habitat conditions within the stream or indirectly due to modification of the riparian zone and storm water runoff resulting from construction and maintenance activities along the transmission line corridor. Potential impacts due to removal of streamside vegetation within

the riparian zone include increased erosion and siltation, loss of instream 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.

Siltation has a detrimental effect on many 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 part of the U.S. Moreover, it is believed that in streams carrying heavy silt loads, the welfare of crayfishes is seriously threatened. While silt in suspension is not necessarily detrimental to crayfish populations; the destruction of their habitat by obliteration of retreats under rocks and debris and smothering of burrows can harm their populations (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).

Murfreesboro-East Franklin Transmission Line

Watercourses that convey only surface water during storm events (i.e., wet-weather conveyances or ephemeral streams) 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 erosion and subsequent sedimentation in streams.

All perennial and intermittent streams along the proposed Murfreesboro-East Franklin Transmission Line would be protected by Standard Stream Protection (Category A) as defined in Muncy 1999 and in Appendix VI. This category of protection is based on the variety of species and habitats that exist in perennial and intermittent streams and the state and federal requirements to avoid harming these aquatic ecosystems. The SMZ width for these streams was determined by the category of protection and the slope of the stream banks as stipulated in Muncy (1999).

With proper implementation of the appropriate stream protection requirements and the use of standard BMPs as outlined in Muncy (1999), all potential direct, indirect, or cumulative impacts to aquatic communities or habitat as a result of the construction, operation, and maintenance of the proposed Murfreesboro-East Franklin Transmission Line would be insignificant.

Pinhook-Radnor Transmission Line

Watercourses that convey only surface water during storm events (i.e., wet-weather conveyances or ephemeral streams) 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 erosion and subsequent sedimentation in streams.

Standard Stream Protection (Category A) would apply to all ponds and other intermittent and perennial streams not designated as Category B protection. This category of protection is based on the variety of species and habitats that exist in perennial and intermittent streams and the state and federal requirements to avoid harming these aquatic

ecosystems. The width of the SMZ is determined by the category of protection and the slope of the stream banks (ibid).

Protection of Important Permanent Streams (Category B), as outlined in Muncy (1999) and Appendix VI would apply to the intermittent and perennial streams in the Mill Creek drainage including unnamed tributaries to Mill Creek, Whittemore Branch, and Sevenmile Creek to provide habitat protection for the federally listed Nashville crayfish. Category B protection was assigned to these creeks based on the potential for adverse impacts related to the construction and maintenance of the proposed transmission line. The proposed project would involve clearing large woody vegetation at stream crossings, which can reduce bank stability causing an increase in stream siltation. Of note, all of the streams receiving Category B protection are listed on the state 303(d) list. The width of the SMZ is determined by the category of protection and the slope of the stream banks (ibid).

With proper implementation of the appropriate stream protection requirements and the use of standard BMPs as outlined in Muncy (1999), all potential direct, indirect, or cumulative impacts to aquatic communities or habitat as a result of the construction, operation, and maintenance of the proposed Pinhook-Radnor Transmission Line would be insignificant.

4.8. Managed Areas

Murfreesboro-East Franklin Transmission Line
Under the Action Alternative, TVA would implement the proposed action. The proposed transmission line would cross the southwestern portion of Scales Mountain, a registered SNA created to protect plant species listed as endangered and rare. The DCH for Braun's rock-cress is located on the northeastern knob and the known population of Alabama snow-wreath is located on the western slope of the middle knob. The existing right-of-way on which the proposed new transmission line would be built covers approximately 7 acres of the southwestern knob, or approximately 2 percent of the total natural area. Because no populations of Braun's rock-cress or Alabama snow-wreath were found in the area of the proposed transmission line during a recent botanical survey (Section 3.4), and because the transmission line rebuild would occur on existing right-of-way, vegetation changes to this natural area would be minimal and insignificant.

The proposed action is of sufficient distance from the four other natural areas that are located near the project area, Radio Tower Marsh, Oaklands Spring Wetland, Stones River National Battlefield, and Stone River Cedar Glade and Barrens SNA. Therefore, no direct, indirect, or cumulative effects to these natural areas are anticipated.

The proposed project would cross Overall Creek, an NRI stream. With the use of BMPs at stream crossings, and because it is an existing right-of-way, any impacts to this stream are anticipated to be minimal and insignificant. Additional NRI streams in the area, the Middle and West Forks of the Stones River, and the Harpeth River, are of sufficient distance from the proposed action that no direct, indirect, or cumulative impacts are anticipated.

Pinhook-Radnor Transmission Line
Because all the nearby natural areas (Mount View Glade Designated SNA, Hobson Pike Glade, Mount View Glade Potential NNL, Cane Ridge Park, Elsie Quarterman Cedar Glade Designated SNA, Nashville Zoo at Grassmere, Radnor Lake Designated SNA and State Wildlife Observation Area, and Dyer Observatory) and the NRI-listed Stones River are of a

sufficient distance from the transmission line, no direct, indirect, or cumulative impacts are anticipated to these areas.

4.9. Recreation

Both proposed transmission line sections are primarily in existing transmission line rights-of-way and have existing transmission line structures. In some instances, recreational facilities have developed around the transmission lines. Construction activities would temporarily disrupt recreational activities, but the impacts would be temporary and insignificant.

Murfreesboro-East Franklin Transmission Line
To determine the proper reconstruction of the transmission line structures located on or adjacent to the development at Judge Fly and Cecil Lewis parks, TVA would contact Williamson County Parks and Recreation during the proposed project planning phases. With this coordination, developed public recreation facilities are expected to have temporary, insignificant impacts during the proposed construction activities. Impacts to informal recreation activities are also anticipated to be temporary and insignificant. Cumulative effects of the proposed action would be insignificant.

Pinhook-Radnor Transmission Line
Impacts to informal recreation activities are anticipated to be temporary and insignificant. Cumulative effects of the proposed action would be insignificant.

4.10. Floodplains

The proposed transmission line project would cross several floodplain areas in Rutherford, Williamson, and Davidson counties, Tennessee. Consistent with EO 11988, an overhead transmission line and related support structures are considered to be 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 right-of-way would be revegetated where natural vegetation is removed, the removal of unique vegetation would be avoided, and BMPs would be used during construction activities. The proposed laydown area would be located outside of the 100-year floodplain.

Neither the original transmission line right-of-way route nor the proposed rerouted section of the Murfreesboro-East Franklin Transmission Line would involve construction within the 100-year floodplain, which would be consistent with EO 11988. The upgrades to the Pinhook- Radnor Transmission Line would not require the construction of new structures in floodplains. Some of the access roads for both lines would involve construction in the 100-year floodplain. Any necessary improvements to the roads would be done in such a manner that upstream flood elevations would not be increased.

4.11. Groundwater

Potential impacts to groundwater could result if sediments from excavated materials enter or clog sinkholes, and from the transport of contaminants such as herbicides and fertilizers

into sinkholes. BMPs as described in Muncy (1999) would be used to avoid contamination of groundwater during construction in the project area. BMPs would be used during construction activities to control sediment infiltration from storm water runoff. Surface water that feeds the collapsed sinkhole located along AR RR1 would be designated as SMZs and protected by the use of BMPs. These practices would protect the stream from any runoff that could flow to the collapsed sinkhole; therefore, no significant impacts to groundwater would be expected as a result of the project construction.

During revegetation, application of herbicides and fertilizers would be avoided in the areas along the right-of-way where sinkholes and springs occur to prevent groundwater contamination. If herbicides were necessary during future right-of-way maintenance, then they would be applied according to the manufactures' labels. Herbicides with groundwater contamination warnings would not be used in areas where sinkholes and springs occur as described in the Section 3.11 Groundwater. With these precautions and the use of BMPs, impacts to groundwater from the proposed action would be insignificant.

4.12. Visual Resources

Visual consequences are examined in terms of visual changes between the existing landscape and proposed actions, sensitivity of viewing points available to the general public, their viewing distances, and visibility of proposed changes. Scenic integrity indicates the degree of intactness or wholeness of the landscape character. These measures help identify changes in visual character based on commonly held perceptions of landscape beauty, and the aesthetic sense of place. The foreground, middleground, and background viewing distances were previously described in Section 3.12.

Murfreesboro-East Franklin Transmission Line

Construction for the proposed Murfreesboro-East Franklin Transmission Line would begin at Cason Lane and end at the existing East Franklin Substation. The new transmission line would be constructed utilizing vacant existing 100-foot right-of-way on the segment between Murfreesboro and the Triune Substation and by rebuilding the existing Triune-East Franklin 161-kV Transmission Line.

From Cason Lane west to Armstrong Valley Road, the landscape has been extensively altered to accommodate new residential development. Additional poles and new locations would increase the number of adversely contrasting elements seen in the immediate area. Given the existing degraded visual coherence and harmony.visible to residents and motorists along SR 99 (Eagleville Road), the new transmission line would not result in significant cumulative impacts to the visual resources of this area.

The proposed route crosses Windrow Road and continues northwest toward Newman Road. Most views would be by motorists along Salem Road in the foreground and middleground and by residents in the middleground and background distances. Approximately 1 mile east of Newman Road, visual impacts would decrease for these residents and motorists as distance from the proposed transmission line increases. The influence of the natural landscape on the transmission line and structures in this area greatly decreases negative impacts on scenic character. The reduction of perceived details is mainly a factor of the natural landscape when viewed from this distance. Evergreen and deciduous vegetation, as well as gradient changes, obscures details, and the transmission line would be seen as a broader, natural pattern as opposed to a focal point in the landscape.

The transmission line would continue past Coleman Hill Road and traverse steep topography south of Indian Mountain. There would be few views of the transmission line for motorists and residents along Coleman Hill Road due to severe topography, distance, and vegetation. Views of the new transmission line and associated structures would likely be seen only by occasional hikers, hunters, and off-road vehicle users. These views would be in the foreground within the transmission line right-of-way. Views outside of the right-of-way would be obscured by dense vegetation and steep topography.

The existing transmission line route turns northwest at Haley Lane north of New Road, crossing US 31/41 and enters the existing Triune Substation. New transmission lines and structures would be visually similar to those transmission structures seen in the landscape now by area motorists, residents, and patrons of commercial establishments along US 31/41.

Continuing west from the Triune Substation, the existing transmission line parallels the right-of-way of SR 96 to Chapel Road near Trinity School to the west, remaining in the foreground views of area residents and motorists. The transmission line turns slightly northwest and enters the existing East Franklin Switching Station just east of I-65. Most of the existing transmission line between Triune and East Franklin uses wooden structures, which would be replaced with taller, more prominent metal structures. Given the existing level of development in this area, including the presence of many other utility lines and other structures, the impacts of rebuilding this section of the transmission line would be visually insignificant. There may be some visual congestion due to an increase in personnel and equipment. This would be temporary until all construction activities were completed.

Pinhook-Radnor Transmission Line

Construction for the new Pinhook-Radnor Transmission Line uprate would begin at the existing Pinhook Substation just north of La Vergne, Tennessee, east of US 41, on Hickory Boulevard. Residents to the northwest and motorists along US 41 would have foreground views of new structures and transmission lines. For area residents, new appurtenances would be visually negligible in the landscape when viewed within the context of the existing substation. For motorists along US 41, views of transmission structures would be brief as the route leaves the substation and continues toward I-24 to the southwest.

The transmission line crosses I-24 and turns slightly northwest toward Old Hickory Boulevard/Bell Road. New construction for the transmission line would be visually similar to other service poles, light poles, and other vertical and broadly horizontal elements seen in the landscape by area motorists and patrons of commercial establishments. Motorists and residents near Whittemore Branch along Old Hickory Boulevard would have foreground views of the route parallel to structures. At the intersection of Nolensville Pike and Old Hickory Boulevard, motorists have views of existing transmission structures to the south.

The transmission line turns northwest at Huntington Parkway and traverses dense residential developments. Residents have foreground views of existing structures, particularly along local roads and open space areas. New construction would add to the number of discordantly contrasting elements seen in the landscape. However, visual contrast with the existing landscape character in this area would be visually insignificant.

Beginning at the intersection of Edmondson Pike and Huntington Parkway, the new transmission line would be installed on existing transmission structures. The route would

terminate at the existing Radnor Substation. The substation is located in a residential area and can be seen by area residents in the foreground from the south and west. Landscape character is not expected to change with the addition of new transmission lines on existing structures.

Operation, construction, and maintenance of the proposed transmission lines for either of these projects would be visually insignificant. There may be some minor visual discord during the construction period due to an increase in personnel and equipment and the use of laydown and materials' storage areas. These minor visual obtrusions would be temporary until the right-of-way and laydown areas have been restored through the use of TVA standard BMPs (Muncy 1999). Therefore, there are no significant visual impacts anticipated as a result of this project.

4.13. Cultural Resources

Murfreesboro-East Franklin Transmission Line
As described in Section 3.13, no archaeological resources, 34 architectural resources (ineligible for listing on the NRHP due to loss of integrity, and one NRHP-listed property (Bostick Female Academy) had been previously identified within the APE of this proposed transmission line. The Bostick Female Academy's historic setting has already been compromised by modern development, thus the proposed transmission line would have no adverse effect on the property.

Ten previously unrecorded architectural resources (HS-1 through HS-10) were identified within the APE and are considered ineligible for listing on the NRHP due to loss of integrity.

One previously unrecorded archaeological site (40WM408) was identified within the APE of the proposed transmission line. Site 40WM408 is an historic cemetery; however, it does not meet the criteria for inclusion on the NRHP and is considered ineligible. One previously unrecorded archaeological site (40RD278) consisting of numerous stone features is located within the visual APE of the proposed project on Indian Mountain. This site is recommended potentially eligible for listing on the NRHP. There would be no direct line of site to the transmission line from any of the stone features so there would be no adverse effect.

Pinhook-Radnor Transmission Line
Background research identified one archaeological site (40DV571) within the APE. The section of Site 40DV571 that lies within the APE as well as to the north and south have been disturbed and are ineligible for listing on the NRHP.

The Tennessee State Historic Preservation Officer has concurred with TVA's determination that the proposed undertaking does not have the potential to affect any historic properties that are eligible for listing or are currently listed on the NRHP (see Appendix I).

4.14. Post-Construction Impacts

4.14.1. Electric and Magnetic Fields

TVA recognizes there is public concern about whether any adverse health effects are caused by electric and magnetic fields (EMF) that result from generation, transmission,

distribution, and use of electricity. Many scientific research efforts and other studies examining the potential health and other effects of EMF have been and are being done. TVA is aware of, and ensures that it stays aware of, published research and study results and directly supports some of the research and study efforts.

Studies, interpretations, and research to date are far from conclusive about potential associations between EMF and possible health impacts. A few studies have been interpreted as suggesting a weak statistical relationship between EMF and some rare forms of cancer. During the summer of 2001, the International Association for Research on Cancer reviewed available epidemiological studies and concluded that childhood leukemia appears to be associated with magnetic fields but that there was not a cause-and-effect relationship. It was concluded that the risk is small but may in some circumstances of higher exposure result in one type of childhood leukemia. The association also concluded that electric fields do not have a connection with cancer.

However, equal or greater numbers of similar studies show no association or cannot reproduce data interpreted as demonstrating an association. No laboratory research has found cause-and-effect health impacts from EMF and certainly none that are adverse. Neither has any concept of how these fields could cause health effects achieved scientific consensus.

There is also no agreement in the scientific or EMF research community as to what if any electric or magnetic field parameters might be associated with potential health effects. There are no scientifically or medically defined safe or unsafe field strengths, although state regulatory bodies in Florida and New York have established edge of right-of-way magnetic field strength limits for 230-kV and larger power transmission lines.

TVA has analyzed and continues to analyze the fields associated with its typical line designs using the best available models and has measured actual fields for a large number of locations along its transmission line easements. Both model data and measurements show that the field strengths for TVA transmission lines are well within Florida and New York limits. Based on such models, expected field strengths for the proposed lines discussed in this document would also be within those existing state guidelines.

TVA's standard location practice has the effect of minimizing continuous public exposures to transmission line EMF. The 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 and potential visual impacts as well as exposures to EMF. Although not absolute location constraints, these buffers weigh heavily in location decisions, influencing selection of route options and alignments. Because EMF diminishes quickly with distance from the conductors, the routing of transmission lines using constraint buffers effectively reduces potential continuous public exposure to EMF. Crossing under lines or otherwise being near them for short periods may increase overall EMF exposure, but only minutely.

4.14.2. Other Impacts

No significant impacts are expected to result from the relatively short-term activities of construction, such as noise, solid waste, etc. Appendices II and III contain procedures for dealing with these issues.

4.15. Irreversible and Irretrievable Commitment of Resources

The materials used for construction of the proposed facilities would be committed for the life of the facilities. Some materials, such as ceramic insulators and concrete foundations, may be irrevocably committed, but the metals used in equipment, conductors, and supporting steel structures could be recycled. The useful life of steel-pole transmission structures is expected to be at least 60 years.

The rights-of-way used for the transmission lines would not be irreversibly committed and could be returned to other uses upon retirement of the line. In the interim, compatible uses of the right-of-way could continue.

Forest products and related wildlife that might have grown on the presently forested portions of the right-of-way would be lost for the life of the project. No locally or regionally significant lost forest or agricultural production would be expected.

4.16. Unavoidable Adverse Effects

After completion of the transmission line:

- Trees would not be permitted to grow within the right-of-way or to a determined height adjacent to the right-of-way that would endanger the transmission line.
- Clearing and construction would result in the disruption of some wildlife, but no permanent habitat changes would occur except in the wooded areas previously described.
- Any burning of cleared material would result in some short-term air pollution.
- Clearing, tree removal, and excavation for pole erection would result in a small amount of localized siltation.
- Transmission line visibility would be minimized through the location; however, there would be some degree of visual effect on the landscape in the project area.

4.17. Relationship Between Local Short-Term Uses of the Environment and Long-Term Productivity

The construction and operation of the proposed transmission line would supply electricity to meet the present and foreseeable expected loads in the TVA Middle Tennessee power service area. This would be accomplished by a localized shift of a small amount of land to use for electric power transmission. If, during the useful life of the transmission line, it is no longer needed or technology renders it obsolete, it can be removed with relatively little difficulty. The land encumbered by the right-of-way could be returned to its previous use or used for other purposes.

The principal change in short-term use of the right-of-way would be the exclusion of trees and permanent structures. Most of the transmission line right-of-way area is existing and has been previously cleared; however, parts of the Murfreesboro-East Franklin Transmission Line have not been cleared recently. At most, the amount of forest being lost would be approximately 77 acres within the right-of-way area, and areas removed from

production are dispersed along the length of the transmission line. The right-of-way cannot support building construction for the life of the project, but the social and economic benefits of the project should outweigh this small loss.

4.18. Summary of TVA Commitments and Proposed Mitigation Measures

To support the preceding conclusions, TVA would commit to the following additional actions to avoid or mitigate possible environmental impacts:

Protection of Terrestrial Plant Resources

- In order to minimize disturbance and overall potential impacts to the wet glade complex on the Bill Rice Ranch, construction and subsequent maintenance activities in this vicinity would be conducted during the dry season from June to December. The flagged area is not to be used as a laydown area or staging area for construction. In addition, vehicles (or other equipment) are restricted to travel within the original path of their tire tracks.

- The area surrounding the Braun's rock-cress (*Arabis perstellata*) population on Scales Mountain has been designated a sensitive area marked in the field and on project drawings. No construction activities or other disturbances, such as transmission line maintenance activities, would occur in the designated sensitive area. The right-of-way between Structures 148, 149, and 150 would be maintained by hand clearing only, and no herbicides would be applied in this area.

Protection of Aquatic Resources

- Category B protections would apply in the Mill Creek drainage to all intermittent and perennial stream crossings (Appendix VI). As soon as is practicable after clearing, these SMZs would be replanted with low-growing woody vegetation.

CHAPTER 5

5. SUPPORTING INFORMATION

5.1. List of Preparers

Hugh S. Barger

Position:	Environmental Engineering Specialist, TVA Power System Operations, Chattanooga, Tennessee
Education/Experience:	B.S., Engineering; 31 years in Transmission Line Planning and Preparation of Environmental Review Documents
Involvement:	Purpose of and Need for Action; Alternatives Including Proposed Action

John T. Baxter

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

W. Nannette Brodie

Position:	Senior Environmental Scientist, TVA Research & Technology Applications, Chattanooga, Tennessee
Education/Experience:	B.S., Geology, B.S., Environmental Science; 12 years in Environmental Analyses, Surface Water Quality and Groundwater Assessments; Registered Professional Geologist
Involvement:	Groundwater

Patricia B. Cox

Position:	Senior Botanist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education/Experience:	Ph.D. Botany, 28 years in Plant Taxonomy at the University Level; 2 years in Botanical Field Assessments
Involvement:	Vegetation, Threatened and Endangered Species

Melissa R. Davis

Position:	Siting and Environmental Design, TVA Power System Operations, Chattanooga, Tennessee
Education/Experience:	B.S., Civil Engineering; 5 years in Siting and Environmental Design
Involvement:	Project and Siting Alternatives

Britta P. Dimick

Position:	Wetlands Biologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education/Experience:	M.S., Botany-Wetlands Ecology Emphasis; B.A., Biology; 9 years in Wetlands Assessments and Botanical Surveys; 3 years in Wetlands Regulations and NEPA Compliance
Involvement:	Wetlands

Jenny K. Fiedler

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

John M. Higgins

Position:	Water Quality Specialist, TVA River Operations, Chattanooga, Tennessee
Education/Experience:	Ph.D., Environmental Engineering, B.S. and M.S., Civil Engineering; 31 years in Water Resource Management; Registered Professional Engineer
Involvement:	Surface Water

Clint E. Jones

Position:	Biologist - Aquatic Ecologist, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education/Education:	B.S., Wildlife and Fisheries Science; 15 years in Environmental Consultation and Fisheries Management
Involvement:	Aquatic Ecology

Anita E. Masters

Position:	Senior NEPA Specialist, TVA Environmental Stewardship and Policy, Chattanooga, Tennessee
Education/Experience:	M.S., Biology/Fisheries, B.S., Wildlife Management; 20 years in Fisheries Biology/Aquatic Community and Watershed Assessments, Protected Aquatic Species and Habitat Monitoring, and NEPA Compliance
Involvement:	NEPA Compliance and Document Preparation

Roger A. Milstead

Position:	Manager, TVA Flood Risk and Data Management, Knoxville, Tennessee
Education/Experience:	B.S., Civil Engineering; 30 years in Floodplain and Environmental Evaluations; Registered Professional Engineer
Involvement:	Floodplains

W. Chett Peebles

Position:	Senior Landscape Architect, TVA Environmental Stewardship and Policy, Knoxville, Tennessee
Education/Experience:	Bachelor of Landscape Architecture; 18 years in Site Planning and Visual Assessment; Registered Landscape Architect
Involvement:	Visual Resources

Richard L. Pflueger

Position:	Land Use and Recreation Specialist, TVA Environmental Stewardship and Policy, Muscle Shoals, Alabama
Education/Experience:	M.B.A., B.S., Accounting; 29 years in Recreation and Economic Development
Involvement:	Recreation

Marianne M. Shuler

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

Jan K. Thomas

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

5.2. List of Agencies and Organizations Consulted

Federal Agencies

U.S. Fish and Wildlife Service

State Agencies

Tennessee Department of Environment and Conservation
Tennessee Historical Commission

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Appendix I – Correspondence

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TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

July 18, 2006

Mr. Thomas O Maher
Tennessee Valley Authority
400 West summet Hill Dr.
Knoxville, Tennessee, 37902-1401

RE: TVA, 161 KV LINE/MURFREESBORO/E. FRANKLIN, WILLIAMSON, RUTHERFORD COUNTY

Dear Mr. Maher:

In response to your request, received on Friday, July 14, 2006, we have reviewed the documents you submitted regarding your proposed undertaking. Our review of and comment on your proposed undertaking are among the requirements of Section 106 of the National Historic Preservation Act. This Act requires federal agencies or applicant for federal assistance to consult with the appropriate State Historic Preservation Office before they carry out their proposed undertakings. The Advisory Council on Historic Preservation has codified procedures for carrying out Section 106 review in 36 CFR 800. You may wish to familiarize yourself with these procedures (Federal Register, December 12, 2000, pages 77698-77739) if you are unsure about the Section 106 process.

Considering available information, we find that the project as currently proposed will NOT ADVERSELY AFFECT ANY PROPERTY THAT IS ELIGIBLE FOR LISTING IN THE NATIONAL REGISTER OF HISTORIC PLACES including the Salem Methodist Church, which is determined National Register eligible. Therefore, this office has no objection to the implementation of this project. Please direct questions and comments to Joe Garrison (615) 532-1550-103. You may find additional information concerning the Section 106 process and the Tennessee SHPO's documentation requirements at www.state.tn.us/environment/hist/sect106.shtm.

We appreciate your cooperation.

Sincerely,

Herbert L. Harper
Executive Director and
Deputy State Historic
Preservation Officer

HLH/jyg

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

August 31, 2006

Mr. Thomas Maher
Tennessee Valley Authority
400 W. Summit Hill Drive
WT 11D - Cultural Resources
Knoxville, Tennessee 37902

RE: TVA, ARCHAEOLOGICAL ASSESSMENT, MURFREESBORO-EAST FRANKLIN 161-KV, UNINCORPORATED, RUTHERFORD COUNTY

Dear Mr. Maher:

At your request, our office has reviewed the above-referenced archaeological survey final report in accordance with regulations codified at 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739). We find that the report meets the Tennessee SHPO Standards and Guidelines For Archaeological Resource Management Studies.

If project plans are changed or archaeological remains are discovered during construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act.

Your continued cooperation is appreciated.

Sincerely,

Herbert L. Harper
Executive Director and
Deputy State Historic
Preservation Officer

HLH/jmb

TENNESSEE HISTORICAL COMMISSION
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
2941 LEBANON ROAD
NASHVILLE, TN 37243-0442
(615) 532-1550

January 18, 2007

Mr. Thomas Maher
Tennessee Valley Authority
400 W. Summit Hill Drive
WT 11D - Cultural Resources
Knoxville, Tennessee 37902

RE: TVA, ARCHAEOLOGICAL ASSESSMENT, PINHOOK-RADNOR
161-KV LINE IMPS., NASHVILLE, DAVIDSON COUNTY, TN

Dear Mr. Maher:

At your request, our office has reviewed the above-referenced archaeological survey report in accordance with regulations codified at 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739). Based on the information provided, we concur that the project area contains no archaeological resources eligible for listing in the National Register of Historic Places.

If project plans are changed or archaeological remains are discovered during construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act.

Your cooperation is appreciated.

Sincerely,

Richard G. Tune
Deputy State Historic
Preservation Officer

RGT/jmb

United States Department of the Interior

FISH AND WILDLIFE SERVICE
446 Neal Street
Cookeville, TN 38501

February 23, 2007

Ms. Peggy Shute, Manager
TVA Regional Natural Heritage
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, Tennessee 37902-1401

Re: FWS #07-FA-0342

Dear Ms. Shute:

Thank you for your letter and enclosure of January 26, 2007, concerning the proposed upgrade to the Murfreesboro-East Franklin and Pinhook-Radnor transmission lines in Davidson, Rutherford, and Williamson counties, Tennessee. Fish and Wildlife Service biologists have reviewed the information submitted and we offer the following comments.

Based on lack of suitable habitat within the right-of-way of the Murfreesboro-East Franklin transmission line and your commitment to prohibit construction activities and aerial application of herbicides in the vicinity of the population of the federally endangered Braun's rock cress (*Arabis perstellata*) that occurs on Scales Mountain near the line, we concur that the proposed upgrade is not likely to adversely affect this species. We also concur that the proposed upgrade of the Pinhook-Radnor transmission line is not likely to adversely affect the endangered Nashville crayfish (*Orconectes shoupi*), provided that the Best Management Practices described in your correspondence are implemented as part of the project. In view of this, we believe that the requirements of section 7 of the Endangered Species Act have been fulfilled for these projects. Obligations under section 7 must be reconsidered, however, if: (1) new information reveals that the proposed projects may affect listed species in a manner or to an extent not previously considered, (2) the proposed projects are subsequently modified to include activities which were not considered during this consultation, or (3) new species are listed or critical habitat designated that might be affected by the proposed projects.

Thank you for the opportunity to comment. If you have any questions, please contact Jim Widlak of my staff at 931/528-6481, ext. 202.

Sincerely,

Lee A. Barclay, Ph.D.
Field Supervisor

Appendix II – Tennessee Valley Authority Right-of-Way Clearing Specifications

1. General - The clearing contractor shall review the environmental evaluation documents (Categorical Exclusion Checklist, Environmental Assessment, or Environmental Impact Statement) for the project or proposed activity, along with all clearing and construction appendices, conditions in applicable general and/or site-specific permits, the storm water pollution prevention plan, and any Tennessee Valley Authority (TVA) commitments to property owners. The contractor shall then plan and carry out operations using techniques consistent with good engineering and management practices as outlined in TVA's Best Management Practice (BMP) manual (Muncy 1992, and revisions thereto). The contractor will protect areas that are to be left unaffected by access or clearing work at and adjacent to all work sites. In sensitive areas and their buffers, the contractor will retain as much native ground cover and other vegetation as possible.

   If the contractor fails to use BMPs or to follow environmental expectations discussed in the prebid or prework meeting or present in contract specifications, TVA will order corrective changes and additional work as deemed necessary in TVA's judgment to meet the intent of environmental laws and regulations or other guidelines. Major violations or continued minor violations will result in work suspension until correction of the situation is achieved or other remedial action is taken at the contractor's expense. Penalty clauses may be invoked as appropriate.

2. Regulations - The clearing contractor shall comply with all applicable federal, state, and local environmental and antipollution laws, regulations, and ordinances including without limitation all air, water, solid and hazardous waste, noise, and nuisance laws, regulations, and ordinances. The contractor shall secure or ensure that TVA has secured all necessary permits or authorizations to conduct work on the acres shown on the drawings and plan and profile for the contract. The contractor's designated project manager will actively seek to prevent, control, monitor, and safely abate all commonly recognized forms of workplace and environmental pollution. Permits or authorizations and any necessary certifications of trained or licensed employees shall be documented with copies submitted to TVA's right-of-way inspector or construction environmental engineer before work begins. The contractor will be responsible for meeting all conditions specified in permits. Permit conditions shall be reviewed in prework discussions.

3. Land and Landscape Preservation - The clearing contractor shall exercise care to preserve the condition of cleared soils by avoiding as much compacting and deep scarring as possible. As soon as possible after initial disturbance of the soil and in accordance with any permit(s) or other state or local environmental regulatory requirements, cover material shall be placed to prevent erosion and sedimentation of water bodies or conveyances to surface water or groundwater. In areas outside the clearing, use, and access areas, the natural vegetation shall be protected from damage. The contractor and his employees must not deviate from delineated access routes or use areas, and must enter the site at designated areas that will be marked. Clearing operations shall be conducted to prevent any unnecessary destruction, scarring, or defacing of the remaining natural vegetation and adjacent surroundings in the vicinity of the work. In sensitive public or environmental areas, appropriate buffer zones shall be observed and the methods of clearing or reclearing modified to protect the buffer and sensitive area. Some areas may require planting native

plants or grasses to meet the criteria of regulatory agencies or commitments to special program interests.

4. Streamside Management Zones - The clearing contractor must leave as many rooted ground cover plants as possible in buffer zones along streams and other bodies of water or wet-weather conveyances thereto. In such streamside management zones (SMZ), tall-growing tree species (trees that would interfere with TVA's National Electric Safety Code clearances) shall be cut, and the stumps may be treated to prevent resprouting. Low-growing trees identified by TVA as marginal electrical clearance problems may be cut, and then stump treated with growth regulators to allow low, slow-growing canopy development and active root growth. Only approved herbicides shall be used, and herbicide application shall be conducted by certified applicators from the TVA's Transmission, Operations, and Maintenance organization after initial clearing and construction. Cutting of trees within SMZs must be accomplished by using either hand-held equipment or other appropriate clearing equipment, such as a feller-buncher. The method will be selected based on site-specific conditions and topography to minimize soil disturbance and impacts to the SMZ and surrounding area. Disturbed soils in SMZs must be stabilized by appropriate methods immediately after the right-of-way is cleared. Stabilization must occur within the time frame specified in applicable storm water permits or regulations. Stumps within SMZs may be cut close to the ground but must not be removed or uprooted. Trees, limbs, and debris shall be immediately removed from streams, ditches, and wet areas using methods that will minimize dragging or scarring the banks or stream bottom. No debris will be left in the water or watercourse. Equipment will cross streams, ditches, or wet areas only at locations designated by TVA after the application of appropriate erosion control BMPs consistent with permit conditions or regulatory requirements.

5. Wetlands - In forested wetlands, tall trees will be cut near the ground, leaving stumps and roots in place. The cambium may be treated with herbicides applied by certified applicators from the TOM organization to prevent regrowth. Understory trees that must be initially cut and removed may be allowed to grow back or may be treated with tree growth regulators selectively to slow growth and increase the reclearing cycle. The decision will be situationally made based on existing ground cover, wetland type, and tree species since tall tree removal may "release" understory species and allow them to grow quickly to "electrical clearance problem" heights. In many circumstances, herbicides labeled for water and wetland use may be used in reclearing.

6. Sensitive Area Preservation - If prehistoric or historic artifacts or features that might be of archaeological significance are discovered during clearing or reclearing operations, the activity shall immediately cease within a 100-foot radius, and a TVA right-of-way inspector or construction environmental engineer and the Cultural Resources Program manager shall be notified. The site shall be protected and left as found until a determination about the resources, their significance, and site treatment is made by TVA's Cultural Resources Program. Work may continue beyond the finding zone and the 100-foot radius beyond its perimeter.

7. Water Quality Control - The contractor's clearing and disposal activities shall be performed using BMPs that will prevent erosion and entrance of spillage, contaminants, debris, and other pollutants or objectionable materials into drainageways, surface water, or groundwater. Special care shall be exercised in refueling equipment to prevent spills. Fueling areas shall be remote from any sinkhole, crevice, stream, or other water body.

Open burning debris will be kept away from streams and ditches and shall be incorporated into the soil.

The clearing contractor will erect and (when TVA or contract construction personnel are unable) maintain BMPs such as silt fences on steep slopes and adjacent to any stream, wetland, or other water body. BMPs will be inspected by the TVA field engineer or other designated TVA or contractor personnel routinely and during periods of high runoff, and any necessary repairs will be made as soon as practicable. BMP inspections will be conducted in accordance with permit requirements. Records of all inspections will be maintained on site, and copies of inspection forms will be forwarded to the TVA construction environmental engineer.

8. Turbidity and Blocking of Streams - If temporary clearing activities must interrupt natural drainage, appropriate drainage facilities and erosion/sediment controls shall be provided to avoid erosion and siltation of streams and other water bodies or water conveyances. Turbidity levels in receiving waters or at storm water discharge points shall be monitored, documented, and reported if required by the applicable permit. Erosion and sediment control measures such as silt fences, water bars, and sediment traps shall be installed as soon as practicable after initial access, site or right-of-way disturbance in accordance with applicable permit or regulatory requirements.

   Mechanized equipment shall not be operated in flowing water except when approved and, then, only to construct necessary stream crossings under direct guidance of TVA. Construction of stream fords or other crossings will only be permitted at approved locations and to current TVA construction access road standards. Material shall not be deposited in watercourses or within stream bank areas where it could be washed away by high stream flows. Any clearing debris that enters streams or other water bodies shall be removed as soon as possible. Appropriate U.S. Army Corps of Engineers and state permits shall be obtained for stream crossings.

9. Air Quality Control - The clearing or reclearing contractor shall take appropriate actions to limit the amount of air emissions created by clearing and disposal operations to well within the limits of clearing or burning permits and/or forestry or local fire department requirements. All operations must be conducted in a manner that prevents nuisance conditions or damage to adjacent land crops, dwellings, highways, or people.

10. Dust and Mud Control - Clearing activities shall be conducted in a manner that minimizes the creation of fugitive dust. This may require limitations as to type of equipment, allowable speeds, and routes utilized. Control measures such as water, gravel, etc., or similar measures may be used subject to TVA approval. On new construction sites and easements, the last 100 feet before an access road approaches a county road or highway shall be graveled to prevent transfer of mud onto the public road.

11. Burning - The contractor shall obtain applicable permits and approvals to conduct controlled burning. The contractor will comply with all provisions of the permit, notification, or authorization including burning site locations, controlled draft, burning hours, and such other conditions as stipulated. If weather conditions such as wind speed or wind direction change rapidly, the contractor's burning operation may be temporarily stopped by TVA's field engineer. The debris to be burned shall be kept as clean and dry as possible and stacked and burned in a manner that produces the minimum amount of smoke. Residue

from burning will be disposed of according to permit stipulations. No fuel starters or enhancements other than kerosene will be allowed.

12. Smoke and Odors - The contractor will properly store and handle combustible and volatile materials that could create objectionable smoke, odor, or fumes. The contractor shall not burn oil or refuse that includes trash, rags, tires, plastics, or other manufactured debris.

13. Vehicle Exhaust Emissions - The contractor shall maintain and operate equipment in a manner that limits vehicle exhaust emissions. Equipment and vehicles will be kept within the manufacturers' recommended limits and tolerances. Excessive exhaust gases will be eliminated, and inefficient operating procedures will be revised or halted until corrective repairs or adjustments are made.

14. Vehicle Servicing - Routine maintenance of personal vehicles will not be performed on the right-of-way. However, if emergency or "have to" situations arise, minimal/temporary maintenance to personal vehicles will occur in order to mobilize the vehicle to an off-site maintenance shop. Heavy equipment will be serviced on the right-of-way, except in designated sensitive areas. The clearing or reclearing contractor will properly maintain these vehicles with approved spill protection controls and countermeasures. If emergency maintenance in a sensitive or questionable area arises, the area environmental coordinator or construction environmental engineer will be consulted. All wastes and used oils will be properly recovered, handled, and disposed/recycled. Equipment shall not be temporarily stored in stream floodplains, whether overnight or on weekends or holidays.

15. Noise Control - The contractor shall take steps to avoid the creation of excessive sound levels for employees, the public, or the site and adjacent property owners. Concentration of individual noisy pieces as well as the hours and locations of operation should be considered.

16. Noise Suppression - All internal combustion engines shall be properly equipped with mufflers. The equipment and mufflers shall be maintained at peak operating efficiency.

17. Sanitation - A designated representative of TVA or the clearing contractor shall contact a sanitary contractor who will provide sanitary chemical toilets convenient to all principal points of operation for every working party. The facilities shall comply with applicable federal, state, or local health laws and regulations. They shall not be located closer than 100 feet to any stream or tributary or to any wetland. The facilities shall be required to have proper servicing and maintenance, and the waste disposal contractor shall verify in writing that the waste disposal will be in state-approved facilities. Employees shall be notified of sanitation regulations and shall be required to use the toilet facilities.

18. Refuse Disposal - The clearing or reclearing contractor shall be responsible for daily cleanup and proper labeling, storage, and disposal of all refuse and debris on the site produced by his operations and employees. Facilities that meet applicable regulations and guidelines for refuse collection will be required. Only approved transport, storage, and disposal areas shall be used.

19. Brush and Timber Disposal (Reclearing) - The reclearing contractor shall place felled tree boles in neat stacks at the edge of the right-of-way, with crossing breaks at least every 100 feet. Property owner requests shall be reviewed with the project manager or right-of-way specialist before accepting them. Lop and drop activities must be specified in the contract

and on plan and profile drawings with verification with the right-of-way specialist before conducting such work. When tree trimming and chipping is necessary, disposal of the chips on the easement or other locations on the property must be with the consent of the property owner and the approval of the right-of-way specialist. No trees, branches, or chips shall remain in a surface water body or be placed at a location where washing into a surface water or groundwater source might occur.

20. Brush and Timber Disposal (Initial Clearing) - For initial clearing, trees are commonly part of the contractor's contract to remove as they wish. Trees may be removed from the site for lumber or pulpwood or they may be chipped or stacked and burned. All such activities must be coordinated with the TVA field engineer, and the open burning permits, notifications, and regulatory requirements must be met. Trees may be cut and left in place only in areas specified by TVA and approved by appropriate regulatory agencies. These areas may include sensitive wetlands or SMZs where tree removal would cause excessive ground disturbance or in very rugged terrain where windrowed trees are used as sediment barriers along the edge of the right-of-way.

21. Restoration of Site - All disturbed areas, with the exception of farmland under cultivation and any other areas as may be designated by TVA's specifications, shall be stabilized in the following manner unless the property owner and TVA's engineer specify a different method:

    A. The subsoil shall be loosened to a minimum depth of 6 inches if possible and worked to remove unnatural ridges and depressions.

    B. If needed, appropriate soil amendments will be added.

    C. All disturbed areas will initially be seeded with a temporary ground cover such as winter wheat, rye, or millet, depending on the season. Perennials may also be planted during initial seeding if proper growing conditions exist. Final restoration and final seeding will be performed as line construction is completed. Final seeding will consist of permanent perennial grasses such as those outlined in TVA's *A Guide for Environmental Protection and Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities.* Exceptions would include those areas designated as native grass planting areas. Initial and final restoration will be performed by the clearing contractor.

    D. TVA holds the option, depending upon the time of year and weather condition, to delay or withdraw the requirement of seeding until more favorable planting conditions are certain. In the meantime, other stabilization techniques must be applied.

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Appendix III – Tennessee Valley Authority Environmental Quality Protection Specifications for Transmission Line Construction

1. General – Tennessee Valley Authority (TVA) and/or the assigned contractor shall plan, coordinate, and conduct operations in a manner that protects the quality of the environment and complies with TVA's environmental expectations discussed in the preconstruction meeting. This specification contains provisions that shall be considered in all TVA and contract construction operations. If the contractor fails to operate within the intent of these requirements, TVA will direct changes to operating procedures. Continued violation will result in a work suspension until correction or remedial action is taken by the contractor. Penalties and contract termination will be used as appropriate. The costs of complying with the Environmental Quality Protection Specifications are incidental to the contract work, and no additional compensation will be allowed. At all structure and conductor pulling sites, protective measures to prevent erosion will be taken immediately upon the end of each step in a construction sequence, and those protective measures will be inspected and maintained throughout the construction and right-of-way rehabilitation period.

2. Regulations - TVA and/or the assigned contractor shall comply with all applicable federal, state, and local environmental and antipollution laws, regulations, and ordinances related to environmental protection and prevention, control, and abatement of all forms of pollution.

3. Use Areas - TVA and/or the assigned contractor's use areas include but are not limited to site office, shop, maintenance, parking, storage, staging, assembly areas, utility services, and access roads to the use areas. The construction contractor shall submit plans and drawings for their location and development to the TVA engineer and project manager for approval. Secondary containment will be provided for fuel and petroleum product storage pursuant to 29CFR1910.106(D)(6)(iii)(OSHA).

4. Equipment - All major equipment and proposed methods of operation shall be subject to the approval of TVA. The use or operation of heavy equipment in areas outside the right-of-way, access routes, or structure, pole, or tower sites will not be permitted without permission of the TVA inspector or field engineer. Heavy equipment use on steep slopes (greater than 20 percent) and in wet areas will be held to the minimum necessary to construct the transmission line. Steps will be taken to limit ground disturbance caused by heavy equipment usage, and erosion and sediment controls will be instituted on disturbed areas in accordance with state requirements.

   No subsurface ground-disturbing equipment or stump-removal equipment will be used by construction forces except on access roads or at the actual structure, pole, or tower sites, where only footing locations and controlled runoff diversions shall be created that disturb the soil. All other areas of ground cover or in-place stumps and roots shall remain in place. (Note: Tracked vehicles disturb surface layer of the ground due to size and function.) Some disking of the right-of-way may occur for proper seedbed preparation.

   Unless ponding previously occurred (i.e., existing low-lying areas), water should not be allowed to pond on the structure sites except around foundation holes; the water must be directed away from the site in as dispersed a manner as possible. At tower or structure sites, some means of upslope interruption of potential overland flow and diversion around the footings should be provided as the first step in construction-site preparation. If leveling

is necessary, it must be implemented by means that provide for continuous gentle, controlled, overland flow or percolation. A good grass cover, straw, gravel, or other protection of the surface must be maintained. Steps taken to prevent increases in the moisture content of the in-situ soils will be beneficial both during construction and over the service life of any structure.

5. Sanitation - A designated TVA or contractor representative shall contact a sanitary contractor who will provide sanitary chemical toilets convenient to all principal points of operation for every working party. The facilities shall comply with applicable federal, state, or local health laws and regulations. They shall not be located closer than 100 feet to any stream or tributary or to any wetland. The facilities shall be required to have proper servicing and maintenance, and the waste disposal contractor shall verify in writing that the waste disposal will be in state-approved facilities. Employees shall be notified of sanitation regulations and shall be required to use the toilet facilities.

6. Refuse Disposal - Designated TVA and/or contractor personnel shall be responsible for daily inspection, cleanup, and proper labeling, storage, and disposal of all refuse and debris produced by his operations and by his employees. Suitable refuse collecting facilities will be required. Only state-approved disposal areas shall be used. Disposal containers such as dumpsters or roll-off containers shall be obtained from a proper waste disposal contractor. Solid, special, construction/demolition, and hazardous wastes as well as scrap are part of the potential refuse generated and must be properly managed with emphasis on reuse, recycle, or possible give away, as appropriate, before they are handled as waste. Contractors must meet similar provisions on any project contracted by TVA.

7. Landscape Preservation - TVA and its contractors shall exercise care to preserve the natural landscape in the entire construction area as well as use areas, in or outside the right-of-way, and on or adjacent to access roads. Construction operations shall be conducted to prevent any unnecessary destruction, scarring, or defacing of the natural vegetation and surroundings in the vicinity of the work.

8. Sensitive Areas Preservation - Certain areas on site and along the right-of-way may be designated by the specifications or the TVA engineer as environmentally sensitive. These areas include but are not limited to areas classified as erodible, geologically sensitive, scenic, historical and archaeological, fish and wildlife refuges, water supply watersheds, and public recreational areas such as parks and monuments. Contractors and TVA construction crews shall take all necessary actions to avoid adverse impacts to these sensitive areas and their adjacent buffer zones. These actions may include suspension of work or change of operations during periods of rain or heavy public use; hours may be restricted or concentrations of noisy equipment may have to be dispersed. If prehistoric or historic artifacts or features are encountered during clearing or construction operations, the operations shall immediately cease for at least 100 feet in each direction, and TVA's right-of-way inspector or construction superintendent and Cultural Resources Program shall be notified. The site shall be left as found until a significance determination is made. Work may continue elsewhere beyond the 100-foot perimeter.

9. Water Quality Control - TVA and contractor construction activities shall be performed by methods that will prevent entrance or accidental spillage of solid matter, contaminants, debris, and other objectionable pollutants and wastes into flowing caves, sinkholes, streams, dry watercourses, lakes, ponds, and underground water sources.

The clearing contractor will erect and (when TVA or contract construction personnel are unable) maintain Best Management Practices (BMPs) such as silt fences on steep slopes and adjacent to any stream, wetland, or other water body. Additional BMPs may be required for areas of disturbance created by construction activities. BMPs will be inspected by the TVA field engineer or other designated TVA or contractor personnel routinely and during periods of high runoff, and any necessary repairs will be made as soon as practicable. BMP inspections will be conducted in accordance with permit requirements. Records of all inspections will be maintained on site, and copies of inspection forms will be forwarded to the TVA construction environmental engineer.

Acceptable measures for disposal of waste oil from vehicles and equipment shall be followed. No waste oil shall be disposed of within the right-of-way, on a construction site, or on access roads.

10. Turbidity and Blocking of Streams - Construction activities in or near SMZs or other bodies of water shall be controlled to prevent the water turbidity from exceeding state or local water quality standards for that stream. All conditions of a general storm water permit, aquatic resource alteration permit, or a site-specific permit shall be met including monitoring of turbidity in receiving streams and/or storm water discharges and implementation of appropriate erosion and sediment control measures.

    Appropriate drainage facilities for temporary construction activities interrupting natural site drainage shall be provided to avoid erosion. Watercourses shall not be blocked or diverted unless required by the specifications or the TVA engineer. Diversions shall be made in accordance with TVA's *A Guide for Environmental Protection and Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities.*

    Mechanized equipment shall not be operated in flowing water except when approved and, then, only to construct crossings or to perform required construction under direct guidance of TVA. Construction of stream fords or other crossings will only be permitted at approved locations and to current TVA construction access road standards. Material shall not be deposited in watercourses or within stream bank areas where it could be washed away by high stream flows. Appropriate U.S. Army Corps of Engineers and state permits shall be obtained.

    Wastewater from construction or dewatering operations shall be controlled to prevent excessive erosion or turbidity in a stream, wetland, lake, or pond. Any work or placing of equipment within a flowing or dry watercourse requires the prior approval of TVA.

11. Clearing - No construction activities may clear additional site or right-of-way vegetation or disturb remaining retained vegetation, stumps, or regrowth at locations other than the structure sites and conductor setup areas. TVA and the construction contractor(s) must provide appropriate erosion or sediment controls for areas they have disturbed that have previously been restabilized after clearing operations. Control measures shall be implemented as soon as practicable after disturbance in accordance with applicable federal, state, and/or local storm water regulations.

12. Restoration of Site - All construction disturbed areas, with the exception of farmland under cultivation and any other areas as may be designated by TVA's specifications, shall be stabilized in the following manner unless the property owner and TVA's engineer specify a different method:

A. The subsoil shall be loosened to a minimum depth of 6 inches if possible and worked to remove unnatural ridges and depressions.

B. If needed, appropriate soil amendments will be added.

C. All disturbed areas will initially be seeded with a temporary ground cover such as winter wheat, rye, or millet, depending on the season. Perennials may also be planted during initial seeding if proper growing conditions exist. Final restoration and final seeding will be performed as line construction is completed. Final seeding will consist of permanent perennial grasses such as those outlined in TVA's *A Guide for Environmental Protection and Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities*. Exceptions would include those areas designated as native grass planting areas. Initial and final restoration will be performed by the clearing contractor.

D. TVA holds the option, depending upon the time of year and weather condition, to delay or withdraw the requirement of seeding until more favorable planting conditions are certain. In the meantime, other stabilization techniques must be applied.

13. Air Quality Control - Construction crews shall take appropriate actions to minimize the amount of air pollution created by their construction operations. All operations must be conducted in a manner that avoids creating a nuisance and prevents damage to lands, crops, dwellings, or persons.

14. Burning - Before conducting any open burning operations, the contractor shall obtain permits or provide notifications as required to state forestry offices and/or local fire departments. Burning operations must comply with the requirements of state and local air pollution control and fire authorities and will only be allowed in approved locations and during appropriate hours and weather conditions. If weather conditions such as wind direction or speed change rapidly, the contractor's burning operations may be temporarily stopped by the TVA field engineer. The debris for burning shall be piled and shall be kept as clean and as dry as possible, then burned in such a manner as to reduce smoke. No materials other than dry wood shall be open burned. The ash and debris shall be buried away from streams or other water sources and shall be in areas coordinated with the property owner.

15. Dust and Mud Control - Construction activities shall be conducted to minimize the creation of dust. This may require limitations as to types of equipment, allowable speeds, and routes utilized. Water, straw, wood chips, dust palliative, gravel, combinations of these, or similar control measures may be used subject to TVA's approval. On new construction sites and easements, the last 100 feet before an access road approaches a county road or highway shall be graveled to prevent transfer of mud onto the public road.

16. Vehicle Exhaust Emissions - TVA and/or the contractors shall maintain and operate equipment to limit vehicle exhaust emissions. Equipment and vehicles that show excessive emissions of exhaust gasses and particulates due to poor engine adjustments or other inefficient operating conditions shall not be operated until corrective repairs or adjustments are made.

17. Vehicle Servicing - Routine maintenance of personal vehicles will not be performed on the right-of-way. However, if emergency or "have to" situations arise, minimal/temporary

maintenance to personal vehicles will occur in order to mobilize the vehicle to an off-site maintenance shop. Heavy equipment will be serviced on the right-of-way except in designated sensitive areas. The Heavy Equipment Department within TVA or the construction contractor will properly maintain these vehicles with approved spill prevention controls and countermeasures. If emergency maintenance in a sensitive or questionable area arises, the area environmental coordinator or construction environmental engineer will be consulted. All wastes and used oils will be properly recovered, handled, and disposed/recycled. Equipment shall not be temporarily stored in stream floodplains, whether overnight or on weekends or holidays.

18. Smoke and Odors - TVA and/or the contractors shall properly store and handle combustible material that could create objectionable smoke, odors, or fumes. The contractor shall not burn refuse such as trash, rags, tires, plastics, or other debris.

19. Noise Control - TVA and/or the contractor shall take measures to avoid the creation of noise levels that are considered nuisances, safety, or health hazards. Critical areas including but not limited to residential areas, parks, public use areas, and some ranching operations will require special considerations. TVA's criteria for determining corrective measures shall be determined by comparing the noise level of the construction operation to the background noise levels. In addition, especially noisy equipment such as helicopters, pile drivers, air hammers, chippers, chain saws, or areas for machine shops, staging, assembly, or blasting may require corrective actions when required by TVA.

20. Noise Suppression - All internal combustion engines shall be properly equipped with mufflers as required by the Department of Labor's "Safety and Health Regulations for Construction." TVA may require spark arresters in addition to mufflers on some engines. Air compressors and other noisy equipment may require sound-reducing enclosures in some circumstances.

21. Damages - The movement of construction crews and equipment shall be conducted in a manner that causes as little intrusion and damage as possible to crops, orchards, woods, wetlands, and other property features and vegetation. The contractor will be responsible for erosion damage caused by his actions and especially for creating conditions that would threaten the stability of the right-of-way or site soil, the structures, or access to either. When property owners prefer the correction of ground cover condition or soil and subsoil problems themselves, the section of the contract dealing with damages will apply.

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Appendix IV – Tennessee Valley Authority Transmission Construction Guidelines Near Streams

Even the most carefully designed transmission line project eventually will affect one or more creeks, rivers, or other type of water body. These streams and other water areas are protected by state and federal law, generally support some amount of fishing and recreation, and, occasionally, are homes for important and/or endangered species. These habitats occur in the stream and on strips of land along both sides (the streamside management zone [SMZ]) where disturbance of the water, land, or vegetation could have an adverse effect on the water or stream life. The following guidelines have been prepared to help Tennessee Valley Authority (TVA) Transmission Construction staff and their contractors avoid impacts to streams and stream life as they work in and near SMZs. These guidelines expand on information presented in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities.*

Three Levels of Protection

During the preconstruction review of a proposed transmission line, TVA Resource Stewardship staff will have studied each possible stream impact site and will have identified it as falling into one of three categories: (A) standard stream protection, (B) protection of important permanent streams, or C) protection of unique habitats. These category designations are based on the variety of species and habitats that exist in the stream as well as state and federal requirements to avoid harming certain species. The category designation for each site will be marked on the plan and profile sheets. Construction crews are required to protect streams and other identified water habitats using the following pertinent set(s) of guidelines:

(A) Standard Stream Protection

This is the standard (basic) level of protection for streams and the habitats around them. The purpose of the following guidelines is to minimize the amount and length of disturbance to the water bodies without causing adverse impacts on the construction work.

Guidelines:

1. All construction work around streams will be done using pertinent Best Management Practices (BMPs) such as those described in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities,* especially Chapter 6, “Standards and Specifications.”

2. All equipment crossings of streams must comply with appropriate state permitting requirements. Crossings of all drainage channels, intermittent streams, and permanent streams must be done in ways that avoid erosion problems and long-term changes in water flow. Crossings of any permanent streams must allow for natural movement of fish and other aquatic life.

3. Cutting of trees within SMZs must be accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. The method will be selected based on site-specific conditions and topography to minimize soil disturbance

and impacts to the SMZ and surrounding area. Stumps can be cut close to ground level but must not be removed or uprooted.

4. Other vegetation near streams must be disturbed as little as possible during construction. Soil displacement by the actions of plowing, disking, blading, or other tillage or grading equipment will not be allowed in SMZs; however, a minimal amount of soil disturbance may occur as a result of clearing operations. Shorelines that have to be disturbed must be stabilized as soon as feasible.

(B) Protection of Important Permanent Streams

This category will be used when there is one or more specific reason(s) why a permanent (always-flowing) stream requires protection beyond that provided by standard BMPs. Reasons for requiring this additional protection include the presence of important sports fish (trout, for example) and habitats for federal endangered species. The purpose of the following guidelines is to minimize the disturbance of the banks and water in the flowing stream(s) where this level of protection is required.

Guidelines:

1. Except as modified by guidelines 2-4 below, all construction work around streams will be done using pertinent BMPs such as those described in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities*, especially Chapter 6, “Standards and Specifications.”

2. All equipment crossings of streams must comply with appropriate state (and, at times, federal) permitting requirements. Crossings of drainage channels and intermittent streams must be done in ways that avoid erosion problems and long-term changes in water flow. Proposed crossings of permanent streams must be discussed in advance with Resource Stewardship staff and may require an on-site planning session before any work begins. The purpose of these discussions will be to minimize the number of crossings and their impact on the important resources in the streams.

3. Cutting of trees within SMZs must be accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. The method will be selected based on site-specific conditions and topography to minimize soil disturbance and impacts to the SMZ and surrounding area. Cutting of trees near permanent streams must be limited to those required to meet National Electric Safety Code and danger tree requirements. Stumps can be cut close to ground level but must not be removed or uprooted.

4. Other vegetation near streams must be disturbed as little as possible during construction. Soil displacement by the actions of plowing, disking, blading, or other tillage or grading equipment will not be allowed in SMZs; however, a minimal amount of soil disturbance may occur as a result of clearing operations. Shorelines that have to be disturbed must be stabilized as soon as possible and revegetated as soon as feasible.

(C) Protection of Unique Habitats

This category will be used when, for one or more specific reasons, a temporary or permanent aquatic habitat requires special protection. This relatively uncommon level of protection will be appropriate and required when a unique habitat (for example, a particular spring run) or protected species (for example, one that breeds in a wet-weather ditch) is known to occur on or adjacent to the construction corridor. The purpose of the following guidelines is to avoid or minimize any disturbance of the unique aquatic habitat.

Guidelines:

1. Except as modified by Guidelines 2-4 below, all construction work around the unique habitat will be done using pertinent BMPs such as those described in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities*, especially Chapter 6, "Standards and Specifications."

2. All construction activity in and within 30 meters (100 feet) of the unique habitat must be approved in advance by Resource Stewardship staff, preferably as a result of an on-site planning session. The purpose of this review and approval will be to minimize impacts on the unique habitat. All crossings of streams also must comply with appropriate state (and, at times, federal) permitting requirements.

3. Cutting of trees within 30 meters (100 feet) of the unique habitat must be discussed in advance with Resource Stewardship staff, preferably during the on-site planning session. Cutting of trees near the unique habitat must be kept to an absolute minimum. Stumps must not be removed, uprooted, or cut shorter than 0.30 meter (1 foot) above the ground line.

4. Other vegetation near the unique habitat must be disturbed as little as possible during construction. The soil must not be disturbed by plowing, disking, blading, or grading. Areas that have to be disturbed must be stabilized as soon as possible and revegetated as soon as feasible, in some cases with specific kinds of native plants. These and other vegetative requirements will be coordinated with Resource Stewardship staff.

Additional Help

If you have questions about the purpose or application of these guidelines, please contact your supervisor or the environmental coordinator in the local Transmission Service Center.

Revision July 2003

Comparison of Guidelines Under the Three Stream and Water Body Protection Categories (page 1)

Guidelines	A: Standard	B: Important Permanent Streams	C: Unique Water Habitats
1. Reference	• All TVA construction work around streams will be done using pertinent BMPs such as those described in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities,* especially Chapter 6, "BMP Standards and Specifications."	Except as modified by guidelines 2-4 below, all construction work around streams will be done using pertinent BMPs such as those described in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities*, especially Chapter 6, "BMP Standards and Specifications."	• Except as modified by guidelines 2-4 below, all construction work around the unique habitat will be done using pertinent BMPs such as those described in *A Guide for Environmental Protection and Best Management Practices for TVA Construction and Maintenance Activities,* especially Chapter 6, "BMP Standards and Specifications."
2. Equipment Crossings	• All crossings of streams must comply with appropriate state and federal permitting requirements. • Crossings of all drainage channels, intermittent streams, and permanent streams must be done in ways that avoid erosion problems and long-term changes in water flow. • Crossings of any permanent streams must allow for natural movement of fish and other aquatic life.	• All crossings of streams must comply with appropriate state and federal permitting requirements. • Crossings of drainage channels and intermittent streams must be done in ways that avoid erosion problems and long-term changes in water flow. • Proposed crossings of permanent streams must be discussed in advance with Resource Stewardship staff and may require an on-site planning session before any work begins. The purpose of these discussions will be to minimize the number of crossings and their impact on the important resources in the streams.	• All crossings of streams also must comply with appropriate state and federal permitting requirements. • All construction activity in and within 30 meters (100 feet) of the unique habitat must be approved in advance by Resource Stewardship staff, preferably as a result of an on-site planning session. The purpose of this review and approval will be to minimize impacts on the unique habitat.

Comparison of Guidelines Under the Three Stream and Water Body Protection Categories (page 2)

Guidelines	A: Standard	B: Important Permanent Streams	C: Unique Water Habitats
3. Cutting Trees	• Cutting of trees within SMZs must be accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. The method will be selected based on site-specific conditions and topography to minimize soil disturbance and impacts to the SMZ and surrounding area. • Stumps can be cut close to ground level but must not be removed or uprooted.	• Cutting of trees with SMZs must be accomplished by using either hand-held equipment or other appropriate clearing equipment (e.g., a feller-buncher) that would result in minimal soil disturbance and damage to low-lying vegetation. The method will be selected based on site-specific conditions and topography to minimize soil disturbance an impacts to the SMZ and surrounding area. • Cutting of trees near permanent streams must be limited to those meeting National Electric Safety Code and danger tree requirements. • Stumps can be cut close to ground level but must not be removed or uprooted.	• Cutting of trees within 30 meters (100 feet) of the unique habitat must be discussed in advance with Resource Stewardship staff, preferably during the on-site planning session. Cutting of trees near the unique habitat must be kept to an absolute minimum. • Stumps must not be removed, uprooted, or cut shorter than 1 foot above the ground line.
4. Other Vegetation	• Other vegetation near streams must be disturbed as little as possible during construction. • Soil displacement by the actions of plowing, disking, blading, or other tillage or grading equipment will not be allowed in SMZs; however, a minimal amount of soil disturbance may occur as a result of clearing operations. • Shorelines that have to be disturbed must be stabilized as soon as feasible.	• Other vegetation near streams must be disturbed as little as possible during construction. • Soil displacement by the actions of plowing, disking, blading, or other tillage or grading equipment will not be allowed in SMZs; however, a minimal amount of soil disturbance may occur as a result of clearing operations. • Shorelines that have to be disturbed must be stabilized as soon as possible and revegetated as soon as feasible.	• Other vegetation near the unique habitat must be disturbed as little as possible during construction. • The soil must not be disturbed by plowing, disking, blading, or grading. • Areas that have to be disturbed must be stabilized as soon as possible and revegetated as soon as feasible, in some cases with specific kinds of native plants. These and other vegetative requirements will be coordinated with Resource Stewardship staff

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Appendix V – Tennessee Valley Authority Right-of-Way Vegetation Management

Overview

TVA must manage the vegetation on its rights-of-way (ROW) and easements to ensure emergency maintenance access and routine access to structures, switches, conductors, and communications equipment. In addition, TVA must maintain adequate clearance, as specified by the National Electrical Safety Code, between conductors and tall growing vegetation and other objects. This requirement applies to vegetation within the ROW as well as to trees located off the ROW.

Each year TVA assesses the conditions of the vegetation on and along its ROWs. This is accomplished by aerial inspections, periodic field inspections, aerial photography, and information from TVA personnel, property owners and the general public. Important information gathered during these assessments includes the coverage by various vegetation types, the mix of plant species, the observed growth, the seasonal growing conditions and the density of the tall vegetation. TVA also evaluates the proximity, height, and growth rate of trees adjacent to the ROW that may be a danger to the line or structures. TVA ROW Specialists develop a vegetation reclearing plan that is specific to each line segment and is based on terrain conditions, species mix, growth, and density.

ROW Management Options

TVA uses an integrated vegetation management approach. In farming areas, TVA encourages property owner management of the ROW using low growing crops. In dissected terrain with rolling hills and interspersed woodlands, TVA uses mechanical mowing to a large extent.

When slopes become hazardous to farm tractors and rotary mowers, TVA may use a variety of herbicides specific to the species present with a variety of possible application techniques. When scattered small stands of tall growing vegetation are present and access along the ROW is difficult, or the path to such stands is very long, herbicides may be used.

In very steep terrain, in sensitive environmental areas, in extensive wetlands, at stream banks and in sensitive property owner land use areas, hand clearing may be utilized. Hand clearing is recognized as one of the most hazardous occupations documented by the Occupational Health and Safety Administration. For that reason, TVA is actively looking at better control methods including use of low volume herbicide applications, occasional single tree injections, and tree growth regulators.

TVA does not encourage tree reclearing by individual property owners because of the high hazard potential of hand clearing, possible interruptions of the line, and electrical safety considerations for untrained personnel that might do the work. Private property owners may reclear the ROW with trained reclearing professionals.

Mechanical mowers not only cut the tall saplings and seedlings on the ROW, they also shatter the stump and the supporting near surface root crown. The tendency of resistant species is to resprout from the root crown and shattered stumps can produce a multi-stem dense stand in the immediate area. Repeated use of mowers on short cycle reclearing with many original stumps regrowing in the above manner can create a single species thicket or

monoculture. With the original large root system and multiple stems, the resistant species can produce regrowth at the rate of 5-10 feet in a year. In years with high rainfall the growth can reach 12-15 feet in a single year. These created dense, monoculture stands can become nearly impenetrable for even large tractors. Such stands have low diversity, little wildlife food or nesting potential, and become a property owner concern. Selective herbicide application may be used to control monoculture stands.

TVA encourages property owners to sign an agreement to manage ROWs on their land for wildlife under the auspices of "Project Habitat," a joint project by TVA, BASF, and wildlife organizations, e.g., National Wild Turkey Federation, Quail Unlimited, and Buckmasters. The property owner maintains the ROW in wildlife food and cover with emphasis on quail, turkey, deer or other wildlife. A variation used in or adjacent to developing suburban areas is to sign agreements with the developer and residents to plant and maintain wildflowers on the ROW.

TVA places strong emphasis on managing ROWs in the above manner. When the property owners do not agree to these opportunities, TVA must maintain the ROW in the most environmentally acceptable, cost-effective, and efficient manner possible.

Herbicide Program

TVA has worked with universities (such as Mississippi State University, University of Tennessee, Purdue University and others), chemical manufacturers, other utilities, U.S. Department of Transportation, U.S. Fish and Wildlife Service, and U.S. Forest Service personnel to explore options for vegetation control. The results have been strong recommendations to use species specific, low volume, herbicide applications in more situations. Research, demonstrations, and other ROW programs show a definite improvement of ROWs treated with selective low volume applications of new herbicides using a variety of application techniques and timing.

Low volume herbicide applications are recommended since research demonstrates much wider plant diversity after such applications. There is better ground erosion protection and more wildlife food plants and cover plants develop. In most situations there is increased development of wild flowering plants and shrubs. In conjunction with herbicides, the diversity and density of low growing plants provide control of tall growing species through competition.

Wildlife managers often request the use of herbicides in place of rotary mowing in order to avoid damage to nesting and tunneling wildlife. This method retains ground cover year around with a better mix of food species and associated high protein insect populations for birds in the right seasons. Most also report less damage to soils (even when compared with rubber tired equipment).

Property owners interested in tree production often request the use of low volume applications rather than hand or mechanical clearing because of the insect and fungus problems in damaged vegetation and debris left on ROW. The insect and fungus invasions, such as pine tip moth, oak leaf blight, sycamore and dogwood blight, etc., are becoming widespread across the nation.

Best Management Practices (BMPs) governing application of herbicides are contained within "*A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities",* which

is incorporated by reference. Herbicides can be liquid, granular, or powder and can be applied aerially or by ground equipment and may be selectively applied or broadcast, depending on the site requirements, species present, and condition of the vegetation. Water quality considerations include measures taken to keep herbicides from reaching streams whether by direct application or through runoff of or flooding by surface water. “Applicators” must be trained, licensed, and follow manufacturers’ label instructions, U.S. Environmental Protection Agency (USEPA) guidelines, and respective state regulations and laws.

When herbicides are used, their potential adverse impacts are considered in selecting the compound, formulation, and application method. Herbicides that are designated “Restricted Use” by USEPA require application by or under the supervision of applicators certified by the respective state control board. Aerial and ground applications are done either by TVA or by contractors in accordance with the following guidelines identified in the TVA BMP manual:

1. The sites to be treated are selected and application directed by the appropriate TVA official.
2. A preflight walking or flying inspection is made within 72 hours prior to applying herbicides aerially. This inspection ensures that no land use changes have occurred, that sensitive areas are clearly identified to the pilot, and that buffer zones are maintained.
3. Aerial application of liquid herbicides will normally not be made when surface wind speeds exceed 5 miles per hour, in areas of fog, or during periods of temperature inversion.
4. Pellet application will normally not be made when the surface wind speeds exceed 10 miles per hour, or on frozen or water saturated soils.
5. Liquid application is not performed when the temperature reaches 95 degrees (F) or above.
6. Application during unstable, unpredictable, or changing weather patterns is avoided.
7. Equipment and techniques are used that are designed to ensure maximum control of the spray swath with minimum drift.
8. Herbicides are not applied to surface water or wetlands unless specifically labeled for aquatic use. Filter and buffer strips will conform at least to federal and state regulations and any label requirements. The use of aerial or broadcast application of herbicides is not allowed within a streamside management zone (SMZs) (200 feet minimum width) adjacent to perennial streams, ponds, and other water sources. Hand application of certain herbicides labeled for use within SMZs is used only selectively.
9. Buffers and filter strips (200 feet minimum width) are maintained next to agricultural crops, gardens, farm animals, orchards, apiaries, horticultural crops, and other valuable vegetation.
10. Herbicides are not applied in the following areas or times: (a) in city, state, and national parks or forests or other special areas without written permission and/or required permits (b) off the right-of-way and (c) during rainy periods or during the 48- hour interval prior to rainfall predicted with a 20 percent or greater probability by local forecasters, when soil active herbicides are used.

Herbicides Currently Used on TVA Rights-of-Way

Trade Name	Active Ingredients	Label Signal Word
Accord	Glyphosate/Liquid	Caution
Arsenal	Imazapyr/Liquid/Granule	Caution
Escort	Metsulfuron Methyl/ dry flowable	Caution
Garlon	Triclopyr/Liquid	Caution
Garlon 3A	Triclopyr/Liquid	Danger
Transline	Clopyralid/Liquid	Caution
Pathfinder II	Triclopyr/RTU	Caution
Krenite S	Fosamine Ammoinium	Caution
Spike 20P	Tebuthiuron	Caution

Herbicides Currently Used for Bare Ground Areas on TVA Rights-of-Way

Trade Name	Active Ingredients	Label Signal Word
Chopper	Imazapyr/RTU	Caution
Topsite	Diuron/Imazapyr	Caution
Roundup	Glyphosate/Liquid	Caution
SpraKil SK-26	Tebuthiuron and Diuron	Caution
Sahara	Diuron/Imazapyr	Caution
Roundup Pro	Glyphosate	Caution

Tree growth regulators (TGRS) may be used on tall trees that have special circumstances where they must be trimmed on a regular cycle.

TGRs Currently Used on TVA Rights-of-Way

TGR	Flurprimidol	Caution
Profile 2SC	TGR-paclobutrazol	Caution

TVA currently utilizes Activate Plus, manufactured by Terra, as an adjuvant to herbicides to improve the performance of the spray mixture. Application rates are consistent with the USEPA-approved label. U.S. Fish and Wildlife Service has expressed some concern on toxicity effects of surfactants on aquatic species. TVA is working in coordination with Mississippi State University and chemical companies to evaluate efficacy of additional low-toxicity surfactants, including LI700 as manufactured by Loveland Industries, through side-by-side test plots in the streamside management zones of area transmission lines.

The herbicides and TGRs listed above have been evaluated in extensive studies in support of registration applications and label requirements. Many have been reviewed in the U.S. Forest Service Vegetation Management Environmental Impact Statements and those evaluations are incorporated here by reference. The result of these reviews has been a consistent finding of limited environmental impact beyond that of control of the target vegetation. All the listed herbicides have been found to be of low environmental toxicity when applied by trained applicators following the label and registration procedures, including prescribed measures, such as buffer zones, to protect threatened and endangered species.

The rates of application utilized are those listed on the USEPA-approved label and consistent with utility standard practice throughout the Southeast. TVA currently uses primarily low volume applications of foliar and basal applications of Accord (Glyphosate) and Accord (Glyphosate)-Arsenal (Imazapyr) tank mixes. Glyphosate is one of the most widely used herbicidal active ingredients in the world, and has been continuously the subject of numerous exhaustive studies and scrutiny to determine its potential impacts on humans, animals and the environment.

Accord - Accord is labeled for vegetation management in forestry and utility ROW applications. It has a full aquatics label, and can be applied to emergent weeds in all bodies of fresh and brackish water. There is limited restriction on the use of treated water for irrigation, recreation or domestic purposes. Accord is applied to the foliage of actively growing plants. The active ingredient is absorbed through the leaves and rapidly moves throughout the plant. Glyphosate prevents the plant from producing amino acids that are unique to plants and which are building blocks of plant proteins. The plant, unable to make proteins, stops growing and dies.

The favorable environmental fate characteristic of Accord herbicide and its major metabolite (breakdown product) aminomethylphosphonic acid (AMPA) is well known. Continuing research is underway with more than 400 studies conducted to date in the laboratory and under field use conditions. These studies show rapid breakdown, little soil or plant debris retention and little vertical movement into soil below the surface.

Glyphosate is naturally degraded by microbes in soil and water under both aerobic (with oxygen) and anaerobic (without oxygen) conditions. AMPA is further degraded in soil and sediments to: phosphorus, nitrogen, hydrogen and carbon dioxide. Glyphosate binds rapidly and completely to a wide range of soils and sediment when introduced into the environment. This essentially eliminates movement in the soil. The average half-life of glyphosate in soils is less than 45 days. Half-life for the dissipation of glyphosate in environmental waters ranges from 1.5 to 14 days.

Glyphosate is non-toxic to birds, mammals and bees and has been shown not to bioaccumulate since it acts in plants through an enzyme system that does not exist in animals or humans.

Arsenal - Arsenal (Imazapyr) has been similarly tested and it is found to have low leaching potential in soils. When available on or in the soil it is broken down rapidly by soil microbes to naturally occurring compounds. When not available, Imazapyr is bound tightly to soil colloids and is unavailable for movement. The half-life in soil is 25 to 65 days.

Extensive chronic and acute toxicity studies have made Arsenal a USEPA classified herbicide as practically non-toxic to humans, mammals, birds, fish, aquatic invertebrates and insects. The chronic studies demonstrate that Imazapyr is non-teratrogenic, non-mutagenic, and not a carcinogen.

The mode of action suppresses amino acids of the plant via an enzyme system containing acetohydroxy acid synthase. This enzyme system does not exist in other forms of life including humans and animals.

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Appendix VI – Summary of Stream Crossings Along the Proposed Murfreesboro-East Franklin and Pinhook-Radnor 161–kV Transmission Lines

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
Murfreesboro - East Franklin				
ASL1	Perennial	A (50 ft)	Trib to Watson Branch	5-ft-wide and 1.5-ft-deep channel located just east of the switching station
ASL2	Perennial	A (50 ft)	Trib to Watson Branch	2-ft-wide and 4-in deep channel that is culverted at the centerline under a driveway and impounded just south of the proposed ROW
ASL3	WWC	BMPs	Trib to Watson Branch	2-ft-wide and 6-in deep channel
ASB1	Perennial	A (50 ft)	Watson Branch	2-ft-wide by 2-ft-deep weakly defined channel
ASB2	Perennial	A (50 ft)	Trib to Mayes Creek	10-ft-wide and 6-ft-deep channel; channelized along paved road, very narrow riparian buffer
ASB3	Perennial	A (50 ft)	Trib to Mayes Creek	3-ft-wide and 1-ft-deep channel that is springfed and flows across mown pasture; crayfish burrows present; stream is not in proposed ROW but spring head is
ASB4	Perennial	A (50 ft)	Trib to Mayes Creek	20-ft-wide and 8-ft-deep channel with a wetted width of 10-15 ft; channelized stream that receives flow from ASB2 and 3; very little riparian zone
ASB5	Perennial	A (50 ft)	Mayes Creek	30-ft-wide and 6-ft-deep channel with a wetted width of 15 ft; large limestone outcrops; good habitat for Nashville crayfish; overgrazed pasture and cornfield on both sides; cattle have direct access to creek; ford just north of proposed ROW
ASL4	WWC	BMPs	Trib to Mayes Creek	2- to 3-ft-wide and 2- to 3-in-deep channel
ASB6	Perennial	A (50 ft)	Trib to Mayes Creek	30-ft-wide and 4-ft-deep channel with a wetted width of 10 ft; bedrock/slab substrate; no riparian vegetation; cattle have access
ASL5	WWC	BMPs	Trib to Mayes Creek	4-ft-wide and 6-in-deep channel

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASL6A	WWC	BMPs	Trib to Mayes Creek	3-ft-wide and 3-ft-deep channel that converges with ASL6
ASL6	Perennial	A (50 ft)	Trib to Mayes Creek	5-ft-wide and 5-in-deep channel; flows through horse pasture; horses have access
ASL7	Perennial	A (50 ft)	Trib to Harpeth River	5-ft-wide and 3-ft-deep channel that flows through a field parallel to Hickory Hills Road and is culverted at Hwy 96; no riparian zone
ASL8	Perennial	A (50 ft)	Trib to Harpeth River	15- to 20-ft-wide and 5-ft-deep channel with a wetted width of 12 ft; stream forks when it enters proposed ROW; a cane stand is located in the middle of the fork; pasture on both sides
ASB7	WWC	BMPs	Trib to Harpeth River	1-ft-wide and 1-ft-deep weakly defined channel; in between Structures 572 and 573
ASB8	WWC	BMPs	Trib to Arrington Creek	Undefined channel that's culverted at access road in middle of proposed ROW In between Structures 574 and 575
ASB9	Perennial	A (50 ft)	Trib to Arrington Creek	25-ft-wide and 6-ft-deep channel with a wetted width of 4 ft; very clean gravel and chert substrate
ASB10	Perennial	A (50 ft)	Trib to Arrington Creek	10-ft-wide and 6-ft-deep channel; parallels Wilson Pike just before Structure 580; culverted at driveway
ASB11	Perennial	A (50 ft)	Trib to Arrington Creek	30-ft-wide and 12-ft-deep channel with a wetted width of 8-12 ft; culverted at Hwy 96 100 ft south of proposed ROW; stream function is altered; moderately eroded in proposed ROW; stream function better outside of ROW
ASB12	Perennial	A (50 ft)	Arrington Creek	75-ft-wide and 10-ft-deep channel with a wetted width of 10 ft; very diverse habitat; hatching stoneflies; culverted at Hwy 96; crosses proposed ROW in between Structures 589 and 590
ASB13	Perennial	LB: A (50 ft) RB: A (100 ft)	Trib to Arrington Creek	7-ft-wide and 3-ft-deep channel that is channelized along Hwy 96; flows into Arrington Creek (ASB12) just downstream of Hwy 96; 50 percent slope on right-descending bank; Structure 590

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASB14	Intermittent	A (50 ft)	Trib to Arrington Creek	8-ft-wide and 2-ft-deep channel that flows through pasture and is impounded southwest of proposed ROW; in between Structures 591-592
ASB15	Intermittent	A (50 ft)	Trib to Arrington Creek	6-ft-wide and 2-ft-deep channel; channelized through agriculture field; mostly mud substrate; in between Structures 594 and 595
ASL9	Intermittent	A (50 ft)	Trib to Wilson Branch	2-ft-wide and 6-in-deep channel that's part of wetlands complex in between Structures 599 and 600
ASL10	Perennial	A (50 ft)	Trib to Wilson Branch	4-ft-wide and 2-ft-deep channel that flows through field in between Structures 602 and 603
ASB16	Perennial	A (50 ft RB, 100 ft LB)	Wilson Branch	30-ft-wide and 8-ft-deep channel; stream is high quality and functioning before and after proposed ROW
ASB17	WWC/Spring	BMPs	Trib to Wilson Branch	3-ft-wide and 1- to 2-ft-deep channel; a spring is located in between ASB17 and Structure 608 just down slope of proposed ROW; precautions should be taken to prevent runoff from entering spring
ASB18	Perennial	A (50 ft)	Trib to Nelson Creek	6-ft-wide and 2-ft-deep channel that flows through field with a forest to the south
ASB19	Perennial	A (50 ft)	Nelson Creek	12-ft-wide and 4-ft-deep channel with a wetted width of 9 ft; springfed; cattle have access to stream
ASB20	Intermittent	A (50 ft)	Trib to Nelson Creek	3-ft-wide and 2-ft-deep channel that emerges from a hillside in existing* ROW
ASB21	Perennial	A (50 ft)	Trib to Nelson Creek	3-ft-wide and 2-ft-deep channel that flow around ridge to ASB19
ASB22	Intermittent	A (50 ft)	Trib to Nelson Creek	6-ft-wide and 2-ft-deep channel that joins ASB21 downstream; impounded upstream of existing* ROW
ASB23	Perennial	A (50 ft)	Trib to Nelson Creek	12-ft-wide and 3-ft-deep channel with a wetted width of 7 ft; fairly high quality with trees stabilizing bank; box culvert at Hwy 840
ASL11	Perennial	A (50 ft)	Trib to Nelson Creek	7-ft-wide and 4-ft-deep channel that flows through cow pasture in between Structures 217 and 216; cows have access to stream
ASL12A	WWC	BMPs	Trib to Nelson Creek	3-ft-wide and 2-ft-deep channel that flows into ASL12

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASL12	Intermittent	A (50 ft)	Trib to Nelson Creek	6- to 8-ft-wide and 4- to 6-ft-deep channel that meanders parallel to the existing* ROW on the north side through horse and cow pasture
ASL13	Intermittent	A (50 ft)	Trib to Nelson Creek	4-ft-wide and 3-ft-deep channel that flows through pasture between Structures 209 and 210, then turns and flows in between 210 and 211
ASL14	Intermittent	A (50 ft)	Trib to Nelson Creek	3-ft-wide and 3-ft-deep channel that flows through woods.
ASL15	Per/Spring	A (50 ft)	Trib to Nelson Creek	2-ft-wide and 3-in-deep channel originates from a spring at a bouldered hillside and flows into wetland; spring is located within existing* ROW
ASL16	Perennial	A (50 ft)	Trib to Nelson Creek	5-ft-wide and 2- to 4-ft-deep channel in ROW, then narrows as it flows along the edge of ROW; runs through woods
ASL17	Per/Spring	A (50 ft)	Trib to Nelson Creek	2-ft-wide and 6-in-deep channel that flows through forest and originates from springs in existing* ROW and runs through wetland
ASL18	Perennial	A (50 ft)	Trib to Nelson Creek	6- to 8-ft-wide and 4-ft-deep channel that flows through woods
ASL19	WWC	BMPs	Trib to Nelson Creek	3-ft-wide and 1-ft-deep channel that flows through woods
ASB24	Perennial	A (50 ft)	Trib to Stewarts Creek	4-ft-wide and 2-ft-deep channel; high-quality headwater stream with clean gravel, cobble, and bedrock substrate; flows into existing* ROW near Structure 195
ASB25	Pond	A (50 ft)	--	30-ft diameter; next to Structure 192
ASB26	Intermittent	A (50 ft)	Trib to Stewarts Creek	10 ft wide and 1 ft deep; quality stream with bedrock slabs and red cedar flat on top of ridge
ASB27	Pond	BMPs	--	40 ft in diameter
ASH15	WWC	BMPs	Trib to Nelson Creek	3-ft-wide by 2-ft-deep channel that feeds ASH4
ASB29	Per/Spring	A (50 ft)	Trib to Nelson Creek	3-ft-wide and 1-in-deep channel from a spring seep in natural area; part of a stream/spring/wetland complex takes up about 60 ft in existing* ROW
ASH4	Intermittent	A (50 ft)	Trib to Nelson Creek	8-ft-wide by 3-ft-deep channel, forested

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASH3	WWC	BMPs	Trib to Nelson Creek	2-ft-wide by 1-ft-deep channel
ASH2	WWC	BMPs	Trib to Nelson Creek	3-ft-wide by 1-ft-deep channel
ASH1	WWC	BMPs	Trib to Nelson Creek	3-ft-wide by 2-ft-deep channel
ASH11	WWC	BMPs	Trib to Nelson Creek	5-ft-wide by 2-ft-deep channel
ASH10	WWC	BMPs	Trib to Nelson Creek	2-ft-wide by 1-ft-deep channel
ASH9	Intermittent	A (50 ft)	Trib to Nelson Creek	10-ft-wide by 2-ft-deep channel; continuation of ASH7
ASH12	WWC	BMPs	Trib to Nelson Creek	4-ft-wide by 2-ft-deep channel that feeds ASH9
ASH 13	WWC	BMPs	Trib to Nelson Creek	4-ft-wide by 2-ft-deep channel that feeds ASH9
ASH14	WWC	BMPs	Trib to Nelson Creek	4-ft-wide by 2-ft-deep channel that feeds ASH9
ASH8	WWC	BMPs	Trib to Nelson Creek	2-ft-wide by 1-ft-deep channel
ASH7	Intermittent	A (50 ft)	Trib to Nelson Creek	8-ft-wide by 3-ft-deep channel; small pools present
ASH6	WWC	BMPs	Trib to Nelson Creek	3-ft-wide by 2-ft-deep channel
ASH5	WWC	BMPs	Trib to Overall Creek	4-ft-wide by 3-ft-deep channel
ASB36	WWC	BMPs	Trib to Overall Creek	3-ft-wide and 2-ft-deep channel that flows into a sinkhole on northeast side of existing* ROW
ASB37	Perennial	A (50 ft)	Trib to Overall Creek	35-ft-wide and 4-ft-deep channel with a wetted width of 10 ft; water goes subterranean while surface flow continues; in between Structures 153 and 154
ASL20	Perennial	A (50 ft)	Trib to Overall Creek	5- to 8-ft-wide and 6- to 12-in-deep channel that flows about 100 ft east of road; forks just outside of existing* ROW; riparian vegetation outside of existing* ROW, but none in the ROW
ASL21	WWC	BMPs	Trib to Overall Creek	5-ft-wide and 3-ft-deep channel that flows through forest
ASL22	WWC	BMPs	Trib to Overall Creek	2-ft-wide and 6- to 12-in-deep channel that flows through forest

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASL23	WWC	BMPs	Trib to Overall Creek	4-ft-wide and 2-ft-deep channel that flows through forest
ASL24	WWC	BMPs	Trib to Overall Creek	5-ft-wide and 2- to 10-ft-deep channel that flows through forest
ASB39	Pond	BMPs	--	Stock pond at base of Structure 123
ASB38	Perennial	A (50 ft)	Overall Creek	75-ft-wide and 10-ft-deep channel with a wetted width of 75 ft; in between Structures 117 and 118
ASB40	WWC	BMPs	Trib to Overall Creek	Runs through a cornfield; contour drainage with mud and bedrock substrate
ASL25	Perennial	A (50 ft)	Puckett Creek	5- to 6-ft-wide and 1-ft-deep channel that flows through pasture and parallels Hwy 99 and culverted at Salem Road; no riparian vegetation
ASL26	WWC	BMPs	Armstrong Branch	15-ft-wide and 2- to 3-ft-deep channel
ASL27	WWC	BMPs	Trib to West Fork Stones River	5-ft-wide and 6-in-deep channel that flows through a newly developing neighborhood; channelized alongside road
ASL28	WWC	BMPs	Trib to West Fork Stones River	15 ft wide and 3 ft deep; channelized through developing neighborhood; located just south of Casin Lane Substation
AR01	WWC	BMPs	Trib to Hurricane Creek	WWC with 5-ft-wide and 3-ft-deep channel; associated with ASL31
AR02	Intermittent	B (100 ft)	Trib to Hurricane Creek	4- to 5-ft-wide and 2- to 3-ft-deep channel that may have been perennial at one time but has been disturbed; access road would cross in existing ASL32 SMZ
AR03	Perennial	B (100 ft)	Trib to Collins Creek	10-ft-wide and 5-ft-deep channel with a wetted width of 6 ft; north fork of access road, enters existing ASB41 SMZ but does not cross stream
AR04	Perennial	B (100 ft)	Trib to Collins Creek	10-ft-wide and 5-ft-deep channel; south fork of access road, would cross upstream of existing ASB41 SMZ
AR05	Intermittent	B (100 ft)	Trib to Collins Creek	5-ft-wide and 2-ft-deep channel; access road would cross downstream of existing ASB43 SMZ
AR06	WWC	BMPs	Trib to Mill Creek	3- to 5-ft-wide and 2- to 6-ft-deep channel that flows into a sinkhole near the middle of the ROW; associated with ASL33

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
AR07	WWC	BMPs	Trib to Whittemore Branch	Braided 12-ft-wide and 3-ft-deep channel in between Structures 139 and 140; associated with ASL37
AR08	Perennial	B (100 ft)	Whittemore Branch	Whittemore Branch; 10- to 15-ft-wide and 6-ft-deep channel that flows next to Bell Road; tributary to Mill Creek and potential habitat for Nashville crayfish; access road would cross downstream of existing ASL38 SMZ
AR09	Perennial	B (100 ft)	Whittemore Branch	Whittemore Branch; 10- to 15-ft-wide and 6-ft-deep channel that flows next to Bell Road; tributary to Mill Creek and potential habitat for Nashville crayfish; access is on existing roads; access road would cross in existing ASL38 SMZ
AR10	Perennial	B (100 ft)	Whittemore Branch	Whittemore Branch; 10- to 15-ft-wide and 6-ft-deep channel that flows next to Bell Road; access road would cross in existing ASL38 SMZ
AR11	Intermittent	B (100 ft)	Trib to Shasta Branch	6-ft-wide and 3-ft-deep channel; access would cross stream using existing road; crosses downstream of existing ASL39 SMZ
AR12	Perennial	B (100 ft)	Shasta Branch	Sevenmile Creek (a tributary to Mill Creek) 20-ft-wide and 6-ft-deep channel; access road would enter SMZ several times, but never cross stream; associated with ASL44 SMZ
AR13	Perennial	B (100 ft)	Sevenmile Creek	30-ft-wide and 6- to 8-ft-deep channel that flows in between Structures 152 and 153; access would be on existing road (entrance to neighborhood); access road is located downstream of existing ASL45 SMZ
AR14	Perennial	B (100 ft)	Brentwood Branch	Access road would cross stream in existing ASL46 SMZ
AR15	Perennial	B (100 ft)	Trib to Brentwood Branch	8-ft-wide and 5-ft-deep channel that flows in between Structures 159 and 160 and again in between 160 and the substation; access road would cross in existing ASL49 SMZ
Pinhook-Radnor				
ASL29	WWC	BMPs	Trib to Percy Priest Lake	6-ft-wide and 4-ft-deep channel located just west of the Pinhook Substation that meanders along the north side of the ROW

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASL30	WWC	BMPs	Trib to Percy Priest Lake	1- to 2-ft-wide and 1-ft-deep channel
ASL31	WWC	BMPs	Trib to Hurricane Creek	5-ft-wide and 3-ft-deep channel
ASL32	Intermittent	A (50 ft)	Trib to Hurricane Creek	4- to 5-ft-wide and 2- to 3-ft-deep channel that may have been perennial at one time, but it has been disturbed; access road goes through stream (ford) and inhibits flow
ASB41	Perennial	B (100 ft)	Trib to Collins Creek	10-ft-wide and 5-ft-deep channel with a wetted width of 6 ft
ASB42	Intermittent	A (50 ft)	Trib to Collins Creek	3-ft-wide and 1-ft-deep channel that has an overgrown pasture for a riparian zone; channel is silt laden
ASB43	Intermittent	A (50 ft)	Trib to Collins Creek	5-ft-wide and 2-ft-deep channel that flows through the base of two grading projects where a large amount of leveling has occurred; 100 ft east of I-24
ASB44	WWC	BMPs	Trib to Collins Creek	6-ft-wide and 3-ft-deep channel that flows on the east side of I-24
ASB45	Int/Spring	B (100 ft)	Trib to Collins Creek	6-ft-wide and 2-ft-deep channel that originates from a spring in the existing* ROW; cattle have access to spring
ASB46	Intermittent	A (50 ft)	Trib to Collins Creek	15-ft-wide and 8-ft-deep channel
ASB47	Perennial	B (100 ft)	Trib to Collins Creek	20-ft-wide and 5-ft-deep channel with a wetted width of 15 ft; tributary to Mill Creek/possible Nashville crayfish habitat; located just east of Cane Creek Road
ASB49	Perennial	B (100 ft)	Trib to Mill Creek	10-ft-wide and 3-ft-deep (braided) channel; possible Nashville crayfish habitat
ASB48	Perennial	B (100 ft)	Mill Creek	100-ft-wide and 10-ft-deep channel with a wetted width of 90 ft; Nashville crayfish habitat
ASL33	WWC	BMPs	Trib to Mill Creek	3- to 5-ft-wide and 2- to 6-ft-deep channel that flows into a sinkhole near the middle of the existing* ROW

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASL35	Perennial	RB: B (200 ft) LB: B (100 ft)	Trib to Whittemore Branch	3- to 6-ft-wide and 1- to 3-ft-deep channel that flows in between Structures 137 and 138 and perpendicular to Old Hickory Blvd.; right-descending bank has a slope of 45 percent
ASL37	WWC	BMPs	Trib to Whittemore Branch	Braided 12-ft-wide and 3-ft-deep channel that flows perpendicular to Old Hickory Blvd. in between Structures 139 and 140
ASL36	Intermittent	A (50 ft)	Trib to Whittemore Branch	5-ft-wide and 3-ft-deep channel that flows through a pasture in between Structures 140 and 141
ASL38	Perennial	B (100 ft)	Whittemore Branch	10- to 15-ft-wide and 6-ft-deep channel that flows next to Bell Road, right under the centerline for about 1/3 of a mile; potential habitat for Nashville crayfish
ASL39	Intermittent	A (50 ft)	Trib to Shasta Branch	6-ft-wide and 3-ft-deep channel
ASL40	WWC	BMPs	Trib to Shasta Branch	5-ft-wide and 6-ft-deep channel that flows into ASL 39
ASL44	Perennial	B (100 ft)	Shasta Branch	Tributary to Mill Creek; 20-ft-wide and 6-ft-deep channel that meanders along the edge (south side) of the existing* ROW for 1/2 a mile, then crosses the centerline, turns, and crosses again
ASL43	WWC	BMPs	Trib to Shasta Branch	3- to 5-ft-wide and 2- to 4-ft-deep channel that flows in between Structures 150 and 151 and into ASL 44
ASL42	WWC	BMPs	Trib to Shasta Branch	5-ft-wide and 3-ft-deep channel that flows in between Structures 150 and 151 and into ASL44
ASL41	WWC	BMPs	Trib to Shasta Branch	3- to 5-ft-wide and 3-ft-deep channel that flows in between Structure 151 and a road and into ASL 44
ASL45	Perennial	B (100 ft)	Sevenmile Creek	30-ft-wide and 6- to 8-ft-deep channel with a wetted width of 30 ft that flows in between Structures 152 and 153 and is the same stream as ASL 44 (Nashville crayfish habitat)
ASL46	Perennial	B (100 ft)	Brentwood Branch	20- to 30-ft-wide and 3- to 6-ft-deep channel that flows into ASL 45 (Nashville crayfish habitat); flows in between Structures 153 and 154

Field ID	Stream Type	SMZ Category	Stream Name	Field Notes
ASL47	WWC	BMPs	Trib to Brentwood Branch	3-ft-wide and 3-ft-deep channel that flows in between Structures 154 and 155
ASL48	WWC	BMPs	Trib to Brentwood Branch	4-ft-wide and 3-ft-deep channel that flows in between Structures 154 and 155
ASL49	Perennial	B (100 ft)	Trib to Brentwood Branch	8-ft-wide and 5-ft-deep channel that flows across centerline in between Structures 159 and 160 and again in between 160 and the substation

* Existing ROW would need to be recleared for new transmission line.

Abbreviations
Blvd. = Boulevard
BMPs = Best Management Practices
ft = Foot or Feet
Hwy = Highway
ID = Identification Number
in = Inch
Int = Intermittent
Per = Perennial
ROW = Right-of-Way
SMZ = Streamside Management Zone
Trib = Tributary
WWC = Wet Weather Conveyance

Appendix VII – Nonnative, Noninvasive Species Suitable For Public Use Areas, Erosion Control/Stabilization and Wildlife Habitat Plantings

KENTUCKY 31 AND OTHER FESCUES - for dam reservations, public use areas, and other facilities; transmission line construction stabilization where fescue is currently present as forage or lawn grasses, or when landowners request it. Not to be used in wildlife plantings or in agricultural license areas.

ZOYSIA VARIETIES - for dam reservations, public use areas, and other facilities.

BERMUDAGRASS - for dam reservations, public use areas, and other facilities.

ANNUAL RYEGRASS - suitable for all sites.

FOXTAIL, BROWNTOP AND JAPANESE MILLETS - suitable for all sites.

BUCKWHEAT - suitable for wildlife plantings.

WINTER WHEAT - suitable for wildlife plantings.

OATS - suitable for wildlife plantings.

ORCHARDGRASS - suitable for all sites.

PERENNIAL RYEGRASS - suitable for all sites.

REDTOP - suitable for all sites.

RYE - suitable for all sites.

TIMOTHY - suitable for all sites.

WEEPING LOVEGRASS - for erosion control use only.

COMMON, KOBE, KOREAN LESPEDEZA - suitable for all sites.

CRIMSON, RED AND LADINO CLOVERS - suitable for all sites.

SOYBEANS - suitable for wildlife plantings.

SORGHUM-MILO -suitable for wildlife plantings.

Invasive Plant Species of High Priority to TVA

Common name	Scientific name
Tree of heaven	*Alianthus altissima*
Alligatorweed	*Alternathera philoxeroides*
Hairy jointgrass	*Arthraxon hispidus*
Japanese bromegrass	*Bromus japonicus*
Oriental Bittersweet	*Celastrus orbiculatus*
Autumn olive	*Elaeagnus umbellata*
Tall fescue	*Festuca elatior**
Hydrilla	*Hydrilla verticillata*
Sericea lespedza	*Lespedeza cuneata*
Common privet	*Ligustrum sinense*
Japanese honeysuckle	*Lonicera japonica*
Amur bush honeysuckle	*Lonicera mackii* (and other closely related species)
Purple loosestrife	*Lythrum salicaria*
Japanese/Nepal grass	*Microstegium vimineum*
Eurasian watermilfoil	*Myriophyllum spicatum*
Spinyleaf naiad	*Najas minor*
Princess tree	*Paulownia tomemtosa*
Common reed	*Phragmites australis*
Japanese knotweed	*Polygonum cuspidatum*
Kudzu	*Pueraria montana*
Multiflora rose	*Rosa multiflora*
Johnson grass	*Sorghum halapense*
Japanese wisteria	*Wisteria floribunda*
Common cucklebur	*Xanthium strumarium*

Watch List:

Common name	Scientific name
Water hyacinth	*Eichhornia crassipes*
Giant salvinia	*Salvinia molesta*

Invasives Exotic Pest Plants of Tennessee

Rank 1 — Severe Threat: Exotic plant species that possess characteristics of invasive species and spread easily into native plant communities and displace native vegetation.

Common name	Scientific name
Tree of heaven	*Ailanthus altissima* (Mill.) Swingle
Mimosa	*Albizia julibrissin* Durz.
Garlic-mustard	*Alliaria petiolata* (Bieb.) Cavara & Grande
Asian bittersweet	*Celastrus orbiculata* Thunb.
Air-potato	*Dioscorea oppositifolia* L.
Autumn olive	*Elaeagnus umbellata* Thunb.
Thorny-olive	*Elaeagnus pungens* Thunb.
Winter creeper	*Euonymus fortunei* (Turcz.) Hand.-Mazz.
English ivy	*Hedera helix* L.
Sericea lespedeza	*Lespedeza cuneata* (Dum.-Cours.) G. Don
Chinese privet	*Ligustrum sinense* Lour.
Common privet	*Ligustrum vulgare* L.
January jasmine	*Lonicera fragrantissima* Lindl. & Paxton

Common name	Scientific name
Japanese honeysuckle	*Lonicera japonica* Thunb.
Amur bush honeysuckle	*Lonicera maackii* (Rupr.) Maxim.
Morrow's bush honeysuckle	*Lonicera morrowii* A. Gray
Tartarian honeysuckle, twinsisters	*Lonicera tatarica* L.
Bush honeysuckle	*Lonicera x bella* Zabel
Purple loosestrife	*Lythrum salicaria* L. [all varieties and cultivars]
Camus Nepal grass, Japanese grass	*Microstegium vimineum* (Trin.) A.
Eurasian water milfoil	*Myriophyllum spicatum* L.
Princess tree	*Paulownia tomentosa* (Thunb.) Sieb. & Zucc. ex Steud
Common reed	*Phragmites australis* (Cav.) Trin. ex Steud.
Japanese knotweed, Japanese bamboo	*Polygonum cuspidatum* Seib. & Zucc
Kudzu	*Pueraria montana* (Lour.) Merr.
Multiflora rose	*Rosa multiflora* Thunb.
Tropical soda apple	*Solanum viarum* Dunal
Johnson grass	*Sorghum halepense* (L.) Pers.
Japanese spiraea	*Spiraea japonica L.f.*

Rank 2 — Significant Threat: Exotic plant species that possess characteristics of invasive species but are not presently considered to spread as easily into native plant communities as those species listed as Rank 1— Severe Threat.

Common Name	Scientific Name
Alligatorweed	*Alternanthera philoxeroides* (Mart.) Griseb.
Mugwort, common wormwood	*Artemisia vulgaris* L.
Hairy jointgrass	*Arthraxon hispidus* (Thunb.) Makino
Japanese barberry	*Berberis thunbergii DC.*
Meadow brome	*Bromus commutatus* Schrad.
Japanese bromegrass	*Bromus japonicus* Thunb. ex Murray
Rye brome	*Bromus secalinus* L.
Thatch bromegrass, cheat grass	*Bromus tectorum* L.
Musk thistle, nodding thistle	*Carduus nutans* L.
Spotted knapweed	*Centaurea biebersteinii* DC.
Canada thistle	*Cirsium arvense* L. (Scop.)
Bull thistle	*Cirsium vulgare* (Savi) Ten.
Leatherleaf clematis	*Clematis ternifolia* DC.
Poison hemlock	*Conium maculatum* L.
Crown vetch	*Coronilla varia* L.
Wild carrot, Queen Anne's-lace	*Daucus carota* L.
Fuller's teasel	*Dipsacus fullonum* L.
Cutleaf teasel	*Dipsacus laciniatus* L.
Burning bush	*Euonymus alata* (Thunb.) Sieb.
Tall fescue	*Festuca arundinacea* Schreb.
Meadow fescue	*Festuca pratensis* Huds.
Dame's rocket	*Hesperis matronalis* L.
Hydrilla, water thyme	*Hydrilla verticillata* (L.f.) Royle
Bicolor lespedeza, shrubby bushclover	*Lespedeza bicolor* Turcz.
Japanese privet	*Ligustrum japonicum* Thunb.
Moneywort, creeping Jenny	*Lysimachia nummularia L.*
Oregon grape	*Mahonia bealei* (Fortune) Carriere
White sweet clover	*Melilotus alba* Medik.
Yellow sweet clover	*Melilotus officinalis* (L.) Lam.
Zebra grass, Chinese silver grass	*Miscanthus sinensis* Andersson
Asian spiderwort	*Murdannia keisak* (Hassk.) Hand.-Mazz.
Parrot's feather, water milfoil	*Myriophyllum aquaticum* (Vell.) Verdc.

Common Name	Scientific Name
Nandina, sacred-bamboo	*Nandina domestica* Thunb.
Hayek Watercress	*Rorippa nasturtium-aquaticum* (L.)
Bunchy knotweed, oriental lady's-thumb	*Polygonum caespitosum* Blume
White poplar	*Populus alba* L.
Curly pondweed	*Potamogeton crispus* L.
Nodding foxtail-grass, Japanese bristle-grass	*Setaria faberi* R.A.W. Herrm.
Foxtail-millet	*Setaria italica (L.) P. Beauv.*
Yellow foxtail, smooth millet	*Setaria pumila (Poir.) Roem. & Schult.*
Green millet	*Setaria viridis (L.) P. Beauv.*
Spreading hedge-parsley	*Torilis arvensis (Huds.) Link*
Coltsfoot	*Tussilago farfara L.*
Common mullein	*Verbascum thapsus L.*
Garden vetch	*Vicia sativa L.*
Common periwinkle	*Vinca minor L.*
Chinese wisteria	*Wisteria sinensis (Sims) DC.*
Wisteria	*Wisteria floribunda (Willd.) DC.*
Common cocklebur, rough cocklebur	*Xanthium strumarium L.*

Rank 3 — Lesser Threat: Exotic plant species that spread in or near disturbed areas and are not presently considered a threat to native plant communities.

Common name	Scientific name
Field garlic	*Allium vineale* L.
Giant reed, elephant grass	*Arundo donax* L.
Bromegrass, rescue grass	*Bromus catharticus* Vahl
Smooth bromegrass	*Bromus inermis* Leyss.
Paper mulberry	*Broussonetia papyrifera* (L.) L'Her. ex Vent.
Corn gromwell	*Lithospermum arvense* (L.) I. M. Johnston
Balloonvine, love-in-a-puff	*Cardiospermum halicacabum* L.
Bachelor's button, cornflower	*Centaurea cyanus* L.
Ox-eye daisy	*Chrysanthemum leucanthemum* L.
Chicory	*Cichorium intybus* L.
Brazilian elodea, Brazilian water-weed	*Egeria densa* Planch.
Russian olive	*Elaeagnus angustifolia* L.
California poppy	*Eschscholzia californica* Cham.
Hairy crabweed	*Fatoua villosa* (Thunb.) Nakai
Gill-over-the-ground, ground ivy	*Glechoma hederacea* L.
Pale-yellow iris	*Iris pseudacorus* L.
Korean clover	*Kummerowia stipulacea* (Maxim.) Makino
Japanese clover	*Kummerowia striata* (Thunb.) Schindl.
Chinaberry	*Melia azedarach* L.
Star of Bethlehem	*Ornithogalum umbellatum* L.
Wild parsnip	*Pastinaca sativa* L.
Lady's thumb	*Polygonum persicaria* L.
Wineberry	*Rubus phoenicolasius* Maxim.
Sicklepod senna	*Senna obtusifolia* (L.) H. S. Irwin & Barneby
Yellow goat's-beard	*Tragopogon dubius* Scop.
Puncturevine	*Tribulus terrestris* L.
Stinging nettle	*Urtica dioica* L.
Spiny cocklebur	*Xanthium spinosum* L.

Watch List A: Exotic plants that naturalize and may become a problem in the future; includes species that are or could become widespread in Tennessee. At this time, more information is needed, and there is no consensus about their status.

Common name	**Scientific name**
Weeping love grass	*Agrostis stolonifera* L.
Sticky alder	*Alnus glutinosa* (L.) Gaertn.
Soft brome	*Bromus hordeaceus* L.
Poverty brome	*Bromus sterilis* L.
Butterfly bush	*Buddleia davidii* Franch.
Hound's-ear, hare's-ear	*Bupleurum rotundifolium* L.
Garden cosmos	*Cosmos bipinnatus* Cav.
Sulpher cosmos	*Cosmos sulphureus* Cav.
Viper's bugloss	*Echium vulgare* L.
Rose of Sharon	*Hibiscus syriacus* L.
Goatweed, St. John's-wort	*Hypericum perforatum* L.
Spearmint	*Mentha spicata* L.
Peppermint	*Mentha x piperita* L.
Grape hyacinth	*Muscari atlanticum* Boiss. & Reut.
Common grape hyacinth	*Muscari botryoides* (L.) Mill.
Water nymph	*Najas minor* All.
Canary grass	*Phalaris canariensis* L.
Bradford pear	*Pyrus calleryana* Decne.
Alder buckthorn	*Rhamnus frangula* L.
Jetbead	*Rhodotypos scandens* (Thunb.) Makino
Ragwort	*Senecio vulgaris* L.
Bur-foxtail	*Setaria verticillata* (L.) P. Beauv.
Bittersweet	*Solanum dulcamara* L.
Hedge nettle	*Stachys floridana* Shuttlew. ex Benth.

Watch List B: Exotic plant species that are severe problems in surrounding states but have not been reported in Tennessee.

Common name	**Scientific name**
Amur peppervine	*Ampelopsis brevipedunculata* (Maxim.) Trautv.
Mile-a-minute, Asiatic tear-thumb	*Polygonum perfoliatum* L.
European buckthorn	*Rhamnus cathartica* L.
Itchgrass	*Rottboellia cochinchinensis* (Lour.) Clayton
Aquarium water-moss	*Salvinia molesta* Mitchell
Chinese tallowtree	*Sapium sebiferum* (L.) Roxb.