Attachment A

Transmission Line Corridor Environmental Review Process and Analysis

SQN LICENSE RENEWAL ER TRANSMISSION LINE CORRIDOR ENVIRONMENTAL REVIEW PROCESS AND ANALYSIS

This attachment briefly summarizes the environmental compliance review process TVA uses for maintenance and modifications of its transmission lines, and presents the results of this process by subject matter for the area surrounding Sequoyah Nuclear Plant (SQN). Also included at the end of this attachment are summary discussions of other miscellaneous transmission line environmental issues (ozone production, and bird collisions and electrocutions).

Because the detailed environmental records for the entire 396.5 miles of SQN transmission lines would be prohibitively voluminous, TVA has elected to provide environmental information for the transmission line areas within a 6-mile radius of SQN (based on a center point that is the midpoint between the two SQN reactors) in this attachment. Each environmental subject associated with transmission line maintenance and modification is discussed in individual sections, which include descriptions of methodology and the results of the 6-mile radius illustrative survey.

Overview of Environmental Compliance Process for Transmission Line Maintenance and Modifications

The TVA Energy Delivery – Transmission Operations and Maintenance (ED-TOM) organization routinely conducts maintenance activities on transmission lines in the TVA system (TVA power service area). These activities include, but are not restricted to, right-of-way (ROW) re-clearing (removal of vegetation), pole replacements, installation of lightning arrestors and counterpoise, and upgrading of existing equipment. Regular maintenance activities are conducted on a 3 – 5 year cycle.

Prior to these any of these activities taking place, the transmission line area (including the ROW) is reviewed by technical specialists in the TVA Biological and Cultural Compliance groups, to identify any resource issues that may occur along that transmission line. These reviews are conducted on a recurring basis that coincides with the maintenance cycle to ensure the most current information is provided to the organizations conducting maintenance on these transmission lines. Experts in the Biological Compliance group evaluate issues involving sensitive natural resources, such as wetlands and protected species. Experts in the Cultural Compliance group program evaluate issues involving archaeological and historic sites and structures.

The transmission lines originating at SQN are currently reviewed under this procedure. The area (as defined by the project manager) potentially impacted by maintenance activities on transmission lines originating at SQN covers parts of Hamilton County, Tennessee. The TVA Biological Compliance group maintains a database of occurrence records for federally and state-listed plants and animals. Occurrence records also include caves, wading bird colonies, champion trees, eagle nests, and natural areas for the entire TVA power service area. Hamilton County wetland information is maintained by TVA Biological Compliance as well, and includes National Wetland Inventory (NWI) maps for the entire TVA power service area. U.S. Geological Survey (USGS) soil survey maps are also used to identify potential wetland areas.

Federally listed threatened and endangered species are overseen by the U.S. Fish and Wildlife Service (USFWS). Updates to the list of federally protected species are provided to TVA's Biological Compliance group via biannual data exchanges with five USFWS field offices within TVA's power service area and through weekly notices in the *Federal Register*. In addition, the

TVA Biological Compliance group conducts biannual data exchanges with the state heritage programs in each of the seven states that lie within TVA's power service area to update the occurrence records for state-listed plant and animal species and natural areas. Through this process, TVA Biological Compliance is able to maintain an updated list of sensitive resources that occur within TVA's power service area.

TVA Biological Compliance also updates, adds, deletes, and edits occurrence records on a daily basis to insure the database is as up-to-date as possible. Biannual data exchanges with the seven state heritage programs and the USFWS are mutually beneficial, because they also help keep the state heritage programs' and USFWS offices' data as up-to-date as possible.

The TVA Cultural Compliance group maintains records of known archaeological sites and historic structures, and routinely gathers information from the seven state historic preservation offices (SHPOs) within TVA's power service area.

Hamilton County, Tennessee, includes 332 individual records for sensitive resources: 241 plant records; 49 animal records; 16 invertebrate records (e.g., aquatic insects and freshwater mussels); and 17 cave records. All records that are present, or are potentially present, in transmission line ROWs are taken into consideration when conducting these transmission line reviews. However, if the information is restricted (e.g., archaeological sites, which are subject to theft), in compliance with applicable laws, it may be omitted from documents, such as this ER, which are intended to be made publicly available.

More detailed explanations of Sensitive Area Review (SAR) class definitions and the associated mapping polygon colors, for re-clearing and pole replacement activities are provided in Tables 1 and 2, respectively.

Table 1. Class Definitions and Associated Polygon Colors of Sensitive Areas for ROW Re-Clearing SARs

Terrestrial Plants (A), Terrestrial Animals (D), and Aquatic Animals (E)			
Class	**Restriction If Sensitive Area in ROW**	**Restriction for Sensitive Areas Potentially Affected When Accessing ROW**	**Polygon Color**
1	No broadcast spraying. Use one of the three following alternatives: (1) hand or mechanical clearing, (2) request field surveys by TVA heritage staff to determine if suitable habitat for these species exists in the subject area, (3) selective spraying of herbicides to shrubs or tree saplings less than 12 feet in height.	Not applicable.	Yellow
2	Hand-clearing only. Vehicles and equipment restricted from area unless confined to existing access road. Special circumstance. **Must contact heritage botanist** prior to entering or conducting maintenance in subject area.	Vehicles and equipment restricted from area unless confined to existing access road.	Red

0	Special circumstance. Terrestrial Animals - Indiana Bat summer roosting habitat: Trees can only be cut between November 15 and March 31. If cutting is necessary outside of this time restriction, a bat mist-net survey is necessary.		Green
Wetlands* (C)			
-	Wetlands obtained from National Wetland Inventory data. Refer to "Wetlands ROW and Pole Replacement Guidelines" for restrictions.		Blue Outline
1	Potential wetlands identified by Natural Heritage wetland biologists based on interpretation of topographic features, water bodies, soil surveys and proximity to NWI features. Refer to "Wetlands ROW and Pole Replacement Guidelines" for restrictions.		Pink Outline
Natural Areas (B)			
Class	**Call****	**Definition**	**Color**
1	No	Same as Class 1 definition above.	Yellow
2	No	Same as Class 2 definition above.	Red
1	Yes	Same as Class 1 definition above, and **must contact area manager** prior to entering or conducting maintenance in subject area.	Yellow hatching
2	Yes	Same as Class 2 definition above, and **must contact area manager** prior to entering or conducting maintenance in subject area.	Red hatching
3	Yes	**Must contact area manager** prior to entering or conducting maintenance in subject area.	Neon Green
0		Special circumstance.	Green
Cultural Resources(F)			
Class	**Restriction If Sensitive Area in ROW**	**Restriction for Sensitive Areas Potentially Affected When Accessing ROW**	**Color**
1	Mechanical clearing must be conducted when the ground is dry and firm. If bulldozer is used, blade must be kept above ground surface to avoid ground disturbance. Material from clearing (timber, brush, and large debris) must be removed from sensitive area.	Vehicles and equipment must be confined to existing access road.	Yellow
2	No mechanical clearing. Hand-clearing only (chainsaws may be used but not heavy equipment). Debris from clearing must be hand-carried out of sensitive area.	All vehicles must be low-pressured tire equipment and must be confined to existing access road.	Red

* Refer to Wetlands Statement included in this package.
** The "Call" column on the accompanying datasheets is used by natural area specialists only. Depending on special circumstances (e.g., certain seasons for specific plant or animal species), the natural area specialist may elect to add a "Yes" (call) or "No" (don't call) to a blank in the column.

Table 2. Class Definitions and Associated Polygon Colors of Sensitive Areas for Pole Replacement SARs

All Resource Areas (Plants, Natural Areas, Wetlands, Terrestrial Animals, and Aquatic Animals)		
Class	**Restriction**	**Color**
1	**Botany**: Sensitive botanical resources are known from the area. Details of proposed activities should be submitted to TVA heritage staff to determine if the proposed activities require restrictions. **Natural Areas**: Refer to table accompanying project for restrictions. **Wetlands**: Potential wetlands identified by natural heritage wetland biologists based on interpretation of topographic features, water bodies, soil surveys, and proximity to NWI features. Refer to "Wetlands ROW and Pole Replacement Guidelines" for restrictions. **Terrestrial Animals**: Refer to table accompanying project for restrictions. **Aquatic Animals**: Refer to table accompanying project for restrictions.	Pink
Wetlands		
-	Wetlands obtained from National Wetland Inventory data. Refer to "Wetlands ROW and Pole Replacement Guidelines" for restrictions.	Blue Outline
Cultural Resources		**Color**
Class	**Restriction**	
1	Presence of significant below-ground cultural resources is highly likely. Work must be scheduled when ground is dry and firm. Only vehicles with low-pressured tires may be used within sensitive area. If structure is a pole, new poles must be placed in existing holes; if structure is a tower, existing footings must be used for new tower. If guy wires are used, existing guy wire anchors must be used for new structure. If any of these conditions cannot be met, then details of proposed activities (nature of work, date work is to take place) must be submitted to TVA Cultural Compliance staff so that a field review can be scheduled.	Yellow
2	Presence of significant cultural resources is known. Work schedule must be submitted to TVA Cultural Compliance staff so that a field review can be scheduled.	Red

(Managed Areas) – Managed Areas, Ecologically Significant Sites, and National Rivers Inventory for Maintenance Activities in TVA Transmission Line ROWs

Managed Areas (MAs) are lands held in public ownership and managed to protect and maintain certain ecological features. Ecologically significant sites (ESSs) are tracts of privately owned land that are identified by resource biologists as containing significant environmental resources. National River Inventory (NRI) streams are free-flowing river segments that are recognized by the National Park Service as possessing remarkable natural or cultural values. TVA's Natural Heritage Program maintains a database of all such lands and streams occurring within the seven-state TVA power service area.

SARs for MAs, ESSs, and NRI streams are completed by utilizing computerized mapping graphics software known as ArcMap. If an MA, ESS, and/or NRI stream is located within a 0.5-mile buffer of the subject transmission line, a polygon is drawn that represents the area's boundaries within the buffer. A description of the area, which includes contact information, restrictions, and the subject transmission line name is listed in the corresponding attribute table.

ROW maintenance and/or clearing and pole replacement activities are two activities that are reviewed for the presence of sensitive resources using the SAR process. If all or any portion of an MA, ESS, and/or NRI stream lies within the buffer of the subject transmission line, a polygon is drawn depicting the boundary of such areas. Restrictions on proposed activities (Class 0, 1, 2, or 3 below) are determined by the type and location of the MA, ESS, and/or NRI stream, as well as consultation with the area manager or resource specialist. The class and contact restrictions, definitions, and polygon color for the above activities are listed in Tables 1 and 2.

After determining the particular class restriction associated with the area, special instructions or comments are added to indicate the importance of the restriction and why it was assigned. For example, when a portion of a national forest is within a 0.5 mile buffer or crossed by the subject transmission line, a Class 3 restriction is assigned and a comment is added indicating (1) the area manager must be contacted, and (2) herbicide use is restricted.

Transmission line projects such as lightning mitigation, counterpoise activities, conveyances, line relocations for state highway department work, and providing delivery points and switches for substations are reviewed for potential impacts to MAs, ESSs, and NRI streams. A 3-mile radius of the project site(s) is reviewed for MAs, ESSs, and NRI streams that might be affected by the proposed activity.

Thirteen transmission lines are considered in scope for the SQN license renewal project, and six of them cross two natural areas within a 6-mile radius (Figure 1). Friendship Forest, located in Hamilton County, is owned by TVA and consists of 680 acres formerly used by University of Tennessee as a forest research center. This natural area has the oldest documented research for genetic tree breeding and pine management in Tennessee. Occurrences of the federally listed large-flowered skullcap (*Scutellaria montana*) have also been documented here. This forest is 1.3 miles northeast of SQN and is crossed by the Watts Bar No. 1 and No. 2 transmission lines. Harrison Bay State Recreation Park, located in Hamilton County, consists of approximately 1,200 acres and was developed as a TVA recreation demonstration area. It is managed by the Tennessee Department of Environment and Conservation. This park is located 1.4 miles south of SQN and has boat docking facilities, camping, picnicking, fishing, hiking, and other activities available for the public. The Concord, Wolftever to Chickamauga, North Ooltewah to South Cleveland to East Cleveland, and Volkswagen to Chickamauga transmission lines extend to the south-southeast and cross Harrison Bay State Park.

In addition, five other natural areas lie within a 6-mile radius of SQN, but are not crossed by existing transmission lines (Figure 1). These natural areas are as follows:

- Chigger Point TVA Habitat Protection Area (HPA) – comprises approximately 15 acres and is located approximately 1.0 miles east of SQN.
- Soddy Creek TVA HPA – comprises approximately 36 acres and is located approximately 2.1 miles northwest of SQN.

- Chickamauga State Wildlife Management Area (WMA) – comprises 4,000 acres in total. The portion that lies within a 6-mile radius of SQN is located approximately 2.3 miles northwest of SQN.
- Ware Branch Bend TVA HPA – comprises approximately 42 acres and is located approximately 2.6 miles northwest of SQN.
- Murphy Hill TVA HPA – comprises approximately 194 acres and is located approximately 4.7 miles northeast of SQN.

(Botany) – Federally and State-Listed Plant Restrictions for Maintenance Activities in TVA Transmission Line ROWs

As part of the SAR process, TVA botanists perform a biological review of all transmission line segments before scheduled maintenance activities occur. The first step in the review process is to identify any federally or state-listed plant species that are likely to be present in the ROWs where work would occur. The TVA Regional Natural Heritage Database, which contains biological and spatial information on occurrences of federally and state-listed plant species in the power service area, is the primary decision-making tool used to determine whether listed species may be present. When combined with other biological and geographic data, including topographic maps, aerial photos, soils maps, ecoregion maps, and video fly-over footage from ROWs where work would occur, the natural heritage data are powerful predictive tools for the botanist conducting the review. Using this information, a species list is developed that includes all federally and state-listed plant species known from within 5 miles of the ROW where work would occur, as well as any additional federally listed species known from the counties where the ROW is located. If the botanist decides that any of these listed plants may be present in a given area, that location is delineated on an electronic map. Depending on the exact nature of the maintenance activity and the specific plant species that may be present, the botanist assigns one of two categories to each delineated area, as discussed below.

When reviewing transmission line segments for ROW re-clearing, the botanist typically assigns a Class 1 restriction when state-listed species may be present (Table 3). This restriction prevents aerial application of herbicide in potentially sensitive areas. If federally and state-listed species are known to occur in the ROW, or if the botanist believes a federally listed plant may be present, the area is assigned a Class 2 restriction. This ensures that the TVA environmental technician responsible for on-the-ground maintenance contacts the botanist before work occurs. After discussing the specifics of the maintenance activities with the environmental technician, the botanist may visit the site to confirm the presence of the listed plant species. Knowing the location of listed species on a site and understanding the operational requirements of specific maintenance activities helps the environmental technician and botanist avoid impacts to listed species when they are present in areas where work would occur.

When reviewing transmission line segments for pole replacement, the botanist typically assigns a Class 1 restriction when state-listed species may be present (Table 3). Similar to the Class 2 restriction for ROW re-clearing, this restriction ensures that the botanist has the opportunity to perform a field review to confirm the presence of the species and develop appropriate avoidance measures in cooperation with the environmental technician assigned to the project.

If federally listed species are known from an area where scheduled maintenance would occur and the activity has the potential to affect the species, TVA would enter into consultation with the USFWS to comply with Section 7 of the Endangered Species Act (ESA).

An April 2012 query of the TVA Regional Natural Heritage Database indicated one federally listed and three state-listed plant species have been reported within a 6-mile radius of SQN, as presented in Table 3. The April 2012 query also indicated none of these four species have been reported within the transmission ROWs that lie within a 6-mile radius of SQN. (To protect the resources, the locations of listed plant species are not illustrated.)

A biological review of the transmission line ROWs located with a 6-mile radius of SQN identified one area capable of supporting the federally listed large-flowered skullcap. By implementing the TVA SAR process for this area, restrictions would minimize or eliminate adverse impacts to listed plant species and ensure compliance with the ESA.

Table 3. Federally and State-Listed Plant Species Documented Within a 6-Mile Radius of SQN

Common Name	Scientific Name	State Status[1] (Rank[2])	Federal Status[(3)]
Gibbous Panic-Grass	*Sacciolepis striata*	SPCO (S1)	-
Large-Flowered Skullcap	*Scutellaria montana*	THR(S2)	LT
Prairie-Dock	*Silphium pinnatifidum*	THR (S2)	-
Tall Larkspur	*Delphinium exaltatum*	END (S2)	-

Source: TVA Regional Natural Heritage Database – April 2012 query.

[1]State Status Abbreviations: END = Endangered; THR = Threatened; SPCO = Special Concern.

[2]State Rank: 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 is particularly vulnerable to extirpation; S2 = Very rare and imperiled within the state, 6 to 20 occurrences; S3 = Rare or uncommon with 21 to 100 occurrences; S4 = Apparently secure; S#S# = Denotes a range of ranks because the exact rarity of the element is uncertain (e.g., S1S2).

[3]Federal Status Abbreviation: LT = Listed Threatened.

(Terrestrial Animals) – Federally and State-Protected Terrestrial Animal Restrictions for SARs Conducted in Support of Maintenance Activities in TVA Transmission Line ROWs

The TVA Regional Natural Heritage Program keeps track of federally and state-protected species reported from the seven-state power service area. The terrestrial animal portion of the database includes all listed birds (breeding and large wintering aggregations), mammals, reptiles, and amphibians. In addition to specific species of animals, the terrestrial portion of the database also includes records of wading bird colonies and caves, as they often are used by multiple species.

Each SAR project is reviewed for the presence of protected terrestrial animals. A 3-mile radius of the project site(s) is typically reviewed for each proposed activity along transmission lines. Once an occurrence is located, a polygon designating the known or likely extent of that occurrence is drawn on an ArcMap electronic topographical map and appropriate class restrictions are applied. Special comments or instructions accompany each entry as

appropriate. For instance, if a cave is located along a power line corridor scheduled for vegetative maintenance, a 200-foot buffer is indicated around the opening of the cave and a "hand clearing only" restriction is applied within the buffer. If the cave is used by a summer or hibernating colony of bats, appropriate time restrictions, as designated in specific recovery plans for each species, are also applied.

Additionally, a search for records of Indiana bat within a 10-mile radius of project site is conducted. Clearing of forested areas that occur within both the project area and within 10 miles of recorded occurrences of Indiana bats is seasonally restricted. This is to prevent impacts to potentially summer roosting Indiana bats. Further, a search for records of species with federal status is conducted for each county associated with the project site.

A December 2011 query of the TVA Regional Natural Heritage Database for terrestrial resources within a 6-mile radius of SQN found records of one federally protected terrestrial species and two Tennessee state-listed terrestrial species as presented in Table 4. The December 2011 query also indicated none of these three species has been reported within the transmission ROWs that lie within a 6-mile radius of SQN. (To protect the resources, the locations of listed terrestrial species are not illustrated.)

In addition, two caves and five wading bird colonies also have been documented within a 6-mile radius of SQN. Further, ospreys have been observed nesting on at least one transmission line structure located within a 6-mile radius of SQN.

Table 4. Federally and State-Listed Terrestrial Animal Species Documented Within a 6-Mile Radius of SQN

Common Name	Scientific Name	State Status[1] (Rank[2])	Federal Status[3]
Bald Eagle	*Haliaeetus leucocephalus*	NMGT (S3)	DM
Bachman's Sparrow	*Aimophila aestivalis*	END (S2)	-
Great Egret	*Ardea alba*	NMGT (S2)	-

Source: TVA Natural Heritage Database – December 2011 query.

[1]State Status Abbreviations: END = Endangered; NMGT = In Need of Management.

[2]State Rank: 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 is particularly vulnerable to extirpation; S2 = Very rare and imperiled within the state, 6 to 20 occurrences; S3 = Rare or uncommon with 21 to 100 occurrences; S4 = Apparently secure; S#S# = Denotes a range of ranks because the exact rarity of the element is uncertain (e.g., S1S2)..

[3]Federal Status Abbreviation: DM = Delisted, recovered, and being monitored.

Bald eagles typically nest in the crown of large trees in close proximity to water over which they forage. Two records for nesting bald eagles occur within a 6-mile radius of the project area. Neither of these documented nests occurs on or in close proximity to associated transmission lines. One nest is located approximately 1 mile upstream of SQN and the other is located greater than 0.5 miles from SQN. Because the nests are greater than 660 feet from associated transmission lines, restriction of actions around these nests is not required.

Bachman's sparrow has been documented on an island within the Chickamauga Reservoir downstream of the plant. Suitable habitat for this species typically includes a well-developed grass and herb layer with limited shrub and hardwood mid-story components. This species is associated with various grassy habitats. These habitats occur in abundance throughout the

project area; therefore, this species would not be affected by transmission line maintenance or modification activities.

Nesting **great egrets** have been documented on an island in the Chickamauga Reservoir and downstream of the plant, which is more than 660 feet from the closest transmission line. Therefore, this presence of great egret would not be affected by transmission line maintenance or modification activities.

Three records of nesting osprey occur within a 6-mile radius of SQN. The closest documented nest is located approximately 1 mile south of SQN on a transmission line structure adjacent to Chickamauga Reservoir near Tennessee River mile (TRM) 483.4. This nest was documented in 2009. The next closest known nest was identified in February 2012 and is also located on a transmission line structure situated in the Chickamauga Reservoir. This nest is approximately 1.3 miles northwest of SQN, near TRM 485.5. The third nest was documented in 2005 and is located approximately 5 miles southwest of SQN on a navigation light in the Chickamauga Reservoir near TRM 478.4. A 660-foot seasonally restrictive buffer typically is placed around active osprey nests between March 1 and July 15. Nesting pairs of osprey typically exhibit site fidelity to a nest site across multiple years, but occasionally a nest site will not be used in a given year. Thus, if actions are proposed within 660 feet of any of these nests between March 1 and July 15, it is recommended that the project proponents contact TVA's Biological and Permitting Compliance Group to discuss options. Options likely would include determination of nest activity, removal of an inactive nest outside of the nesting and breeding season and, if necessary, coordination with USDA Wildlife Services if actions need to occur near an active nest.

Two documented **caves** occur within a 6-mile radius of SQN and are further than 0.43 miles from the closest transmission line and, therefore, would not be affected by transmission line maintenance or modification activities.

Of the five **wading bird colonies** documented within a 6-mile radius of SQN, the closest colony is approximately 0.8 miles northwest of a structure on the Watts Bar No. 2 transmission line. The colony is at a sufficient distance such that it would not be affected by transmission line maintenance or modification activities.

(Aquatic Animals) – Federally and State-Protected Aquatic Animal Restrictions for Maintenance Activities in TVA Transmission Line ROWs

SARs are intended to provide a general, high-level review of sensitive aquatic species that could potentially occur in a project area. The SAR process consists of identifying aquatic species that potentially occur in the area, identifying potentially suitable habitats for sensitive aquatic species, and creating restriction polygons in a GIS.

To identify aquatic species potentially occurring in the project area, the biologist queries the TVA Regional Natural Heritage Database, which tracks federally and state-protected aquatic species in the seven-state TVA power service area. Records of listed aquatic species are tracked in a spatial database along with pertinent biological information. During SARs, the database is used to determine the potential presence of aquatic species located in watercourses that intersect the transmission line segment of interest by querying all aquatic species within a 10-mile radius of the project area and occur within the potentially affected watersheds.

Because the SAR process is restricted to desktop review, it is not possible to identify potentially suitable habitat during field surveys. Instead, USGS 7.5-minute topographic quadrangles, aerial photographs, and the NHD are used to identify habitat based on drainage area, location of watercourses within the watershed, proximity to listed species, and expert opinion.

Once potentially suitable habitat has been identified in the project area, polygons are created around appropriate watercourses by buffering "flowlines" and "waterbodies" provided in the NHD medium-resolution dataset. This dataset is not all inclusive, but does provide a digital version of many "blue-line" streams found on a USGS topographic quadrangle. Depending on the proximity of the watercourse to a listed aquatic species and the federal or state status of the species, the biologist assigns the polygon a restriction class. Class 1 restrictions are typically assigned to polygons associated with state-listed species and prohibit the use of aerial spraying when maintaining ROWs. If a federally listed species has been reported to occur or is likely to occur in the ROW, the polygon is assigned a Class 2 restriction. This restriction requires all clearing to be performed by hand, and limits vehicle and equipment access to and from the area except when confined to an existing access road.

Sensitive Aquatic Species in the Vicinity of SQN

A SAR of transmission lines within a 6-mile radius of SQN and originating from SQN indicated two federally listed and one state-listed aquatic species occurring within the potentially affected watershed as presented in Table 5. None of these three species has been reported within the transmission line ROWs that lie within a 6-mile radius of SQN. (To protect the resources, the locations of listed aquatic species are not illustrated.)

The mainstem of the Tennessee River upstream of Chickamauga Dam (Chickamauga Reservoir) was restricted (Class 1) due to the presence of the state-listed highfin carpsucker and a historic pink mucket mussel record in the channel.

Table 5. Federally and State-Listed Aquatic Animals Known to Occur Within a 6-Mile Radius of SQN

Common Name	Scientific name	State Status[1] (Rank)[2]	Federal Status[3]
Fish			
Highfin Carpsucker	*Carpiodes velifer*	NMGT (S2S3)	-
Mollusks			
Dromedary Pearlymussel	*Dromus dromas*	END (S1)	LE
Pink Mucket	*Lampsilis abrupta*	END (S2)	LE

Source: TVA Natural Heritage Database – December 2011 query.
[1]State Status Abbreviations: END = Endangered; THR = Threatened; NMGT = In Need of Management.
[2]State Rank: 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 is particularly vulnerable to extirpation; S2 = Very rare and imperiled within the state, 6 to 20 occurrences; S3 = Rare or uncommon with 21 to 100 occurrences; S4 = Apparently secure; S#S# = Denotes a range of ranks, because the exact rarity of the element is uncertain (e.g., S1S2)..
[3]Federal Status Abbreviation: LE = Listed Endangered.

(Wetlands) – Wetlands Review for Maintenance Activities in TVA Transmission Line ROWs

Prior to the performance of any maintenance activities in TVA transmission line ROWs, office-level reviews are conducted by TVA wetland biologists. These reviews include review of the NWI map, Soil Survey Geographic (SSURGO) database 2011 county soil surveys (produced by the Natural Resource Conservation Service), and topographic maps, aerial imagery, and TVA photos of transmission line structures and spans. Potential wetland areas not indicated on the NWI map are identified based on interpretation of topographical features, water bodies, soils information, TVA photos, and proximity to NWI features. NWI wetlands and other previously unmapped potential wetland areas are superimposed as layers on an ArcMap electronic topographical map. These ArcMap images are sent to the client accompanied by the *Wetlands ROW and Pole Replacement Guidelines*, as well as an Excel spreadsheet listing areas that have been included with the NWI data as areas of potential wetlands and what guidelines are to be used.

The NWI wetlands are indicated in dark blue outline on ArcMap drawings. Additional potential wetland areas in the ROWs are identified in dark pink outline. If an access route with an ROW follows an existing road that does not require any repair or upgrading, no further wetland reviews are needed. Repair and upgrading includes, but is not limited to grading, fill addition, new or upgraded stream crossings, and vegetation removal. If a new or upgraded access route is necessary, environmental reviews of those particular access areas are conducted as required by the National Environmental Policy Act (NEPA).

The NWI data were compiled using high-altitude aerial photography, some of which is now more than 15 years old, with limited field verification. However, the limitations of the NWI data are considered in the performance of ROW maintenance and pole replacement to avoid accidental wetland impacts. Because there could be wetlands present for which no map evidence or other data currently exist, maintenance crews remain alert to such things as water on the surface of the ground, soil saturation, the type of vegetation growing in an area, and evidence of present, seasonal, or temporary flooding.

Best management practices (BMPs), as described in Bowen et al. (2012), and ED environmental protection guidelines for transmission line construction and ROW vegetation management are implemented to avoid and minimize potential resource impacts. These techniques would be implemented in all locations where NWI wetlands and potential wetland areas are indicated on the project maps submitted by Biological Compliance staff.

Site-specific recommendations for ROW re-clearing include the following:

- Depending on site conditions, either generic tree-cutting guidelines for protection of important permanent streams, wetlands, springs or sinkholes, or one of six specific wetland clearing methods may be used for tree clearing on TVA transmission line ROWs (Bowen et al. 2012). These methods specify techniques for tree clearing and removal that are selected based on wetland hydrology and condition in order to avoid and minimize wetland impacts.
- According to wetland clearing method CM-6 (Bowen et al. 2012), if the wetland is a scrub-shrub, emergent, or grazed wetland, there should be no equipment entry, and minimal intrusion by all mechanized equipment.
- For aerial or ground herbicide application, use is restricted to those herbicides that are EPA approved for use in aquatic areas.

- If possible, mechanical clearing should be conducted when the ground is dry or minimally saturated. Ruts should be minimized to avoid altered hydrologic patterns, soil compaction, and disruptions in vegetation regeneration.

Specific recommendations for pole replacement activities include the following:

- Entry of vehicles or heavy equipment in wetlands should be avoided when possible.
- If entry is unavoidable, appropriate measures such as mats and low ground-pressure equipment should be used.
- Impacts to vegetation should be avoided or minimized.

In addition, certain activities that may occur during pole replacement in wetlands may be regulated under Sections 404 and 401 of the Clean Water Act. U.S. Army Corps of Engineers (USACE) Nationwide General Permit (NWP) #12 authorizes certain activities related to utility line construction and contains conditions to ensure that impacts to wetlands are minimal. Section 401 gives states the authority to certify whether activities permitted under Section 404 are in accordance with state water quality standards. A qualified TVA or TVA contract wetlands specialist would be required to delineate wetland(s) and provide the wetland determination data forms, which are included in the permit application.

TVA also follows Executive Order 11990, which requires all federal agencies to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands, in carrying out the agency's responsibilities involving new construction in wetlands.

Wetlands in Transmission Line ROWs Within a 6-Mile Radius of SQN

NWI data were reviewed for TVA transmission line ROWs within a 6-mile radius of SQN (Figure 2). This review provided a representation of the class, size, and typical locations of wetlands that are in, or may be crossed by, TVA transmission line ROWs that originate at SQN. The NWI indicated that ROWs cross wetlands in 20 locations. The NWI data include the transmission line crossings of Chickamauga Reservoir, embayments along Chickamauga Reservoir, aquatic beds associated with the shallow areas along Chickamauga Reservoir, isolated ponds, and linear ephemeral, intermittent, and perennial stream/drainage crossings. The NWI classified the wetlands mapped in the ROWs as lacustrine aquatic bed (L2AB3) and open water (L1OW), palustrine open water (POW), palustrine forested (PFO1), palustrine scrub-shrub (PSS1), riverine perennial (R2UB) and intermittent (R4SB). Because of ROW clearing, any areas indicated as forested wetlands would have been converted to scrub-shrub and emergent wetlands. The hydrologic regimes include temporarily flooded (A), seasonally flooded (C), semi-permanently flooded (F), and permanently flooded (H). In addition to NWI maps, further review of the transmission lines using aerial video, photographs, imagery, topographic maps, and soils indicated 10 potential wetland areas. These include areas with naturalized vegetation along wide drains and isolated ponds.

Potential impacts to wetlands resulting from ROW maintenance activities include vegetation damage, soil compaction and erosion, sedimentation, and hydrologic alterations. These impacts are avoided or minimized during TVA maintenance operations by following the recommendations of the guidelines presented above and implementing all relevant BMPs. In addition, the appropriate permits are obtained if required for the specific activity.

(Cultural) – Cultural Resource Reviews Related to Operations and Maintenance Activities in TVA Transmission Line ROWs

Regulatory Background

The National Historic Preservation Act of 1966 [36 CFR Part 800] requires TVA to carry out a process for assessing project effects to historic properties from each TVA action involving construction and/or ground-disturbing activity. A "historic property" is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places." Ground-disturbing activities undertaken as part of transmission line maintenance and operations are reviewed by TVA Cultural Compliance staff on a case-by-case basis using the SAR procedure. The purpose of a Cultural Compliance SAR is to evaluate whether the undertaking has potential for adverse effects to historic properties, including historic structures and buried prehistoric (Native American) sites. If the undertaking does have potential for adverse effects to a historic property, then procedures for avoiding, minimizing, or mitigating the effects are put into place utilizing a set of procedures, beginning with the SAR.

Cultural Compliance staff begin the SAR procedure by examining topographic maps of the transmission lines under review in order to identify (1) historic properties in the vicinity of the transmission line corridor; and (2) conditions that suggest high potential for cultural resources that have potential for listing on the National Register of Historic Places (NRHP). Using ArcMap, the project maps are examined while maps showing cultural resources are superimposed. For out-of-state transmission line corridors, shapefiles containing cultural resources have been supplied by the Kentucky State Historic Preservation Office (SHPO). The Alabama SHPO provides TVA with online access to its database of cultural resources. Cultural resource data in other states must be obtained by special request on a case-by-case basis. These data are supplemented with TVA's own cultural resource data. Because not all areas crossed by TVA transmission lines have been surveyed by archaeologists, the staff also uses ArcMap to identify areas with high potential for historic properties. This potential is based on an analysis of slope, landforms, proximity to permanent water sources, the extent of development, knowledge of the geologic history of the area, and other factors. Existing conditions are read from the USGS topographic quadrangles, recent aerial photography supplied by Microsoft Visual Earth, and the photos and videos available from the ED transmission line index. Historic conditions are evaluated in part by using the TVA land acquisition maps, which are superimposed on project maps to identify the past locations of historic structures in the project area. All of these data sources are taken into consideration while evaluating the presence of historic properties, or potential for undocumented historic properties, along each transmission line ROW under review.

When a historic property or area with high potential for undocumented historic properties is identified within the ROW of the transmission line under review, it is marked with a polygon in ArcMap. The polygons are saved in a ArcMap shapefile that contains all the polygons for every SAR completed by Cultural Compliance staff since 2004. Data associated with each polygon include a brief description of the resource or potential for resources, a code for restrictions on maintenance and operation activities, and a code for restrictions on access to the location of the area represented by the polygon. Restrictions are based on BMPs and are defined in Tables 1 and 2.

These data are made available to ED so that the restrictions can be followed during routine operation and maintenance activities. When ED is unable to meet the conditions, they are instructed to contact Cultural Compliance staff, which assesses the need for a field review or other actions.

Field reviews are conducted by Cultural Compliance staff or by consulting archaeologists when the desktop review is insufficient to fully rule out the potential for adverse effects to historic properties. During the field review, archaeologists look for signs of intact, buried prehistoric deposits using surface survey and subsurface probes (when appropriate). If no artifacts or features are identified and if the project site appears to have low potential for historic properties, the area is cleared. If the field review results in the identification of intact historic properties or a high potential for historic properties, an attempt is made to discern whether the resource may be potentially eligible for the NRHP. However, a formal assessment of eligibility would not be undertaken during a field review. Rather, if the site is potentially eligible for the NRHP, then a Phase II investigation is called for. The Phase II investigation is undertaken by a managed task contractor and includes systematic testing, the purpose of which is to evaluate whether the identified resource is a historic property (i.e., is eligible for listing on the NRHP) and to assess possible effects to the site from transmission line maintenance/operation. TVA is obligated to consult with the SHPO during the Phase II investigation. The SHPO has 30 days to comment on TVA's findings and recommendations.

Avoidance is generally feasible for transmission line maintenance projects when cultural resources are present. Avoidance means that no work could be performed within the restricted area, or that additional restrictions are placed on the work so that effects to the historic property are avoided. When avoidance is not feasible, mitigation will be required. Mitigation may consist of data recovery, which requires a Phase III investigation. The purpose of a Phase III investigation is to recover important scientific information from the historic property before it is unavoidably adversely affected by TVA's undertaking. Prior to initiating fieldwork on a Phase III investigation, TVA will coordinate the signing of a memorandum of agreement (MOA) with consulting parties (usually confined to the SHPO, but can also include other parties such as Native American tribes). The MOA outlines the manner in which mitigation will take place, and is prepared and signed in consultation. Several weeks or months may be required for the execution of an MOA, depending on whether there is agreement on the document and on the scope of the data recovery project.

Cultural Resources Within a 6-Mile Radius of SQN

To estimate the number of cultural resources that might be affected by transmission lines associated with SQN, the area within a 6-mile radius of the SQN (based on a center point that is the midpoint between the two SQN reactors) was overlaid on a map showing cultural resources in the vicinity. The "select by location" method was then used to select all cultural resources within the latter database that fall within or intersect the 6-mile radius. A total of 110 known cultural resources fall within or intersect the 6-mile radius. Of these 110 sites, 11 are listed as potentially eligible and four as ineligible for the NRHP. The remaining 95 sites have not been assessed for their NRHP eligibility. Five of the 110 known cultural resources lie within or adjacent to transmission line corridors; of these, one is ineligible, and the rest have not been evaluated for NRHP eligibility. (To protect cultural resources, the locations of sites are not illustrated.)

Ozone

Under some conditions ozone may be produced in small amounts from corona discharges (ionization of the air) in the operation of transmission lines and substations, particularly at the higher voltages. Such corona discharges can result from abrasions, foreign particles, or sharp points on electrical conductors and electrical equipment. Complex electrochemical reactions take place within the discharge processes of positive and negative corona, resulting in the generation of ozone (O_3) and various oxides of nitrogen, collectively known as NO_x.

Dissociation of oxygen molecules in air due to the ionization processes creates atomic oxygen, which in subsequent reactions gives rise to ozone and nitric oxides.

Extensive field tests concerning ozone were conducted over a 19-month period during 1971 and 1972 by the Illinois Institute of Technology Research Institute for the Commonwealth Edison Company. These tests were made to determine if measurable quantities of ozone are generated by high-voltage transmission lines. Continuous ozone measurements were made adjacent to a 345-kV switchyard with a high concentration of 345-kV and 128-kV transmission lines and adjacent to a 765-kV line; these were compared with continuous ambient measurements made at locations in the same areas but remote from the transmission lines. From this investigation, it was concluded that high-voltage transmission lines up to 765-kV do not generate ozone measurable above the ambient at ground level adjacent to the lines under tested weather conditions. (Fern and Brabets 1974)

A detailed discussion of ozone from power lines is contained in the Electric Power Research Institute's AC transmission line reference book (EPRI 2005). The following information was excerpted from that reference:

> "The rapid growth of high-voltage transmission in the early 1970s raised some concerns of the possibility of ozone generation by corona discharges on transmission line conductors and its impact on ambient air quality. Careful studies in the laboratory and measurements near transmission lines have clearly shown, however, that transmission lines do not make any significant contribution to ambient atmospheric ozone levels.
>
> Several factors influence the rate of generation of ozone, the most important being conductor surface gradient, mode of corona discharge and the ambient weather conditions—i.e., temperature, humidity, precipitation, and wind. The presence of water and humidity, although increasing the efficiency of ozone generation, makes ozone decay faster than in dry weather. At normal values of ambient temperature and humidity, ozone reverts back to molecular oxygen in about 20 to 30 minutes.
>
> A number of studies have been carried out to determine the contribution of transmission lines to the ambient ozone levels. One of these investigations was carried out along the American Electric Power (AEP) 765-kV transmission system (Frydman, M., A. Levy, and S.E. Miller. "Oxidant Measurements in the Vicinity of Energized 765-kV Lines." *IEEE Transactions on Power Apparatus and Systems.* Vol. PAS-92. pp. 1141-1148. May/June 1973), in which short-term measurements of ozone were taken at 20 different locations along the line. No ground-level ozone contribution attributable to the transmission line was detected during the tests. Subsequently, a measurement program extending several months before and after the energization of a 765-kV line was carried out at one site near the line (Frydman, M. and C.H. Shih. "Effects of the Environment on Oxidants Production in AC Corona." *IEEE Transactions on Power Apparatus and Systems.* Vol. PAS-93. pp. 436-443. January/February 1974). Detailed analysis of the data confirmed that the line did not contribute to ambient ozone level.
>
> In order to maximize the probability of detecting ozone from a full-scale line, long-term measurements were conducted on the C-Line at the Apple Grove 750-kV Test Project (Roach et al. 1978). The Apple Grove C-Line was a test line operating at 775-kV using a 2.54-cm conductor in a four-conductor bundle. This sub-conductor in a bundle of four was too small to ever be considered for an operating line because it created a very high surface electric field of the center phase bundle of 24.41 kV/cm. Ozone sensors were placed at 0.6

m and 9.1 m above ground at a distance of 30 m from the center phase of the horizontally configured line. The results of the study showed that

1. Ozone could be detected during foul weather at the 9.1 m sensor location;
2. It could not be detected at ground level under any weather conditions;
3. It could not be detected at the 9.1 m sensor location during dry weather conditions; and
4. The prediction model developed from laboratory tests (Roach et al. 1974) agreed quite well with measurements.

The results of this study were used in the extensive hearings conducted in State of New York Public Service Commission Cases 26529 and 26559 – "Common Record Hearing on Health and Safety of Extra-High Voltage Transmission Lines." The conclusion of those hearings was that ozone was not an issue in the design or siting of 765-kV transmission lines.

Measurements carried out in the vicinity of one of Hydro-Quebec's 735-kV lines (Varfalvy et al. 1985) showed that any ozone from the line could not be distinguished from the normal fluctuations of ambient ozone levels."

In view of the design and construction standards employed by TVA in building its transmission facilities, corona discharges are minimal to nonexistent. TVA specifications require that transmission line hardware and electric equipment for operation at 500,000 volts be factory tested to assure corona-free performance up to maximum operating voltage levels. Accordingly, any ozone which could possibly be generated by the 500-kV transmission lines would be environmentally inconsequential and harmless to vegetation, animals, and humans.

Bird Collisions and Electrocutions

Considerable work has been done in the western United States regarding electrocution hazards for large birds, raptors in particular, on distribution voltage lines, but this is not normally a problem on transmission lines due to the relatively large phase-to-ground and phase-to-phase spacing. All TVA transmission lines terminating at SQN are 161 kV or 500 kV with large phase-to-phase and phase-to-ground spacing. Minimum spacing for TVA transmission line towers is as shown in Table 6.

Table 6. TVA Transmission Line Tower Spacing

Electrical Separation	161-kV Towers	500-kV Towers
Conductor Phase Wire Spacing	10 feet 5 inches	25 feet
Conductor-to-Ground Distance	6 feet	12 feet

Due to sensitive protective relaying on TVA power lines, bird electrocutions will normally result in momentary interruptions of line service, all of which are investigated to determine the cause. In the past 5 years, for the entire 16,000 miles of TVA power lines, TVA has averaged approximately 15 momentary service interruptions per year due to electric arcs from bird electrocutions or nests. Raptor or heron nests can be removed as needed for corrective action, but only after the young have fledged. Any removal of nests would require coordination with USDA Wildlife Services, which maintains the appropriate permit from the USFWS for removal of bird nests.

Bird fecal contamination can also result in momentary service interruptions. In the past 5 years, TVA has averaged approximately 20 momentary service interruptions per year due to fecal

contamination from roosting birds; most of these involve vultures, but it can also be from herons. Vultures occasionally roost in large numbers on TVA structures in some areas, such as near chicken houses or dump sites. In such cases, installation of “buzzard shields” is the usual corrective action.

All TVA transmission lines are visually inspected twice a year, via either helicopter or foot patrol. The transmission corridor vegetation is also annually inspected by personnel that walk each span of the transmission lines, and vegetation maintenance is performed every 2 to 3 years. TVA environmental compliance personnel also perform frequent field work involving transmission line corridors. During these various transmission corridor activities, bird mortality is only infrequently observed, and there have not been enough instances to consider line and structure collisions as having an impact on avian populations.

Literature Cited

Bowen A., J. Branum, C. Chandler, A. Dattilo, et al. 2012. *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority Transmission Construction and Maintenance Activities*, Revision 2.1, Chattanooga, Tennessee. Spring 2012.

Electric Power Research Institute. 2005. “Corona Loss and Ozone” in *AC Transmission Line Reference Book – 200 kV and Above*. Third Edition, Final Report. December.

Fern, W. J. and R. I. Brabets. 1974. “Field Investigation of Ozone Adjacent to High Voltage Transmission Lines.” *IEEE Transactions on Power Apparatus and Systems.* Volume PAS-93, Issue 5, pp. 1269 – 1280. September.

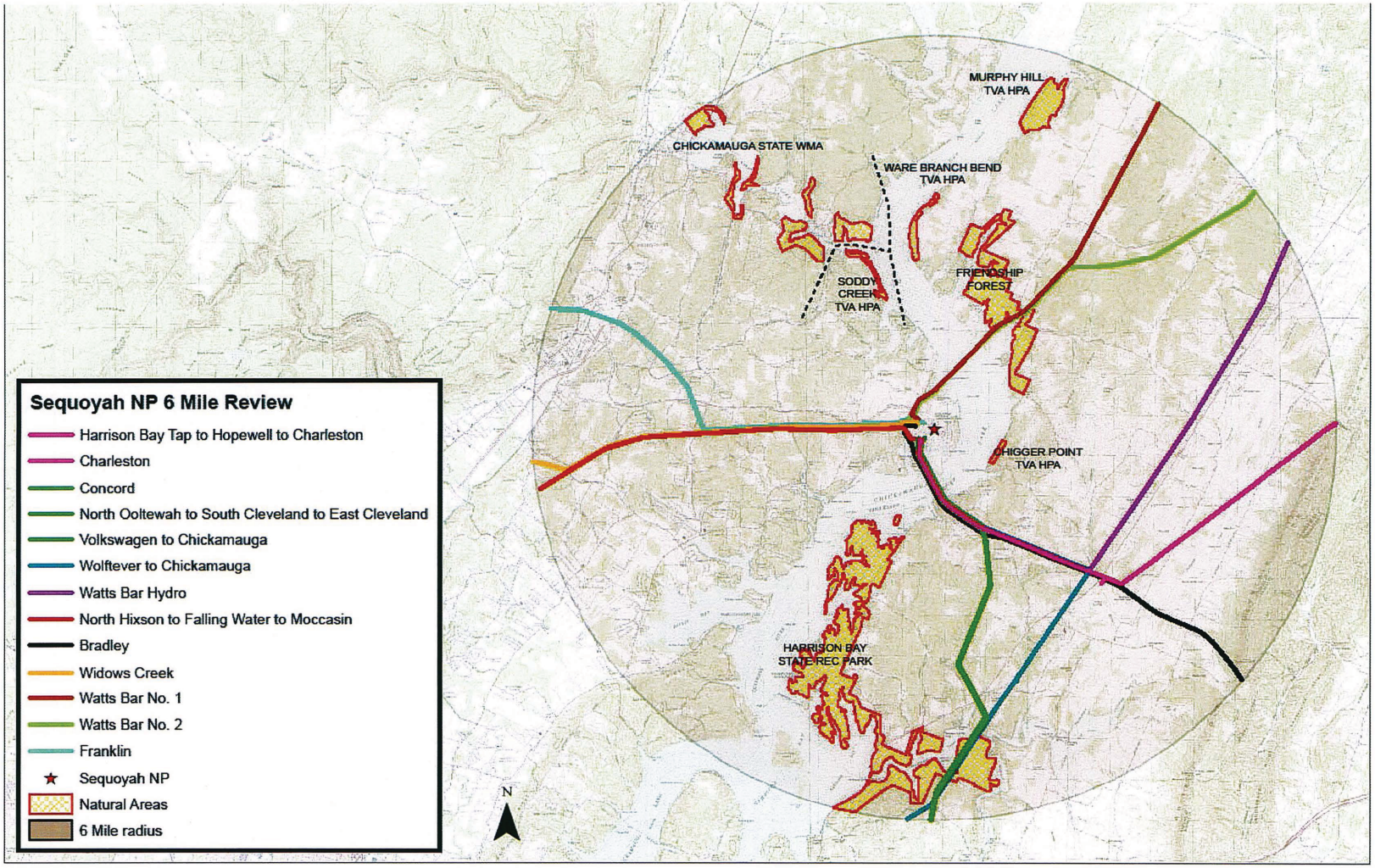

Figure 1
Natural Areas and Transmission Lines Within a 6-Mile Radius of SQN

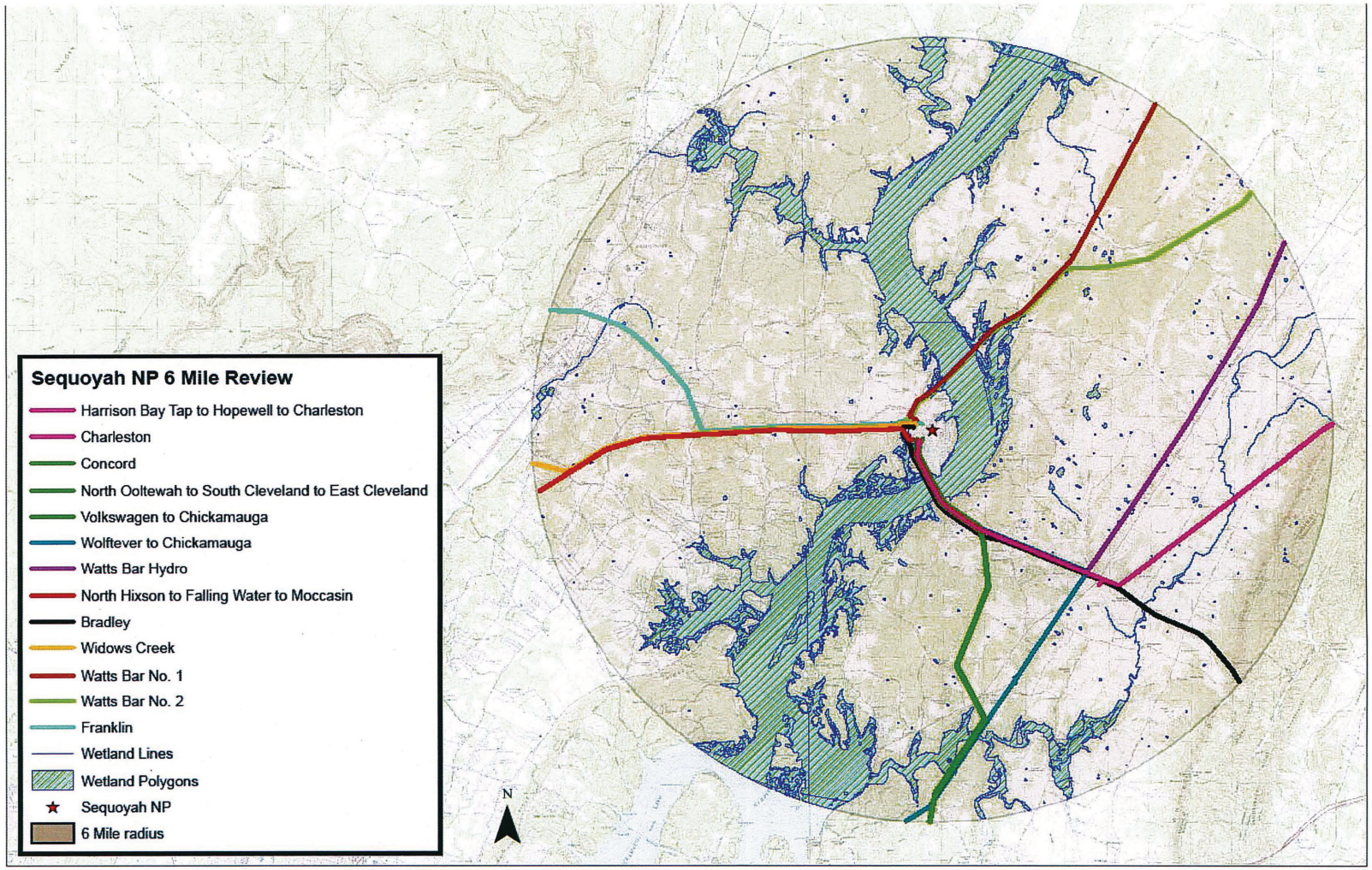

Figure 2
Wetlands and Transmission Lines Within a 6-Mile Radius of SQN