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TVA SOLAR PHOTOVOLTAIC PROJECTS
FINAL PROGRAMMATIC ENVIRONMENTAL ASSESSMENT
Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee, and Virginia

Prepared by:
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September 2014

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Symbols, Acronyms, and Abbreviations

AC	Alternating current
APE	Area of Potential Effect
BLM	Bureau of Land Management
BMP	Best Management Practice
CWA	Clean Water Act
dBA	A-weighted decibel
DC	Direct current
DCH	Designated Critical Habitat
EA	Environmental Assessment
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FAA	Federal Aviation Administration
GHG	Greenhouse gas
kW	Kilowatt(s), i.e., 1,000 watts
MW	Megawatt(s), i.e., 1,000,000 watts
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
PEA	Programmatic Environmental Assessment
PPA	Power purchase agreement
PV	Photovoltaic
PSA	Power Service Area
SHPO	State Historic Preservation Office
SMZ	Streamside Management Zones
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
USDA	United States Department of Agriculture
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

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CHAPTER 1 – PURPOSE AND NEED FOR ACTION

1.1 Introduction

The Tennessee Valley Authority (TVA) is increasing the amount of renewable energy in its energy portfolio by constructing and operating solar photovoltaic (PV) systems and/or purchasing electric power from such facilities located in its 170-county power service area (PSA), which is shown in Figure 1-1. The power generated by these solar PV facilities is typically delivered to TVA's electric grid by direct connection or via interconnections with local power companies (i.e., municipal utilities and cooperatives) that distribute TVA power. Solar power facilities are located on existing buildings (Figure 1-2), undeveloped "greenfield" sites (Figure 1-3), and developed sites including "brownfield[1]" sites (Figure 1-4) in public or private ownership within the TVA PSA.

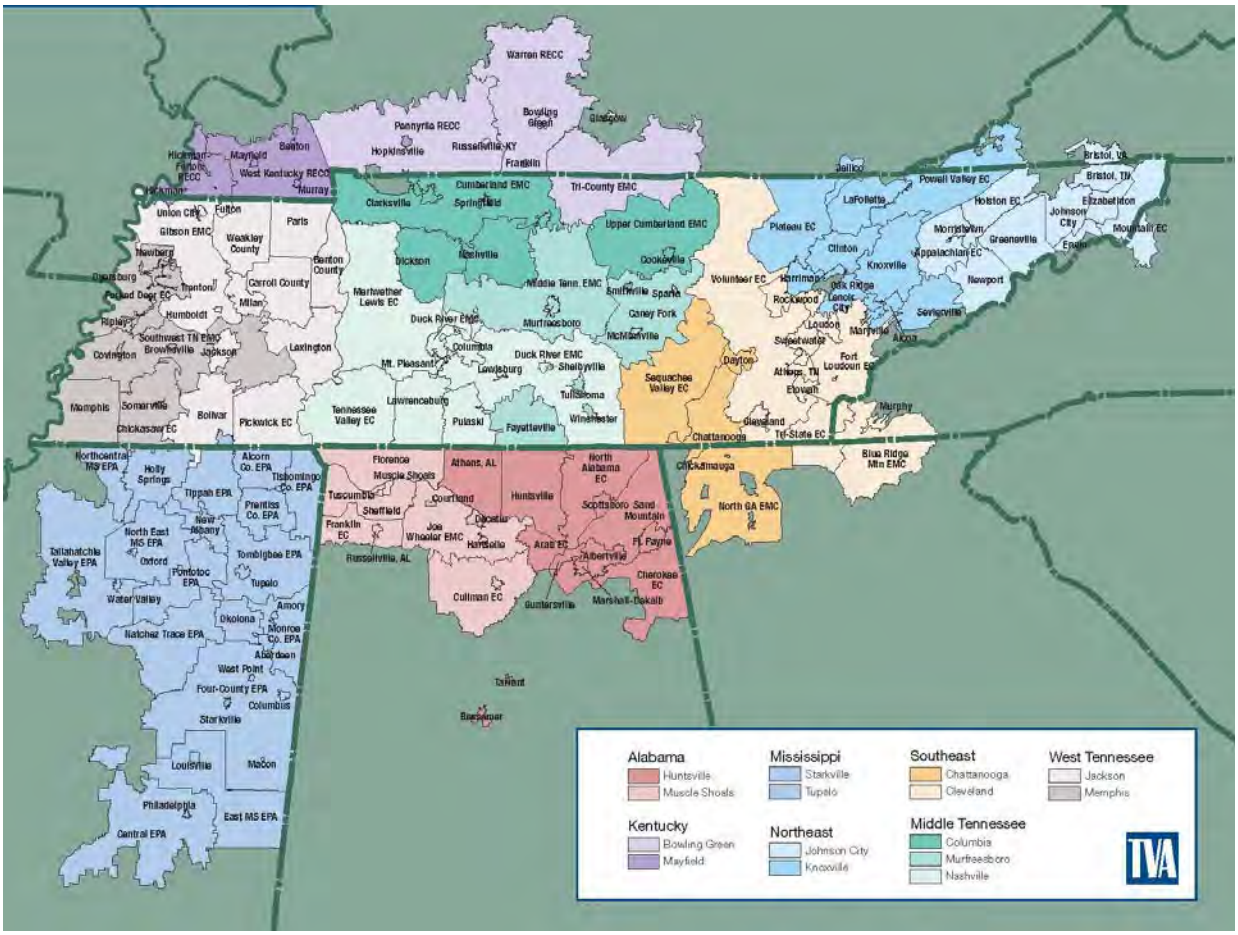

Figure 1-1. Map of the TVA Power Service Area and Local Power Companies

[1] As used in this document, a *brownfield* site is one that has been previously disturbed or developed. This status does not necessarily suggest that a site is contaminated.

Figure 1-2. A 200-kilowatt Rooftop Solar Installation in Chattanooga, Tennessee

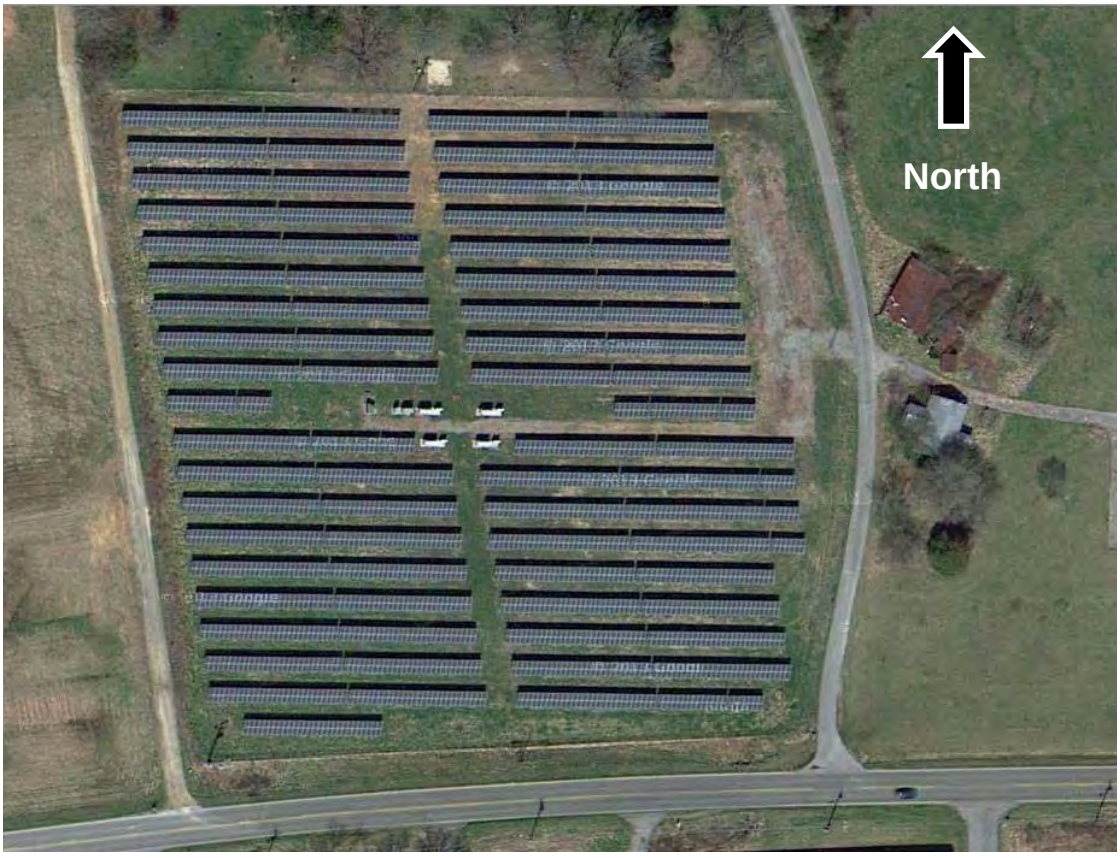

Figure 1-3. A 1-megawatt Solar Farm near Blairsville, Georgia

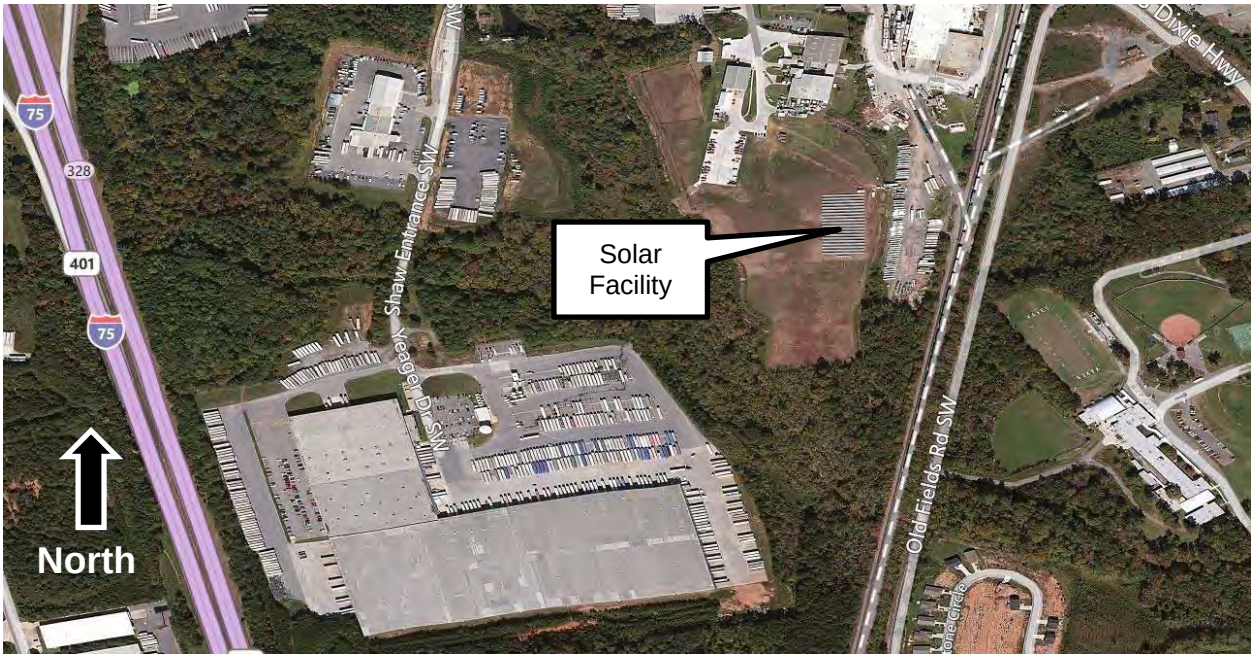

Figure 1-4. A 200-kilowatt Solar Farm on a Capped Landfill near Dalton, Georgia

Solar PV power generation is the direct conversion of light into electricity at the atomic level. Flat plate PV panels or modules are typically used to capture sunlight for this process. Some materials exhibit a property known as the photoelectric effect, which causes them to absorb photons of light and release electrons. When these free electrons are captured, an electric current is produced. This direct current (DC) electrical power generated in each module is combined and sent to one or more inverters[2] and transformers[3] to produce alternating current (AC) electrical power at residential, commercial, and utility voltages. In general, solar PV modules last up to 25 years.

1.2 Purpose and Need

TVA was created as a federal agency to improve the quality of life for residents of the Tennessee Valley, to foster economic development, and to promote conservation and wise use of the region's natural resources. One way that TVA fulfills this mission is by investing in renewable energy technologies located within its PSA. TVA defines renewable energy as energy production that is sustainable and often naturally replenished, such as solar, wind, biomass, and hydroelectric.

TVA's strategy for acquiring renewable energy is guided by its 2011 Integrated Resource Plan (TVA 2011a), which recommended adding between 1,500 to 2,500 megawatts (MW) of cost-effective renewable energy to the TVA system by 2020. Since the Integrated Resource Plan was implemented, more than 1,645 MW of renewable capacity has been established. This capacity includes approximately 1,515 MW of wind energy, 80 MW of solar-generated power, an additional 7 MW of hydroelectric power gained from recent hydromodernization improvements, and 45 MW of power generated from biomass.

[2] An inverter is an electrical device that converts direct current electrical energy to alternating current.
[3] A transformer is an electrical device that increases or decreases the voltage of alternating current electric power.

In addition to having power purchase agreements (PPAs) for wind energy, TVA, in partnership with local power companies, offers a portfolio of renewable energy programs. These include Green Power Providers, Solar Solutions Initiative, and the Renewable Standard Offer which contribute to TVA's goals and strategy for acquiring renewable energy. Cost-effective renewable energy is an important part of TVA's balanced portfolio of energy generation sources, helping to meet TVA's vision to be one of the nation's leading providers of low-cost and cleaner energy by 2020.

The use of solar PV technology promotes TVA's environmental stewardship efforts to continue to improve air quality in the region. It makes TVA's energy generation portfolio cleaner, and supports TVA's economic development initiatives to support jobs and invest in the Tennessee Valley.

1.3 Background

In 1995, TVA created a roadmap for meeting the energy needs of its customers for the next 25 years entitled *Energy Vision 2020 -- Integrated Resource Plan Environmental Impact Statement*. In *Energy Vision 2020*, TVA identified a long-range strategy that prepared TVA to meet the needs of its customers. One of the key recommendations resulting from this study was that TVA should research and develop renewable energy resources including wind, biomass, and solar photovoltaic technologies.

In January 1998, TVA and its local power company partners announced plans to provide end-use customers the ability to purchase renewable energy generated by wind, solar, and biomass sources. The resulting Green Power Switch program was launched in 2000. To provide power for the Green Power Switch program, TVA constructed a small wind farm, several small PV facilities, and a system to generate power from methane collected at a wastewater treatment plant.

TVA subsequently established the pilot Generation Partners program and its successor, the Green Power Providers program (http://www.tva.com/greenpowerswitch/providers/index.htm). Green Power Providers is a voluntary program offered by participating local power companies to their consumers, and the energy generated serves as a supply source for Green Power Switch subscribers. The program encourages residential and small commercial customers to install small-scale renewable and solar energy facilities (up to 50 kilowatts (kW)) at homes or businesses. The program provides tools and incentives for eligible consumers to offset some of their electric bill with renewable energy production.

The Green Power Switch and Green Power Providers programs were followed by other renewable energy programs administered by TVA. These include the Renewable Standard Offer (http://www.tva.com/renewablestandardoffer/index.htm) and the Solar Solutions Initiative. The Renewable Standard Offer is a program where TVA purchases power at a set market price from 50-kilowatt (kW) to 20-MW renewable energy installations within the TVA service territory. The Solar Solutions Initiative (http://www.tva.com/renewablestandardoffer/ssi.htm) is a sub-program of the Renewable Standard Offer that aims to support the existing local solar industry while also serving as a recruitment tool for new industry into the Tennessee Valley through incentive payments for qualifying solar facilities between 50 kW and 1 MW in DC capacity.

A summary of these programs (as of 2014) is provided as Table 1-1 below. The number of participating projects in these programs may change over time. The maximum facility area

requirement shown in the rightmost column is the approximate land or rooftop area of the largest facility in each of the applicable programs.

Table 1-1. Summary of Current TVA Solar Energy Programs

Applicable Program	System Size	Average Annual Capacity Additions	Average Annual Number of New Participating Projects	Maximum Facility Area Requirement
Green Power Providers[1]	50 kW or less	10 MW	500 to 600	5,000 square feet
Solar Solutions Initiative	>50 kW to 1 MW	10 to 16 MW[2]	25 to 50	10 acres
Renewable Standard Offer	>50 kW to 20 MW	100 MW	5 to 10	200 acres

[1]The maximum system size of earlier versions of this program and its predecessor, Generation Partners, was 1 MW.
[2]The range will likely increase to 20 MW in 2015.

In June 2001, TVA finalized a generic environmental assessment (EA) entitled *Construction and Operation of Photovoltaic Facilities within the Tennessee Valley Power Service Territory*. This review documented the potential environmental impacts of TVA's actions to develop solar facilities designed to generate from 10 to 100 kW of power. More than 2,300 solar facilities are operating or have been approved across the region. TVA owns and operates less than 1 percent of this generating capacity. TVA will continue to provide opportunities to develop solar power systems within its PSA through initiatives such as Green Power Providers, Renewable Standard Offer, and the Solar Solutions Initiative. Most solar projects developed under the Renewable Standard Offer and Solar Solutions Initiative have been and are likely to be considerably larger scale than those addressed in the 2001 generic EA.

This programmatic environmental assessment (PEA) was prepared to identify and document, at a programmatic level, the potential environmental effects of developing and operating qualifying solar facilities as well as TVA's purchase of power from these facilities. The types of environmental safeguards that would be routinely implemented during their construction and operation to avoid or reduce environmental effects were identified during the development of this PEA and are described in Section 2.1.2. Solar facilities within the scope of this PEA include ground-mounted solar facilities that occupy 10 acres or less on a greenfield site; ground-mounted solar facilities that occupy 20 acres or less of a brownfield site; and building-mounted solar facilities, regardless of their size. Projects participating in the Green Power Providers program are not within the scope of this PEA. However, proposed solar installations under the Solar Solutions Initiative and those under the Renewable Standard Offer that meet the acreage requirements would be within the scope of this PEA.

Recently constructed and proposed ground-mounted solar facilities in the TVA region have occupied between about 4 and 8 acres per MW of generating capacity, with an average of almost 6 acres per MW. Rooftop-mounted solar facilities have occupied an average of approximately 3 acres of rooftop area per MW. Thus, a 10-acre greenfield solar facility is expected to typically generate 1 to 2 MW, and a 20-acre brownfield facility would generate about 3 to 4 MW. Based on this recent experience and near-term forecasts, the projects considered in this PEA are estimated to occupy an additional 200 acres of land (or equivalent rooftop space) per year. However, due to unforeseen circumstances, this figure could increase to perhaps as much as 500 acres per year, or it could decrease slightly.

1.4 Decision to be Made

As stated in the 2011 Integrated Resource Plan, TVA is committed to pursuing the generation or purchase of additional renewable energy, including electric power generated by photovoltaic facilities. Currently, TVA assesses the environmental impacts of each solar project for which it has control and responsibility by preparing an individual environmental assessment under the National Environmental Policy Act (NEPA). TVA must decide whether to continue case-by-case NEPA assessments for the purchase of power generated by solar projects, or to assess the generic impact of future acquisitions of solar-generated power through a programmatic environmental review. The two alternatives are presented in Chapter 2.

1.5 Related Environmental Reviews and Consultation Requirements

- *Environmental Impact Statement for TVA's Integrated Resource Plan: TVA's Environmental & Energy Future* (TVA 2011a)

  This environmental impact statement (EIS) addressed the environmental consequences of adopting TVA's Integrated Resource Plan, which was developed to determine how TVA will meet the electrical needs of its customers over the next 20 years while fulfilling its mission of low-cost, reliable power, environmental protection, and economic development. All strategies considered involved increased reliance on renewable energy.

- *Construction and Operation of Photovoltaic Facilities within the Tennessee Valley Power Service Territory.* Generic Environmental Assessment (TVA 2001)

  This document assessed the impact of TVA's actions to work with partners such as local power distributors to construct and operate solar facilities designed to generate 10 to 100 kW of electric power.

TVA has completed several environmental assessments to document the potential environmental effects of establishing power purchase agreements with solar facilities. These documents are listed below.

- Final Environmental Assessment – Strata Solar Farm Project, McNairy County, Tennessee (TVA 2013).

- Purchase of Power Generated at the Hampton, Sweetwater Cove, and 1 MW Solar Projects, Cherokee, Clay, and Avery Counties, North Carolina. Environmental Assessment (TVA 2014a).

- Purchase of Power generated at the Lance Cove and Carter Cove Solar Projects, Clay County, North Carolina. Environmental Assessment (TVA 2014b).

- Purchase of Power Generated at Three Starkville Area Solar Facilities, Oktibbeha County, Mississippi. Environmental Assessment (TVA 2014c).

- Purchase of Power Generated at Pulaski Energy Park Solar Farm Expansions, Giles County, Tennessee. Environmental Assessment (TVA 2014d).

Additionally, TVA recently adopted EAs prepared by the Federal Aviation Administration (FAA) (2011) and U.S. Department of Energy (DOE) (2011) regarding TVA's purchase of power

generated by solar facilities located in Chattanooga and in Haywood County, Tennessee, respectively.

1.6 Scope of the Programmatic Environmental Assessment

This PEA was prepared in accordance with TVA's policies and procedures under NEPA and the Act's implementing regulations promulgated by the Council on Environmental Quality. It was undertaken to analyze and document potential environmental impacts associated with construction and operation of qualifying solar facilities in TVA's PSA. This document does not address any specific project site. Rather, it is intended to cover the facilities described below in Section 2.1.2. The solar facilities included under this document include the following installations.

- ground-mounted facilities occupying 10 acres or less on greenfield (i.e., previously undisturbed) sites
- ground-mounted facilities occupying 20 acres or less on brownfield (i.e., previously disturbed or developed) sites
- building-mounted facilities regardless of building size

Several of the non-site-specific environmental impacts of solar facilities are described in the *Environmental Impact Statement for TVA's Integrated Resource Plan* (TVA 2011a). The generation of electricity by solar facilities does not result in the direct emission of air pollutants, including greenhouse gases (GHGs). On a life-cycle basis, GHG emissions from solar facilities are a small fraction of those of conventional fossil-fueled generating facilities and are comparable to those of nuclear generating facilities. The direct land requirements for ground-mounted solar facilities are high relative to fossil and nuclear generating facilities when standardized by facility generating capacity. However, unlike fossil and nuclear facilities, some of the land may be available for other uses during solar facility operation, and the long-term impacts to the site are low. The analyses in this PEA focus on the following resources with the potential to be affected by the construction and operation of qualifying solar projects.

- Groundwater
- Surface Water
- Wetlands
- Floodplains
- Wildlife
- Vegetation
- Aquatic Ecology
- Threatened and Endangered Species
- Managed Areas and Ecologically Significant Sites
- Land Use and Prime Farmlands
- Cultural Resources
- Visual Resources
- Socioeconomics and Environmental Justice

TVA requested comments on a draft of the PEA from the federal and state agencies and federally recognized Tribes listed in Chapter 5. TVA also posted the PEA on its website. A 30-day comment period was provided. Consequently, comments were received from four federal

agencies, 17 state agencies, one Tribe, two local governmental bodies, four private organizations, and one individual. All comments were considered, and the final PEA was amended as necessary. Comments and responses to those comments are provided as Appendix A.

1.7 Necessary Permits or Licenses

Local building permits would be required for most projects. Likewise, an NPDES construction stormwater permit would often be required. Because solar projects of the size considered in this PEA typically do not involve discharges to surface waters, are unlikely to be situated in wetlands or floodplains or involve work in streams, the remaining permits mentioned below are not likely to be required. Nevertheless, the following permits could apply to proposed solar projects, depending on site-specific circumstances.

Permit Type	Applicability
Local building or construction permit	As required by local government.
Open burning permit	As required by local or state government.
Individual National Pollutant Discharge Elimination System (NPDES) permit/permit modification	Required for new wastewater discharges or changes to existing discharges.
NPDES Construction Stormwater Permit and/or Non-coal Mining Permit	Required if 1 or more acres would be disturbed by construction activities such as clearing, grubbing, soil borrow or grading.
Clean Water Act Section 404 Permit	Required if work would be performed in streams, wetlands, reservoirs or other waters of the U.S. This also includes work below the normal high water elevation even if the site is not inundated at the time the work is performed.
Clean Water Act Section 401 Water Quality Certification	Required for work under federal license or permit that would result in a discharge to waters of the U.S.
Permit to Construct in Floodplain	Required in Kentucky if work would occur within the 100-year floodplain.
State Operating or “no discharge” permits	Required for activities that generate or manage wastewater where no discharge occurs (e.g., sewage and/or process wastewater holding tanks, equipment washing/cleaning).
Small Renewable Energy Projects (Solar) Permit by Rule (9VAC15-60)	Applies only in Virginia to projects meeting certain criteria.

Permit Type	Applicability
Groundwater Protection Permit (Underground Injection Control Permit or septic system construction approval)	Required for constructing or modifying a subsurface disposal system for sewage or prior to diverting runoff into a sinkhole. Septic systems may be subject to state or local permitting requirements.

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CHAPTER 2 - ALTERNATIVES

2.1 Description of Alternatives

There are two reasonable alternatives available to TVA. These include the No Action Alternative and the Action Alternative. These alternatives are described below.

2.1.1 The No Action Alternative

Under the No Action Alternative, TVA would continue to participate in its current renewable energy programs and would pursue adding additional solar-generated power to its energy portfolio. Currently, when TVA enters into an agreement to purchase power from an independent solar power supplier, TVA conducts an environmental review consistent with the requirements of NEPA. Because TVA does not have a categorical exclusion[4] for this action, this review typically involves the preparation of an environmental assessment or environmental impact statement (TVA 1983). TVA may conduct the environmental review and prepare the appropriate NEPA documentation or the supplier can prepare an environmental report, which TVA may subsequently use as the basis for its NEPA documentation. Under the No Action Alternative, TVA would continue this course of action to meet its environmental review obligations under NEPA.

2.1.2 The Action Alternative

As with the No Action Alternative, under the Action Alternative, TVA would pursue the acquisition of additional power generated by solar facilities. However, the NEPA review process would be conducted in the manner described below.

Environmental Review of Solar Facilities Built and Owned by TVA
In the event TVA chooses to construct a solar facility, an environmental review would be conducted on a case-by-case basis in accordance with TVA's NEPA procedures (TVA 1983). Depending on the particular circumstances surrounding the proposed facility, the resultant NEPA document could tier from this PEA or incorporate findings from this PEA.

Environmental Review of Acquiring Power from Existing Solar Facilities
In situations where TVA proposes to purchase power from existing solar facilities, and if no changes to those facilities would occur as a result of that PPA, no further environmental review would be conducted because such actions (i.e., the purchase of power) do not normally cause any change in current conditions, and therefore, cause no environmental effects. However, if a proposed PPA should present unique circumstances such that the purchase of power from that existing facility would cause environmental consequences, TVA would initiate an appropriate environmental review for that specific proposed action. That review could tier from this PEA or incorporate relevant findings from this PEA.

Environmental Review of Acquiring Power from Proposed Non-TVA Solar Facilities
Under the Action Alternative, as part of the process for enacting a PPA to acquire solar-generated power from a proposed facility meeting the size criteria described above in Section

[4] *Categorical exclusion* is defined as "a category of actions which do not individually or cumulatively have a significant effect on the human environment and which have been found to have no such effect in procedures adopted by a Federal agency in implementation of these regulations (§1507.3) and for which, therefore, neither an environmental assessment nor an environmental impact statement is required."

1.6, TVA would require developers to supply certain environmental information about the site characteristics of the proposed facility. (Alternatively, the developer could request TVA to develop this information on a reimbursable basis.) This information would describe the physical characteristics of the proposed solar site and any applicable permits that would be required to construct and operate the facility. Prior to submission of this environmental information, TVA would consult with the developer to ensure that the submitted information will meet TVA requirements. The submitted material would include current information about the following resources and conditions on the proposed site, access roads, and within any corridors containing utility connections necessary for the project.

- Cultural resources, including the presence of onsite archaeological resources and the presence of any historic structures or historic districts within the viewshed of the proposed facility.

- Threatened and endangered species, including those listed under the Endangered Species Act (ESA), critical habitat designated under the ESA, and species listed as threatened, endangered, or of other conservation concern by state natural resource agencies, that occur on the site or in the immediate vicinity.

- Wetlands, including the presence of any jurisdictional or non-jurisdictional wetlands onsite or in the immediate vicinity of the proposed site.

- Unique natural features, including the presence of streams listed on the Nationwide Rivers Inventory or streams considered Wild and Scenic Rivers; caves; unique habitats or geological features (e.g., sinkholes or rock ledges); and managed areas either on the site or in the vicinity of the site. Managed areas include lands held in public ownership that are managed by an entity such as the National Park Service, U.S. Department of Agriculture, state agencies, counties, etc., to protect and maintain certain ecological and/or recreational features.

- Floodplains, particularly the occurrence of the 100-year floodplain within the boundaries of the proposed site, including access roads and any corridors for new transmission system or utility connections.

- Prime farmlands, particularly the presence of any onsite prime farmlands as defined under the federal Farmland Protection Policy Act. If the site of a proposed solar facility (including access roads or utility corridors) contains such prime farmland, TVA would complete Form AD-1066 (Farmland Conversion Impact Rating). A score exceeding 160 indicates that the subject farmland needs further consideration for protection.

- Waste materials or contamination, especially the presence of buried wastes or contaminants on brownfield sites. TVA would require developers of solar facilities on brownfield sites to perform site investigations to determine the presence of any onsite buried wastes or contaminants and the likelihood of the release of dispersion of contaminants due to project actions. Depending on circumstances, TVA could require a Phase I environmental site assessment consistent with ASTM Standard E1527-13.

Using the site information and other available information, TVA would screen each proposed project to determine the potential for adverse environmental effects to the resources listed above. The findings of this site-specific environmental review would be documented using

TVA's Categorical Exclusion Checklist (TVA 30494 [9-2001]) or other appropriate documentation prepared in accordance with TVA's NEPA Procedures (TVA 1983).

In cases where sensitive resources are present on the site or the project has the potential to significantly affect one or more of those resources listed above, TVA would encourage or require the developer, as necessary, to develop appropriate measures to avoid adverse effects or to reduce them to minor and insignificant levels. Additionally, TVA would require solar facility developers to employ the routine measures listed in Section 2.3 to avoid or reduce potential adverse environmental effects. In situations where none of the resources listed above are present on the site of the proposed facility, TVA determines that none of these resources would be affected beyond a minor and insignificant extent, or if the developer modifies the project to the extent that TVA determines there is no potential for significant effects to these resources, the findings of this PEA with respect to NEPA compliance would apply to the proposed solar project.

However, during the screening process, in the event that TVA determines that proposed avoidance or mitigation measures are not feasible or practicable, such measures would not effectively eliminate the potential for significant adverse effects to the above listed resources, or if there is substantial controversy over the significance of the environmental impacts, the proposed project would be subject to a project-specific environmental review consistent with TVA NEPA procedures. Relevant portions of this PEA could be incorporated into that project-specific environmental review.

This PEA addresses the potential environmental effects of proposed ground-mounted solar projects that occupy 10 acres or less of a greenfield site, ground-mounted solar projects that occupy 20 acres or less of a brownfield site, and building-mounted solar facilities, regardless of the footprint size. Greenfield sites are areas of undeveloped land, can be open or forested, and are sometimes used for agricultural purposes. Brownfield sites are properties that have been previously disturbed or developed. As such, brownfield sites may contain hazardous substances, pollutants, or contaminants.

PV cells come in many sizes and shapes, and they are typically connected together to form modules. Each module generally includes a glass panel, a protective frame and two electrical leads. Modules can be combined and connected to form PV arrays of different sizes and power outputs. Arrays are connected to inverters that convert the electricity from DC power to AC power which is then interconnected with and fed to a local power company or the TVA grid. A typical panel is rectangular with an area of approximately 15 to 20 square feet and has an output of 250 to 350 watts DC.

Typically, PV arrays are mounted on a rack-type structure. This structure can be mounted on the ground using poles or ballasted systems or on buildings. Solar arrays are commonly mounted on the roofs of large buildings. However, some solar arrays are integrated directly into a building's surface for a more aesthetic appeal. These modules can be produced in several colors, either translucent or patterned, enabling the panels to be integrated into the building's architecture and design. Additional details are provided below.

Ground-mounted Arrays

The suitability of a given site for ground-mounted arrays depends on its topography and the type of mounting structure that would be used. Generally, developers of solar PV facilities prefer relatively flat sites or sites with a gentle south-facing slope that do not require extensive grading.

Typically, site preparation for ground-mounted systems requires minor grading and the removal of onsite woody vegetation, depending on the particular site.

Once a site has been prepared, prefabricated modular racking systems are installed to support the PV panels. The racking systems are mounted on support structures installed into the ground at a typical depth of 1.5 to 5 feet, depending on local soil and wind conditions. These support structures are typically piles or metal posts that are driven into the ground by specialized pile drivers equipped with a hydraulically driven, high-frequency vibratory hammer. However, in certain circumstances where soil conditions are not suitable for driven pile supports, the use of helical screws may be required. Similarly, ballasted rack systems that do not penetrate the ground can be used in situations where the installation of support poles is either infeasible or impractical. A ballasted, non-penetrating system located on a capped landfill near Dalton, Georgia is shown as Figure 1-4.

The most common ground-mounted, non-residential configuration in the TVA region uses fixed-tilt panel racking system mounted in multiple rows in an east-west orientation with the panels facing south to achieve the best exposure to the sun (Figure 1-2). Because they are fixed in place, the arrays can be arranged in long rows and require minimal maintenance. These arrays of panels for ground-mounted structures are generally placed between 2 and 4 feet above the ground elevation. Arrays are typically mounted at an angle that depends on the amount of wind loading particular to the site. In the southeastern United States, typical angles are between 10 and 30 degrees. The height of the array at the rear of the panels is usually between 7 and 10 feet above ground elevation. The spacing between arrays depends on the tilt angle, which determines the amount of shadowing. Thus, distances between rows of panels may range from about 2 to 20 feet. Typical arrays of fixed-tilt ground-mounted panels and their support structures are illustrated in Figure 2-1.

Figure 2-1. Fixed-tilt Solar Arrays and Support Structures

Tracking systems are less common in the TVA region, and may be either single-axis tracking systems or dual-axis tracking systems. Various configurations of single-axis tracking systems are available. However, the most common single-axis configuration used in the TVA PSA utilizes a horizontal axis as shown in Figure 2-2. With this configuration, arrays of panels are

arranged in rows similar to fixed-tilt systems. However, unlike fixed-tilt systems, which normally have rows aligned in an east-west orientation, the rows in a single-axis tracking system are typically arranged in a north-south alignment. Specialized racking systems typically use electrically powered drive systems to tilt the entire row over an approximately 90-degree arc to keep the array aligned perpendicular with the sun's position in the sky.

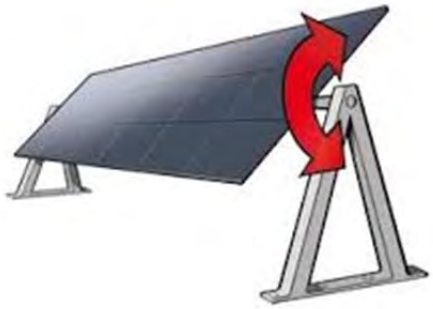

Figure 2-2. A Single-axis Tracking System

Dual-axis tracking systems such as shown in Figure 2-3 typically consist of a square or rectangular array of panels mounted on a single support pole. The mounting mechanism allows the array to pivot on two axes, i.e., side-to-side and up-down, to achieve the best solar exposure. Because allowances must be made to prevent arrays from casting shadows on other panels, tracking modules often require a somewhat larger site for a given amount of generating capacity than fixed-tilt systems. However, because of their ability to track the sun, these systems can increase the generating efficiency of the individual panels and may generate more power per unit of area than fixed systems.

Figure 2-3. A Dual-axis Tracking System

The panels in an array are connected by modular electrical wiring systems. Groups of arrays are typically connected by underground electrical cables which terminate at the DC-to-AC inverters. Buried electrical cables connect the inverters to a central point, at which the facility is typically connected to the local power company's distribution system by an above-ground power line. Because of the relatively small amount of power being generated, this connector line would likely be mounted on single wooden or metal pole structures located on a narrow (i.e., 50-foot wide or less) right-of-way. The local power company's distribution network is connected to the TVA transmission system. The installation of a transformer is usually required at the solar

farm connection point to match the voltage of the facility with that of the local electrical distribution system.

Solar facilities are typically enclosed by security fencing. Normally, the site is either revegetated with grass or other low-growing vegetation or the area is covered with gravel to retard the growth of vegetation. The majority of ground-mounted solar PV systems built to date in the TVA region operate on vegetated sites. Operational ground-mounted solar facilities require regular vegetation maintenance to prevent plant growth that could block sunlight from reaching the solar panels. Shadows, even if very localized, can cause significant drops in the affected panel's ability to convert sunlight into electric power. Vegetation maintenance normally is accomplished by periodic mechanical mowing. In some cases, herbicides or biological controls (livestock grazing) are used to control onsite vegetation.

Side-of-pole mounts are suitable where a pole has an additional feature mounted to its top, such as a light fixture or an antenna. Pole mounting raises what would otherwise be a ground-mounted array above weed shadows and livestock, and may satisfy electrical code requirements regarding inaccessibility of exposed wiring. Pole-mounted panels are open to more cooling air on their underside, which increases performance. Multiple pole-top racks can be formed into a parking carport or other shade structure.

Building-mounted Arrays

Solar arrays can also be mounted on buildings in a variety of ways. PV arrays are commonly located on the roofs of buildings. Typical candidate sites include buildings with either flat or low-slope roofs oriented to the south, such as large commercial or industrial buildings and warehouses. Depending on the particular circumstances, the arrays may be mounted flat (i.e., parallel) on the roof surface (Figure 1-2) or in tilted rows similar to a ground-mounted system. Unlike ground-mounted systems, tilted rooftop row systems are typically only one panel tall. Larger roof-mounted panels are generally placed as much as 2 feet above the roof surface to facilitate cooling and avoid heat build-up in warmer months. Others may be mounted nearly flush to the roof surface. Some rack designs involve penetrating the existing roof, while other systems may involve essentially no roof penetration. The electrical connections between a building-mounted system and the local power system may use existing conduits or connections, or a separate connection can be established. In either case, the necessary connection tends to be short.

PV arrays may also be located on buildings or structures as awnings or shades rather than on the roof. Also, PV arrays have been incorporated into the structure or architectural features of some buildings. However, these systems tend to be more expensive (and uncommon) than the traditional ground- or building-mounted facilities. Building-mounted PV arrays often have a lower potential for environmental impacts than ground-mounted systems.

2.2 Comparison of Alternatives

Under the No Action Alternative, TVA would continue acquisition of solar-generated power from suppliers. Environmental reviews of prospective projects would be conducted on a case-by-case basis at the appropriate level in accordance with TVA NEPA procedures.

Under the Action Alternative, TVA would continue to pursue various solar power projects to increase the amount of solar-generated power in its generation portfolio, but the NEPA process for qualifying projects under this PEA would change. This PEA addresses acquisition of solar-

generated power from future projects occupying 10 acres or less on greenfield sites, 20 acres or less on brownfield sites, or roof-mounted facilities regardless of footprint size.

The potential environmental consequences of adopting either alternative are similar. Regardless of the alternative selected, TVA would likely continue to acquire power via agreements with solar developers from a variety of solar facilities across the TVA PSA. However, under the Action Alternative, the environmental review process could be conducted more quickly and efficiently than under the No Action Alternative. Thus, implementation of the Action Alternative could expedite the procurement of additional solar power as compared to the No Action Alternative. A summary of the impacts and findings anticipated under each alternative is provided in Table 2-1.

Table 2-1. Summary of Impacts/Findings by Resources

Resource	Impacts/Findings
Groundwater	With implementation of best construction practices and best management practices (BMPs) Construction and operation of solar facilities on greenfield sites are expected to be minor. Only minor effects are anticipated at brownfield sites with use of avoidance or mitigating techniques when appropriate such as the use of structures minimizing soil penetration and soil disturbance. No effects from building-mounted installations are anticipated.
Surface Water	With proper implementation of BMPs, construction-related effects would be minor and temporary. Any operational effects from ground-mounted solar sites would be minor. Any effects from building-mounted installations would be minor.
Wetlands	No significant impacts are anticipated as a result of avoidance of wetlands through appropriate siting of the solar project or adherence to mitigation measures under Executive Order (EO) 11990 and Section 404 of the Clean Water Act.
Floodplains	No significant impacts are anticipated as a result of the avoidance of floodplains through appropriate siting of the solar project or the adherence to mitigation measures under EO 11988.
Wildlife	Impacts to individual animals are not expected to reach levels that would reduce the health of local or regional species populations. Only minor effects are anticipated.
Vegetation	Minor impacts to the vegetation of the region are anticipated with the application of appropriate avoidance and mitigative measures. Effects to forest resources are expected to be negligible. TVA would comply with EO 13112 (Invasive Species).
Aquatic Ecology	Impacts to aquatic life are anticipated to be minor with the implementation of appropriate BMPs and guidance for Streamside Management Zones (SMZs).
Threatened and Endangered Species	In compliance with the ESA, TVA would determine potential effects to federally listed threatened or endangered species and avoid or mitigate these effects.

Resource	Impacts/Findings
Managed Areas and Ecologically Significant Sites	Direct impacts are possible from construction at greenfield sites. Indirect impacts are possible if construction occurs adjacent to an area managed for wilderness or scenic qualities. With mitigation under applicable regulations, significant impacts are not anticipated.
Land Use and Prime Farmland	Solar facilities would be a long-term interim use of the site, but the site could be used for various other purposes at the end of life of the facility. TVA would comply with the Farmland Protection Policy Act and determine on a case-by-case basis if prospective solar facilities that score over 160 on Form AD-1006 need additional protection to mitigate impacts to prime farmland.
Cultural	TVA would follow the Section 106 process under the National Historic Preservation Act to identify historic properties, assess potential effects, and minimize or mitigate any adverse effects.
Visual	Appropriate site selection and implementation of appropriate screening measures are expected to reduce visual changes to minor levels. Minor and temporary impacts to visual resources could be present during construction activities. Projects within a five mile vicinity of an airport would require coordination with the FAA to ensure no effects to airport properties.
Socioeconomics and Environmental Justice	Economic effects to the local economy would likely be positive, but minor. Due to the nature of the proposed actions, disproportionately high adverse impacts on minority and low-income populations are unlikely. Project-specific evaluations of Environmental Justice will be conducted.

2.3 Identification of Mitigation and Avoidance Measures

In addition to requiring site information for the environmental screening process described above in Section 2.1.2, TVA expects that suppliers will comply with the requirements of all applicable laws, regulations, and permits, including coordination with appropriate state agencies as mentioned in Attachment A. TVA would consult with appropriate state and federal agencies as appropriate consistent with the requirements of Section 106 of the National Historic Preservation Act (NHPA) and Section 7 of the ESA.

Also, TVA would require suppliers to comply with the following routine requirements to avoid adverse environmental effects.

- Only clean fill shall be used.
- All onsite heavy equipment shall be inspected for leaks.
- Any installation of underground wiring or utilities and the use of any heavy equipment onsite shall be conducted in a manner to minimize soil and cover disturbance.
- Herbicides or pesticides shall not be applied within 50 feet of a water body.

- The project shall not increase the loading of any pollutant/contaminant to a stream currently listed on the Clean Water Act (CWA) Section 303(d) list as a result of any discharges to surface waters.

- Any underground utilities shall be identified before any digging takes place, and all utility pipes/lines shall be marked and avoided during construction activities.

- Prospective suppliers shall provide TVA with proof of all local or state zoning approvals or verify that such approvals are not required.

- Developers of solar facilities in the TVA PSA shall take practicable measures to minimize the visibility of solar facilities by taking advantage of topography and vegetation to restrict the views of projects from visually sensitive areas.

- Developers of solar projects within a five mile vicinity of an airport in the TVA PSA shall coordinate with the FAA to ensure that appropriate FAA procedures are followed.

2.4 The Preferred Alternative

TVA's preferred alternative is the Action Alternative.

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CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter includes descriptions of the current status of the potentially affected environment with respect to those resources and environmental issues identified in Section 1.6. Any potential effects to these resources that are likely to result from implementing either of the alternatives are also described in this chapter. As stated in Chapter 2, anticipated environmental effects would be virtually the same under either alternative. Thus, the potential effects described in this chapter are those anticipated from TVA actions to acquire additional solar-generated power, regardless of the alternative.

In the course of this environmental review, TVA determined that the following resources are not likely to be affected adversely by the proposed action and that any potential effects would be very minor or negligible. Thus, potential effects to air quality and the production of greenhouse gases; noise; and transportation are summarized below.

Air Quality and Greenhouse Gases
Emissions of pollutants that could impact air quality could temporarily increase during construction of solar facilities. Exhaust from gasoline- or diesel-powered vehicles and equipment would temporarily emit various air pollutants. Because of the limited sizes designated for these projects and the short duration of the construction period, construction activities would not affect the attainment status of the airshed or the airshed designation in the project area.

The use of gasoline- or diesel-powered equipment during construction would increase greenhouse gases that may contribute to climate change. However, these emissions would be of short duration and would be negligible in comparison to other regional sources of greenhouse gas emissions. Generation by solar facilities would largely replace and/or supplement generation by peaking generating resources such as natural gas-fired combustion turbines and hydroelectric generation, and by intermediate generating resources such as natural gas-fired combined cycle plants and smaller coal-fired plants. This would result in the avoidance of emissions of GHG emissions that would have resulted from generation by fossil-fueled generating facilities. Due to the scale of the solar facilities considered in this PEA, the avoided GHG emissions would comprise a relatively small proportion of TVA's system-wide GHG emissions.

Noise
Potential noise impacts associated with implementation of solar facilities covered under this document would occur primarily during construction. Heavy equipment such as front end loaders, graders, equipment to drive support pilings, and backhoes, if used for site preparation, could produce noise levels as great as 95 A-weighted decibels (dBA)[5] within a distance of 50 feet. Such noise decreases as distance from its source increases, and noise levels would decrease to approximately 66 dBA at 0.25 mile (TVA 2001). A noise level of 65 dBA is comparable to the ambient noise in a commercial area or normal speech at a range of 3 feet. Thus, construction activities could contribute temporary, short-duration noise to the ambient sound environment around each project site. However, construction activities would be of

[5] *dBA* is a measure of sound pressure (loudness) relative to the hearing range of the human ear.

relatively short duration and would occur during daylight hours, when people are less disturbed by noise.

Essentially no noise is generated by the operation of the solar panels themselves because they have no moving parts. However, the associated inverters and transformers typically emit a hum during operation. Inverters are typically encased in cabinets and are frequently located centrally on the site for practical reasons. The level of noise generated by inverters and transformers depends on several factors such as their electrical capacity and the amount of noise damping provided by their enclosures. Nevertheless, because noise levels from this equipment are typically low, noise at the site boundary tends to be indistinguishable from background noise.

Minor contributions to ambient noise levels could be generated by motors and drive systems used to tilt the arrays toward the sun at those solar facilities equipped with tracking mechanisms to keep the panels facing the sun. However, if maintained properly, these mechanical drive systems tend to operate with minimal noise.

Because solar facilities cannot generate at night, they generate essentially no noise during the overnight hours. Thus, short- or long-term and cumulative effects related to noise from the installation and operation of proposed solar facilities would be minor.

Transportation

Solar projects covered under this document are not anticipated to adversely affect local roadway networks. The material required for construction would not require the use of oversized trucks and would not normally require roadway closures. Construction activities and the deliveries of construction materials and equipment could possibly cause minor temporary delays on adjacent roadways. However, potential traffic delays could be avoided through mitigation strategies such as flagging during heavy commute periods and avoiding deliveries during periods of heavy traffic load. Operation and maintenance of the facilities are not anticipated to change the existing levels-of-service on the surrounding road network.

Possible impacts at airports relative to visibility are addressed in Section 3.12. No significant impacts are anticipated for other modes of transportation such as railways or bike paths as a result of future solar projects covered under this PEA.

Local Infrastructure

Although the solar facilities considered in this PEA could possibly connect directly to the TVA transmission system, they are much more likely to connect to the distribution system operated by a local power company. Because these PV systems do not generate large amounts of power compared to large “baseload” plants, the likelihood that the additional power acquired from these plants would require the construction of new transmission lines or upgrades to the TVA transmission system is very low. TVA’s approval for solar facilities includes an evaluation of the effects of the facilities on both the TVA and local power company systems to assure the reliability of these systems is maintained.

Solar facilities typically require no process water or cooling water. However, the panels may require periodic cleaning, especially if they are located in a site that is prone to dust. An estimated 1,000 to 1,500 gallons per acre per year could be required to wash panels. However, because the TVA PSA receives frequent rain events, washing of the PV panels is not normally required. Thus, water needs for such facilities are minor. Because of limited staff required onsite at ground-mounted facilities, an onsite connection to a municipal sewage system is typically not necessary. An all-weather access road is necessary for ground-mounted solar

facilities. Regular trash pickup would not be essential. Thus, adverse effects or strains on the local or utility infrastructure would be minor.

The remainder of this chapter contains a description of the affected environment and the potential environmental effects that would be likely to occur under the two alternatives to the resources listed in Section 1.6. Additionally, this chapter contains a discussion of unavoidable adverse environmental impacts as well as a description of irreversible and irretrievable commitments of resources.

3.1 Groundwater

3.1.1 Affected Environment

Groundwater is water that flows or seeps downward and saturates soil or rock, supplying springs and wells. Groundwater often begins as precipitation and soaks into the ground, where it is stored underground in rock crevices and in the pores of geologic materials forming aquifers. The quality and quantity of groundwater that supplies aquifers are dependent on many factors such as soil cover, rock type, and rainfall. The Tennessee Valley covers a diverse territory that falls within many physiographic provinces; thus, groundwater quantity and quality vary greatly throughout the Valley.

3.1.2 Environmental Consequences

Solar projects would involve construction, operation, and maintenance of a proposed facility. Because construction activities at ground-mounted facilities (either greenfield or brownfield sites) would create areas of exposed soil, such actions could temporarily increase the potential for sedimentation and the entry of sediments into groundwater. Likewise, contamination of groundwater can potentially occur from the operation of ground-mounted solar facilities, primarily from the application of chemicals such as fertilizers and herbicides. Additionally, onsite sewage disposal systems (i.e., septic systems) can potentially affect groundwater. The solar facilities of the size considered in this PEA typically do not have onsite septic systems. However, such systems are subject to state and local regulations.

As authorized by the Clean Water Act (CWA), the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete water conveyances such as pipes or man-made ditches. Within the TVA PSA, the NPDES permit program is administered by the respective states. The NPDES stormwater program requires construction site operators engaged in clearing, grading, and excavating activities that disturb 1 acre or more to obtain coverage under an NPDES permit for their stormwater discharges. This permit requires the applicant to prepare a Stormwater Pollution Prevention Plan that outlines measures that will be implemented to avoid or minimize adverse effects to water quality.

As a condition of entering into a PPA with a solar developer, TVA would require the developer to implement appropriate best management practices (BMPs), such as those required by construction stormwater permits, to avoid adverse effects to groundwater quality or to reduce such impacts to insignificant levels.

Appropriate BMPs that TVA would require include measures such as:

- Installing measures to prevent sediment from flowing to groundwater via sinkholes or springs.
- Installing measures to control sediment infiltration from stormwater runoff.

- Avoiding the use of herbicides with groundwater contamination warnings during revegetation and maintenance activities.
- Using caution in the application of fertilizers to establish vegetation to prevent erosion and applying such fertilizers according to the manufacturer's label.

The implementation of such practices would reduce the potential for adverse effects to groundwater quality from the construction and operation of solar facilities on greenfield sites, and any such effects are expected to be minor.

Where proposed solar facilities would be constructed on brownfield sites, TVA would determine if the proposed project could change the brownfield characteristics and pose a threat to groundwater resources. Additionally, construction at brownfield sites may require the developer to coordinate with the appropriate state environmental regulatory agencies. In such circumstances, appropriate measures would be developed and taken to avoid or minimize potential effects to groundwater. Such measures include modifying the project plan and utilizing mounting structures (e.g., ballasted mounting systems) that would minimize soil penetration and soil disturbance. However, in the event that TVA determines that a proposed ground-mounted brownfield solar facility would pose an obvious significant threat to groundwater quality, even with the implementation of reasonable avoidance measures, TVA would conduct a separate environmental review for the facility. Therefore, with respect to those solar facilities that qualify under this PEA, potential effects to groundwater quality from the construction and operation of ground-mounted solar facilities at brownfield sites are expected to be minor.

Previous experience with the size solar facilities considered in this PEA indicates that water requirements for such facilities are minimal. Thus, few if any of the future facilities are likely to require an onsite well to supply water. Because the volume of groundwater use is likely to be minimal, the likelihood of depleting groundwater supplies is very low. Therefore potential effects to groundwater quantity would be minor.

Because the potential for groundwater contamination from the construction and operation of building-mounted solar facilities is extremely low and because such solar facilities would not involve ground disturbance, no effects to groundwater quantity or quality are anticipated from installation of building-mounted solar projects.

The additional acreage of projects covered under this PEA is estimated to consist of approximately 200 acres or equivalent rooftop space each year and is not likely to exceed 500 additional acres per year. Thus, cumulative impacts to groundwater would be minor.

3.2 Surface Water

3.2.1 Affected Environment

Surface water consists primarily of precipitation that collects in surface water bodies, like oceans, lakes or streams. Another source of surface water is groundwater that is hydraulically connected or discharges to surface waters through geologic features such as springs. Surface waters in the Tennessee Valley vary greatly in quality and size, based on effluent resources (including drainage and discharges from industrial activities, agriculture, and stormwater), soils, precipitation amounts, and influence from groundwater resources. These waters are regulated by the CWA and are managed by the individual states within the TVA PSA with oversight from the U.S. Environmental Protection Agency.

3.2.2 Environmental Consequences

As mentioned above in Section 3.1, surface water quality can be affected by the construction of ground-mounted solar projects due to increased silt load resulting from runoff during and following soil-disturbing activities. Soil disturbances associated with installation or construction activities can potentially result in adverse water quality impacts. Soil erosion and sedimentation can clog streams and ground water features and can threaten aquatic life. Removal of onsite vegetation and the installation of impervious surfaces (e.g., paved areas and buildings) can alter site runoff patterns.

Ground-mounted Installations

Proposed ground-mounted solar facilities that would disturb more than 1 acre of land area by clearing, grading, filling, and excavating or similar construction activities require an NPDES construction stormwater permit issued by the respective state environmental management agency. This permit typically requires the preparation and implementation of a site-specific Stormwater Best Management Plan that identifies specific BMPs to address construction-related activities that would be adopted to minimize potential stormwater impacts. Likewise, a spill plan would also be required. The site-specific spill plan would address chemicals and petroleum product use and storage on the work site and the actions to take in case of a spill.

The developer of a solar facility, either an independent supplier or TVA, would be responsible for obtaining all applicable federal, state and local permits and complying with all permit requirements during construction and operation of the site. Additionally, for solar facilities proposed at brownfield sites, an evaluation of the installation's site soil and contaminants would be undertaken as part of TVA's initial screening process to determine if any work undertaken at the site would adversely affect any past or present remedial action taken at the site under the Comprehensive Environmental Response, Compensation, and Liability Act (i.e., "CERCLA" or "Superfund"), the Resource Conservation and Recovery Act (RCRA) or comparable state statutes.

Because various measures to protect surface water quality would be implemented during construction and operation of proposed ground-mounted solar facilities, any effects to local surface water quality are expected to be temporary and minor.

The presence of buildings and infrastructure can create impervious areas that prevent rain from percolating through the soil and result in additional runoff of water and pollutants into storm drains, ditches, and streams. Clearing of vegetation and ground cover and the addition of impervious surfaces could alter the current onsite stormwater flows. Because the proposed solar facilities considered in this PEA would be relatively small and similar facilities considered in previous TVA reviews have typically involved the installation of minimal amounts of impervious surfaces or buildings onsite, noticeable alterations of surface runoff are not anticipated.

Additional wastewater streams potentially generated by the operation and maintenance of solar activities may include domestic sewage, non-detergent equipment washing, refueling of equipment, and dust control. Portable toilets or other temporary or permanent facilities may be necessary for the construction workforce. Facility developers would be responsible for complying with all appropriate local, state, and federal regulations during the installation of utilities and/or septic systems. Likewise, operators of facilities in which more than one acre of land would be disturbed would be responsible for conducting construction and operational activities in accordance with BMPs described in the Stormwater Pollution Prevention Plan.

Building-Mounted Installations
The construction and operation of building-mounted solar facilities would result in very little potential for surface water impacts. Debris and other waste materials associated with installation would be either recycled or properly disposed of in landfills permitted for that purpose. Thus, construction of building-mounted solar facilities is not expected to affect the quality of local surface waters.

Building-mounted PV arrays typically require limited maintenance. Nevertheless, occasional maintenance activities such as periodic inspections, repairs, and cleanings may be necessary. Such maintenance activities are not expected to affect surface water quality to any noticeable extent.

Cumulative Effects
Because of the relatively small amount of additional acreage (200 to 500 acres) affected per year, no adverse cumulative impacts to local surface water quality are anticipated from projects considered in this document. Solar facility owner/operators are responsible for any discharges associated with their particular project in accordance with all applicable federal, state, and local requirements to ensure that concentrations of metals and other parameters do not adversely impact water quality of surrounding surface waters.

3.3 Wetlands

3.3.1 Affected Environment

Wetlands are those areas inundated by surface or groundwater such that vegetation adapted to saturated soil conditions is prevalent. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, mud flats, and natural ponds. Executive Order (EO) 11990, Protection of Wetlands, directs federal agencies to minimize the destruction, loss or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. In addition, activities in wetlands are regulated under the authority of the federal CWA and various state water quality protection regulations.

Wetlands are ecologically important because of their beneficial effect on water quality, their moderation of flow regimes by retaining and gradually releasing water, their value as wildlife habitat, and as areas of botanical diversity. Wetlands are typically transitional ecosystems between terrestrial and aquatic communities.

As summarized in Table 3-1, the type and extent of wetlands across the TVA PSA vary by ecoregion. In the eastern portions of the TVA region, wetlands occupy a relatively small percent of the landscape relative to uplands within the Blue Ridge, Ridge and Valley, and Central Appalachians ecoregions. These ecoregions are typically marked by relatively steep topography and deeply incised stream channels, and wetlands in these areas are typically small and isolated or linear in feature and associated with the floodplain areas of streams, rivers, and creeks (Hefner et al. 1994). Farther west, the topography levels out, and wetlands become more common. Broad, flat floodplain areas are common features, and various types of wetland habitats, especially bottomland hardwood forested wetlands, are widespread in some of the western-most portions of the PSA.

Table 3-1. Regional Variation of Wetland Abundance by Ecoregion

Ecoregion	Percent of Ecoregion Covered by Wetlands (all types of wetlands)
Blue Ridge	>0.1
Ridge and Valley	>0.1
Central Appalachians	0.3
Southwestern Appalachians	0.2
Interior Plateau	>0.7
Interior River Valley and Hills	4.6
Southeastern Plains	10.3
Mississippi Valley Loess Plain	4.6
Mississippi Alluvial Plain	19.0

Source: Loveland and Acevedo (2012).

Palustrine wetlands are the predominant wetlands in the TVA region. As described by Cowardin et al. (1979), these are nontidal wetlands dominated by trees, shrubs, persistent emergent vegetation, and emergent mosses or lichens. These wetlands include bottomland hardwood forests and upland swamps (forested wetlands), scrub-shrub wetlands, beaver ponds (aquatic-bed or emergent wetlands), wet meadows and marshes (emergent wetlands), and highland bogs (forested, scrub-shrub, or emergent wetlands that have organic soils). Lacustrine (i.e., related to a lake) and riverine (i.e., river-related) systems are also wetland types found within the region. These wetlands consist of aquatic beds containing floating or submersed aquatic plants and are more common in the western portion of the TVA region.

3.3.2 Environmental Consequences

As part of its site-specific screening process, TVA would determine if a proposed solar facility would have adverse effects to wetlands. This includes jurisdictional (i.e., those wetlands that are subject to federal regulation) and non-jurisdictional wetlands. Facilities constructed on greenfield sites are likely to have the greatest potential for direct wetland impacts. Generally, sites within or containing wetland areas tend to be unsuitable for construction of solar projects due to the presence of water. Any wetland impacts would be mitigated under regulations implementing Section 404 of the CWA, applicable state regulations and EO 11990.

Potential direct effects to wetlands are unlikely for most solar projects. Those that would affect wetlands would be subject to mitigation in accordance with regulations. Thus, cumulative effects to wetlands are expected to be minor.

3.4 Floodplains

3.4.1 Affected Environment

A floodplain is the relatively level land area along a stream or river that is subjected to periodic flooding. The area subject to a one-percent chance of flooding in any given year is normally called the 100-year floodplain. The construction and operation of solar facilities and/or the purchasing of electric power from solar sources could occur anywhere within the TVA service area.

As a federal agency, TVA is subject to the requirements of EO 11988, Floodplain Management. The objective of EO 11988 is "…to avoid to the extent possible the long- and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative" (United States Water Resources Council 1978). The EO is not intended to prohibit floodplain development in all cases, but rather to create a consistent government policy against such development under most circumstances. The EO requires that agencies avoid the 100-year floodplain unless there is no practicable alternative.

3.4.2 Environmental Consequences

As stated in Section 2.1.2, TVA would conduct site-specific analyses to identify the presence of onsite floodplains. If the proposed site is located outside of the 100-year floodplain, the project would be consistent with EO 11988, and the construction, operation, and maintenance of that project are not likely to have any effects on floodplains or their functions.

Also as stated in Section 2.1.2, in its screening process, TVA would determine if the construction, operation, and maintenance of a proposed solar project would adversely affect local floodplains or their functions. If the proposed site is located within the 100-year floodplain, and the project involves a ground-mounted system, TVA would determine practicable alternatives to the construction of the solar project within the 100-year floodplain. If no practicable alternative exists, then panels and all electrical equipment would necessarily be located at least 1 foot above the 100-year flood elevation at that location, and the project would have to comply with the requirements of the National Flood Insurance Program consistent with the local community's floodplain regulations. If the project is located along a TVA reservoir, more stringent flood risk requirements may apply.

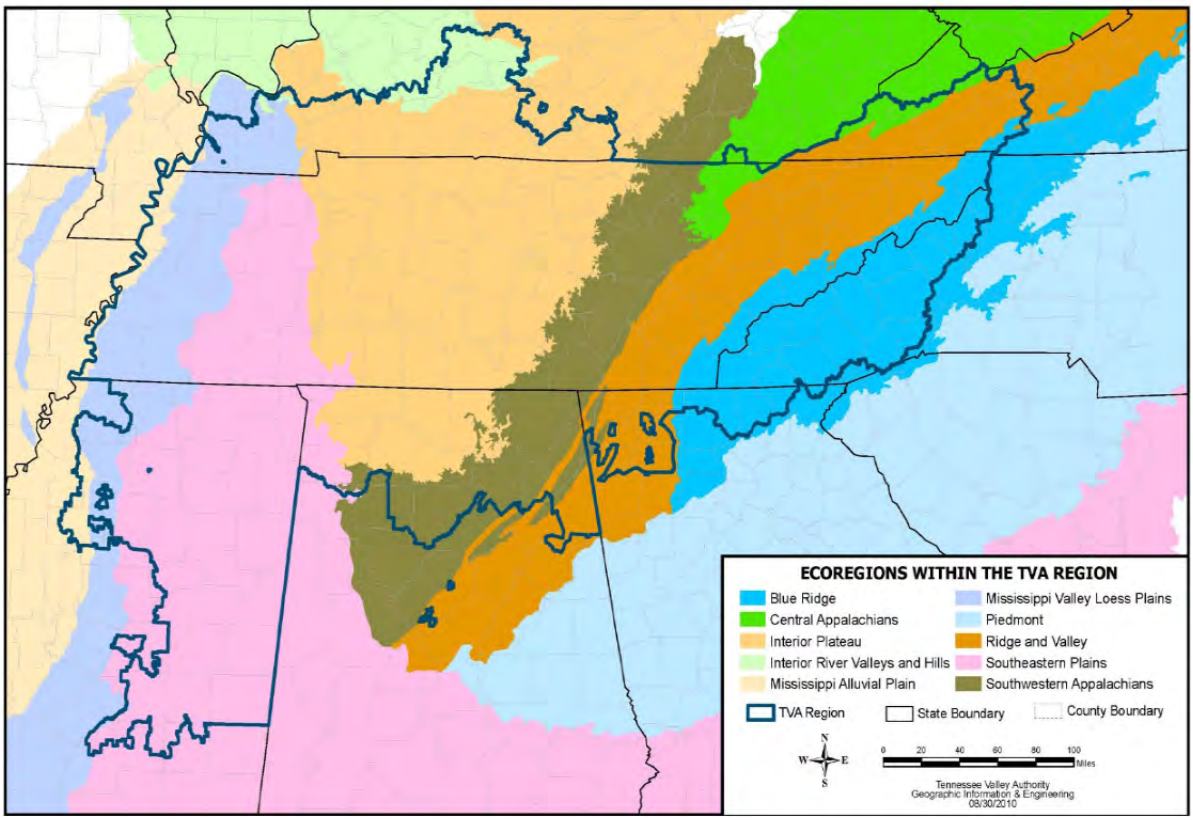
If the proposed solar facility involves mounting the equipment on an existing building, an evaluation of flooding impacts to the building would be considered. Although the PV equipment would be located on the sides or on top of a building, at an elevation that would likely be well above the 100-year flood elevation, the building itself could be subject to flood damage.

Typically, the equipment at proposed solar sites would be located at elevations above the 100-year floodplain. Panels and all electrical equipment would be elevated consistent with the requirements of the National Flood Insurance Program. Thus, installation and operation of ground-mounted or roof-mounted solar PV systems covered under this PEA are not expected to cause any long-term or cumulative direct impacts to floodplains or flood elevations.

3.5 Wildlife

3.5.1 Affected Environment

The TVA PSA contains portions of nine ecoregions (see Figure 3-1) that provide a unique mixture of wildlife habitat. Ranging from bottomland hardwood swamps in the floodplains of the Mississippi Alluvial Plain to high-elevation balds and spruce-fir/northern hardwood forests in the Blue Ridge Mountains, this diverse mixture of habitats supports a rich assemblage of wildlife communities.



Source: adapted from Omernik (1997)

Figure 3-1. Ecoregions of the TVA Power Service Area

Approximately 55 species of reptiles, 72 species of amphibians, 184 species of breeding birds, and 76 species of mammals occur in these ecoregions throughout the TVA PSA (Ricketts et al. 1999; Stein 2002; Tennessee Ornithological Society 2007; Tennessee Wildlife Resources Agency (TWRA) 2005). Although some wildlife species have widespread distributions, others have restricted ranges unique to specific ecoregions (TWRA 2005). Forest habitats in the Blue Ridge Mountains, for example, provide globally significant habitat for many species, especially amphibians and land snails (Ricketts et al. 1999). The high elevations found in the Blue Ridge Ecoregion also provide habitat for relict populations of animals typically found in more northern latitudes.

EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, requires federal agencies implementing or planning actions that could affect migratory birds and their habitats to "support the conservation intent of the migratory bird conventions by integrating bird conservation principles, measures, and practices into agency activities and by avoiding or minimizing, to the extent practicable, adverse impacts on migratory bird resources when conducting agency actions."

Many wide-ranging species occur throughout the TVA region, and most species that are tolerant to humans continue to thrive in the region. Wildlife populations have been greatly altered by loss and modification of habitats due to agriculture, mining practices, forestry practices, urbanization, and the construction of reservoirs. While some species flourish under these changes, others have shown marked declines. Grassland-dependent and woodland-dependent birds, for example, have shown dramatic decreases in their numbers (Southern Appalachian

Man and Biosphere 1996). Approximately 48 percent of birds in North America that use grasslands for breeding grounds are of conservation concern, and 23 species are significantly declining in number (North American Bird Conservation Initiative (NABCI) 2009). Both brownfield and greenfield sites have the potential to be comprised of grasslands, 85 percent of which are privately owned in North America and serve as important habitat for 29 grassland-obligate breeding bird species (NABCI, 2013). Approximately 22 percent of area-dependent woodland birds are of conservation concern. These numbers have declined by 10 percent through 1980 but have shown some increases in recent years (NABCI 2009). Habitats used by these species have been modified largely by urban development and agricultural practices. Based on the U.S. Environmental Protection Agency (2011) definition of a brownfield, and TVA's definition of a greenfield (for the purposes of this environmental review), the potential presence of forest and woodland habitat is not precluded from potentially occurring within brownfield or greenfield sites that may be selected for solar generation.

In general, gulls, wading birds, waterfowl, raptors, game birds, game mammals, and nongame wildlife (reptiles, amphibians, and small mammals) exhibit stable or increasing numbers throughout the TVA PSA. Populations of white-tailed deer, wild turkey, coyote, and beaver have shown large population increases and have fair potential to be present in or near project sites. Species associated with river corridors such as osprey and herons have also shown notable recoveries, largely since the ban of the insecticide DDT. This trend is quite noticeable along the Tennessee River, as breeding populations of these species had been relatively scarce in portions of northwest Alabama or northeast Tennessee prior to the late 1990s. In recent years, however, breeding populations of these species have expanded into these areas and have become more evenly distributed throughout the Tennessee Valley Region. Recent surveys show that shorebirds and waterfowl communities are quite diverse in portions of the TVA PSA, especially during autumn and spring migrations. Due to the objective to avoid or reduce exposure of equipment to persistently wet environments, siting of solar farms in areas that intersect riparian, lacustrine, or wetland habitat likely would be kept to a minimum, thereby limiting potential for presence of species associated with these wet habitat types.

There is some potential for solar farms to be sited on TVA-managed property. Habitats on TVA lands are just as complex as other lands found throughout the TVA PSA, and they support diverse communities of wildlife. Important habitats found in the Tennessee Valley Region include riparian corridors, bluffs, swamps, grasslands, rivers, reservoirs, islands, large unfragmented forested landscapes, and karst habitats (i.e., landscapes comprised of exposed limestone and characterized by sinkholes, underground streams, and caverns).

Riparian habitats associated with the Tennessee River and its tributaries provide important habitats for wildlife. Coupled with unique features such as vernal pools, oxbows, bluffs, and islands, these areas provide a diverse array of nesting and foraging habitats for wildlife. Similar to site selection across private lands, selection of greenfield or brownfield sites containing these features likely would be minimized, both to avoid complications with operating equipment in wet environments, and to limit environmental impacts.

Open lands are comprised of herbaceous fields, livestock pasture, agricultural practices, and other early successional habitats. Most of these areas have been greatly modified by intensive row cropping and timber harvesting. Yet, these habitats also provide needed environment for species favoring early-successional habitats. Given the relative ease of preparing open lands for use as solar farms (i.e., reduced clearing and grading compared to sites with forest cover, karst features or steep gradients), open lands will likely be a common feature among greenfield and brownfield sites selected.

Caves are abundant features throughout much of the TVA PSA, especially in north Alabama, northwest Georgia, and the eastern half of Tennessee. These sites provide a unique mixture of microhabitats used by a diverse array of cave-dependent species, some endemic to single cave systems. Cave and karst systems are present at high elevations, in forested landscapes, along river and reservoir shorelines, and across agricultural settings. Due to the abundance of karst and cave features across the TVA PSA in both developed and undeveloped settings, there is some potential for caves to occur within brownfield and greenfield sites.

3.5.2 Environmental Consequences

The primary source of impacts to wildlife populations from the construction and operation of solar facilities is the alteration of habitats from grading and the removal of onsite vegetation at ground-mounted facilities. The installation of PV panels, supporting racks, and security fencing, as well as the habitat fragmentation resulting from solar facility construction, could also affect wildlife. The extent of habitat disturbance and the resulting effects on wildlife would be site-specific and vary depending on the habitat conditions, topography, and size of the site. Most ground-mounted solar facilities constructed in the TVA region to date have been on pastures, hayfields, and cropland and only a small number of facilities have required the clearing of forest Building-mounted solar installations typically would pose little potential for affecting wildlife.

Construction activities and noise associated with mobilization, equipment operations, and human presence have the potential to displace animals to adjacent areas. In most cases, any naturally occurring habitat would either remain in an early-successional state (i.e., agricultural or otherwise open land), or be permanently converted to early-successional habitat if tree cover is present and needs to be removed. Some species of endemic wildlife would possibly return to the project site upon completion of construction activities if a component of suitable habitat remains (i.e., shelter, food source, reproductive opportunity). However, larger mammals such as deer and coyotes would likely be excluded by the presence of security fences. Arboreal species and those requiring some degree of woody cover likely would not return. Mortality to any individual animals burrowing underground within the project area (e.g., shrews, moles and voles) may occur as a result of construction associated with installing support structures and underground wires or cables. Because of their localized nature, such effects would be minor.

Projections indicate that future solar projects could occupy an additional 200 to 500 acres per year, or equivalent rooftop space, across the TVA region. Potential effects to wildlife are difficult to quantify due to lack of site-specific locations and associated lack of information on what proportions of each habitat type would be affected. However, qualitative conclusions can be made based on the following circumstances: specific sites would be 20 acres at most; site preparation would likely involve minimal grading and excavating; and sites would be maintained via mechanical mowing or with livestock. Thus, impacts to individual animals that may occur in project sites are not expected to reach levels that would reduce the health of respective local or regional species populations. Because of the limited acreage of land involved, long-term cumulative effects to wildlife are expected to be minor.

3.6 Vegetation

3.6.1 Affected Environment

The terrain across the TVA region is diverse and crosses nine ecoregions from the mountains of the Blue Ridge to the bottomland hardwoods and cypress swamps of the Mississippi Alluvial Plain (Figure 3-1). The TVA region, rich in biodiversity, is composed of numerous habitats and

plant communities which provide habitats for approximately 4,000 species of herbs, shrubs, and trees.

Ecoregions

The TVA region spans nine ecoregions, which include the Blue Ridge, the Ridge and Valley, the Central Appalachians, the Southwestern Appalachians, the Interior Plateau, the Interior River Valley and Hills, the Southeastern Plains, Mississippi Valley Loess Plain, and the Mississippi Alluvial Plain (Omernik 1987).

The easternmost part of the PSA is in the Blue Ridge Ecoregion, an area composed of remnants of an ancient mountain chain. This region has a greater variation in terrain than other regions in the Tennessee Valley. Terrain ranges from nearly level along floodplains to rugged mountains that reach elevations of more than 6,000 feet. The southern Blue Ridge is one of the richest centers of biodiversity in the eastern United States and one of the most floristically diverse (Griffith et al. 1998). The land cover in this ecoregion is dominated (80 percent) by mesophytic forest which includes the Appalachian oak forest, and 13.5 percent of the land cover is in the form of agriculture (Dyer 2006; U.S. Geological Survey (USGS) 2008). Within the forest regions are several significant plant communities such as the northern hardwood forests, and at the highest elevations in Tennessee and North Carolina, the southeastern spruce-fir forest. Shrub, grass, and heath balds, hemlock, cove hardwoods, and oak-pine communities are also significant.

Located east of the Southwestern Appalachian Ecoregion and west of the Blue Ridge, the Ridge and Valley Ecoregion has complex folds and faults with alternating valleys and ridges trending northeast to southwest. Ridges have elevations of up to 3,000 feet and are generally capped by dolomites and resistant sandstones on the west sides, while valleys have developed in more soluble limestones and dolomites. The dominant soils in this ecoregion are residual clays and silts derived from in-situ weathering. Karst features such as sinkholes and springs are numerous in the Ridge and Valley. Soils vary in their productivity, and 56 percent of the land cover is forested (USGS 2008) with Mesophytic Forest, Appalachian Oak Forest as the dominant forest regions with Southern Mixed Forest and the Oak-Pine section occurring in the southern-most area of the ecoregion (Dyer 2006). Land cover also includes pasture, intensive agriculture (30 percent), and 9 percent in urban and industrial areas (USGS 2008).

The Central Appalachian Ecoregion stretches from central Pennsylvania through West Virginia, Maryland, Virginia, and Kentucky and into northern Tennessee (Omernik, 1987). It is primarily a high, dissected, rugged plateau composed of sandstone, shale, conglomerate, and coal. The Cumberland Mountains of Tennessee and Kentucky are known for their rugged terrain, cool climate, and infertile soils. As a result, this limits agriculture, and most of the land cover is forest. According to USGS (2008), approximately 83 percent of the Central Appalachians consist of mesophytic forests with areas of Appalachian oak forests covering the high hills and low mountains. The remaining land use is in the form of agriculture (7 percent) and urban or developed areas (3 percent).

The Southwestern Appalachian Ecoregion, which is subdivided into the Cumberland Plateau and Sequatchie River Valley, rises about 1,000 to 1,500 feet higher than the adjoining Ridge and Valley Ecoregion to the east and Interior Plateau to the west. It extends about 175 miles, ranging northeast to southwest across central Tennessee. The bedrock is a sequence of near horizontal Pennsylvanian sandstones, shales, conglomerates, and coals, underlain by Mississippian and older shale and carbonates. The area underlain by the resistant Pennsylvanian sandstones has produced a “table-top” landscape. Groundwater usually occurs

in areas of shallow, sandy soils and in deeper cracks in the bedrock. At depth, the Mississippian carbonates possess mature Karst features. Sinkholes, large caves, sinking streams, and springs typify the landscape, resulting in a complex aquifer system. Rapid groundwater movement is typical. Approximately 75 percent of the land cover is mesophytic forest with 16 percent considered agricultural lands and almost 3 percent is developed (USGS 2008).

The Interior Plateau Ecoregion is a series of grassland plateaus and forested uplands that are generally lower in elevation than the Appalachian Mountains to the east but higher than the plains to the south (USGS 2008) and occupies much of central Tennessee and parts of Kentucky and northern Alabama. The Interior Plateau consists of the east and west Highland Rim and the Central Basin. The Highland Rim was formed from flat-lying Mississippian carbonates and these formations constitute the most extensive aquifer in the Tennessee region. The Central Basin (Nashville Basin) is an oval area in middle Tennessee lying about 200 feet below the surrounding Highland Rim. The bedrock consists of carbonate rocks that are generally flat-lying but are locally folded, and the soil cover is usually thin and home to a globally uncommon ecosystem, the limestone cedar glades and barrens. The plant communities associated with the cedar glades and barrens within the Central Basin are home to 544 plant species, 448 which are native, and of those 21 are endemic to the glades/barrens (Baskin and Baskin 2003). The forested area of the Central basin, as previously mentioned, has closer affinities to the beech-maple-basswood forest of the Midwest than to the mesophytic forests of the other sections of the Interior Plateau. Fifty percent of the land use is in the form of agricultural practices, with 38 percent being forested, and approximately 10 percent developed.

Within the TVA region, a small portion of the Interior River Valley and Hills Ecoregion can be found in northwest Kentucky, where it is made up of nearly level lowlands dominated by agriculture and forested hills. It is characteristically underlain by carboniferous sedimentary rock. Drainage conditions and terrain strongly affects land use. Wetlands are common on lowlands and bottomlands. Bottomland deciduous forests and swamp forests were once extensive on poorly-drained, nearly level, lowland sites, but most have been replaced by cropland and pastureland. Hilly uplands remain mostly forested. This ecoregion includes Kentucky's Western Coal Fields, where both underground and surface coal mining are now extensive.

The Southeastern Plains Ecoregion, the largest ecoregion in the east, extends from near the Gulf of Mexico in the south to Maryland in the north and up to Tennessee in the west. In the TVA region, this ecoregion is found in parts of western Alabama, eastern Mississippi, and western Tennessee. The irregular, relatively flat plains of the region are covered by a mosaic of forests (51 percent), agricultural lands (22 percent), and wetlands (10 percent). Natural forests of pine, hickory, and oak once covered most of the ecoregion, but much of the natural forest cover has been replaced by heavily managed timberlands (USGS 2008).

Sandwiched between the Mississippi Valley Alluvial Plain to the west and the Southeastern Plains to the east, the Mississippi Valley Loess Plain Ecoregion extends from western Kentucky south to Louisiana. The topography consists primarily of irregular plains. A highly erodible, thick layer of loess, a unique geologic deposit consisting almost entirely of wind-transported, silt-sized grains of quartz and other common minerals, is the distinguishing characteristic of this region (Omernik, 1987). Forest, agriculture, and developed land account for more than 90 percent of the land cover in the ecoregion. The southern portion of the ecoregion is a mosaic of forest and cropland, while agriculture is the dominant land use in the northern portion. Trees,

cotton, corn, soybeans, strawberries, and tobacco are common crops grown throughout the region (USGS 2008).

The Mississippi Alluvial Plain occurs along the Mississippi River floodplain on the very western edge of the TVA region. Bottomland hardwood forests and cypress swamps, also referred to as forested wetlands, are the dominant natural plant communities in this region. A key factor in the development and maintenance of these communities is their ability to survive extended periods of flooding. Much of land use within the region is agricultural, with some areas of deciduous forest. According to Griffith et al. (1998), soybeans, cotton, corn, sorghum, and vegetables are the main crops. The natural vegetation consists of southern floodplain forests consisting of typical species such as oak, tupelo, and bald cypress.

Globally Rare Communities and Sensitive or Threatened Ecosystems

NatureServe (2013) recognizes 83 community associations within the TVA region as having a Global ranking of G1. The G1 ranking defines communities that are Critically Imperiled and at a high risk of extinction due to extreme rarity (often five or fewer occurrences worldwide). A list of the G1 ranked communities is provided as Appendix A. The G1 communities are classified based on their NatureServe vegetation classification, the state in which they are found, if they occur in rare ecosystems (described below), and the ecoregion(s) in which they occur (Figure 3-1). Often, rare communities harbor endangered and native plant and/or animal species, as well as species not found outside the TVA region.

Approximately two thirds of all G1 communities found within the TVA region occur within the Blue Ridge Ecoregion. The Interior Plateau contains about 15 percent, and the Southwestern Appalachians harbor about eight percent. The remaining six ecoregions contain relatively few G1 plant communities. Often these globally rare communities are found in sensitive or threatened ecosystems such as the Southern Appalachian spruce-fir forest, cedar glades, grasslands, prairies and barrens, Appalachian bogs, fens and seeps (including ponds), and bottomland hardwood forests. Most of these sensitive ecosystems are being threatened by anthropogenic related causes such as urban development, agricultural practices, and the introduction of exotic species. Of these sensitive communities, cedar glades along with grasslands, prairies and barrens could be encountered during planning of future solar projects.

Cedar Glades

Cedar glades are areas of exposed limestone bedrock, gravel, and/or shallow soil over limestone bedrock, sparsely vegetated with low-growing herbaceous plants and red cedars (Quarterman et al. 1993). Their greatest concentration occurs within the Interior Plateau Ecoregion in central Kentucky, central Tennessee, and northern Alabama. A few glades also occur within the Ridge and Valley province of Alabama, Georgia, Tennessee and Virginia. Twenty-two species or subspecies of plants are endemic to these southeastern glades (Baskin and Baskin 1986; 2003), five of which are listed under the ESA. The total area of remaining cedar glades, most of which are within the TVA region, is only a few thousand acres. Many glades have been destroyed or heavily disturbed by urban development, highway construction, agricultural activities and reservoir impoundment. Often these fragile ecosystems are used for illegal dumping grounds for household waste and for recreational use by off road vehicles. In addition, many glades are being invaded by invasive plant species that out-compete native plants (U.S. Fish and Wildlife Service (USFWS) 2009).

Remnant Grasslands, Prairies and Barrens

In the southeastern United States, native grasslands and prairies, while frequently being reduced to roadside remnants, occur sporadically throughout the region in a wide range of

ecological settings (Pyne 2008). According to McGowen et al. (2009), the open prairie habitat, dominated by little bluestem, also contains many other species of grasses and herbaceous plants (such as big blue stem, Indian grass, compass plant, and Mexican hat) that are characteristic of the Great Plains. A specific type of grassland community, the Southern Appalachian Grassy Bald, consist of treeless areas covered by grasses, sedges and forbs and surrounded by spruce-fir forests at high elevations in the Blue Ridge (Jenkins 2007).

The barrens ecosystems are a mosaic of open-canopy woodlands with a grassy understory and areas of essentially treeless grassland. According to DeSelm and Murdock (1993), the barrens in the southern Appalachians are related by their dominant plants to prairies of the west and north, but are unique in that they have strong local and southern plant relationships. Big bluestem, little bluestem, Indian grass, pale-purple coneflower, and prairie gentian are species in common with the tall grass prairies of the Midwest and false asphodel and snowy orchids are disjunct species from the coastal plain (USFWS 2009). Other than human impacts, one of the main threats associated with these ecosystems is from encroachment of woody vegetation into the open areas. One of the best examples of this ecosystem is the Southern Coastal Plain Blackland Prairie and Woodlands found in Mississippi and Alabama. Areas of Blackland Prairie are typically found on well drained, slowly permeable, alkaline soils, while the Blackland Woodlands are mostly an oak-hickory forest associated with strongly acidic soils. These open prairies are also home to several endemic and rare species of plants (e.g., the celestial lily, old Cahaba rosinweed, purple prairie clover, and three flowered hawthorn). However, due to the region's fertile soil, much of the prairie has been lost to agriculture and has been reduced to small remnants. It is estimated that less than 1 percent of the Black Belt's open prairie habitat remains intact. The remaining prairie remnants are threatened by development, erosion, encroachment of eastern red cedar, waste disposal, fire suppression and other human activities. In recent years, areas in several of the higher-quality prairies have been disturbed by recreational driving and planting green-fields for deer hunting (McGowen et al. 2009). In addition, the invasion of Chinese tallow tree, cogongrass and kudzu alters the ecosystem and inhibits the growth of native species (Stanton and Wymer 2008).

Invasive Plants

Invasive plants infest under and beside forest canopies and occupy small forest openings, increasingly eroding forest productivity, hindering forest use and management activities, and degrading diversity and wildlife habitat. They occur as trees, shrubs, vines, grasses, ferns, and forbs. Some have been introduced into this country accidentally, but most were brought here as ornamentals or for livestock forage. These robust plants arrived without their natural predators of insects and diseases that tend to keep native plants in natural balance. Now they increase across the landscape with little opposition, beyond the control and reclamation measures applied by landowners and managers on individual land holdings (Miller 2003).

Most lands in and around the TVA power service area have been invaded by introduced non-native plant species. Non-native plants are known to occur across Southern Appalachian forests, accounting for 15 to 20 percent of the documented flora (U.S. Forest Service (USFS) 2009). According to NatureServe (2013), invasive non-native species are the second leading threat to imperiled native species. Not all non-native species pose threats to our native ecosystems. Many species introduced by European settlers, are naturalized additions to our flora and are considered to be non-native non-invasive species. These "weeds" have minor negative impacts to native vegetation. Examples include Queen Anne's lace and dandelion. However, other non-native species are considered to be exotic invasive species and do pose threats to the natural environment. EO 13112 (Invasive Species) defines an invasive species as any species, including its seeds, eggs, spores, or other biological material capable of

propagating that species, that is not native to that ecosystem; and whose introduction does or is likely to cause economic or environmental harm or harm to human health (U.S. Department of Agriculture (USDA) 2007; 2009).

According to the Federal Noxious Weed List of 2006 (USDA 2007), the Supplement (USDA 2009), and the Southeastern Exotic Plant Pest Council (2008), there are four known federal noxious weeds reported from the TVA region: cogongrass, giant salvinia, hydrilla, and tropical soda apple. Currently, Georgia, Mississippi and Tennessee have developed agreements with federal and state agencies to create Cooperative Weed Management Areas to implement an Early Detection Rapid Response program to assist public and private landowners with controlling invasive species. These three states have developed these plans in hopes of controlling cogongrass. Cogongrass is an aggressive invader of natural and disturbed areas throughout the southeast, disrupting ecosystem functions, reducing wildlife habitat, decreasing tree seedling establishment and growth, and altering fire regimes and intensities (Evans et al. 2008). Miller et al. (2008) estimated the area covered by 33 invasive species within the southern states. Their data show that 19 percent of Alabama, 5 percent of Georgia, 16 percent of Kentucky, 5 percent of North Carolina, 16 percent of Tennessee, and 10 percent of Virginia forests are estimated to be covered by non-native species.

3.6.2 Environmental Consequences

The acquisition of additional renewable energy by TVA would involve the construction, operation and maintenance of solar power facilities across its service area. Although the vast majority of the plant communities within the TVA region are well represented throughout the region, there are rare habitats such as cedar glades, barrens, flatwoods, grasslands and prairies that support rare plant species and have few infestations of non-native plants.

As stated in Section 2.1.2, TVA would determine site characteristics, including the presence of rare or unique plant communities at prospective solar facility sites. If rare plant communities are present, site-specific measures to avoid or mitigate adverse impacts to these sensitive resources would be developed and implemented.

As of 2011, over 30 million acres of forested land occur within counties located in the TVA PSA (USFS 2014). While several million acres of that forested habitat are comprised of intensively managed pine plantations, the vast majority of the forest in the PSA has regenerated naturally and is in varying stages of succession. As stated earlier, an estimated additional 200 to 500 acres of land or equivalent roof space would be used per year for the solar projects considered in the PEA. Even if all this area were to be situated in forested areas, that conversion would represent a miniscule percentage of forest resources present at the local, regional or state level. Thus, potential effects to forest resources are expected to be negligible.

Most sites in the region that are maintained as open areas contain a substantial proportion of invasive plant species. Disturbances associated with agriculture, grazing, and mowing prevent tree species from becoming established, but can also encourage invasion and establishment of weedy plants. The vast majority of these invasive plants are common throughout the region, and construction, operation, and maintenance of a solar facility would have little to no effect on the extent or abundance of these invasive plant species at the county, regional, or state level.

If TVA determines that a federal-noxious plant is present on a prospective solar site, effective measures to ensure TVA compliance with EO 13112 would be developed and implemented. In the event sensitive plant habitats are present, appropriate avoidance measures to ensure there would be no major impacts resulting from construction, operation and maintenance of the facility

would be implemented. Therefore, only minor direct, indirect, or cumulative impacts to the vegetation of the region are anticipated.

3.7 Aquatic Ecology

3.7.1 Affected Environment

The TVA PSA contains portions of the Tennessee, Cumberland, and Alabama River systems. Aquatic features of these river systems drain a diverse physiography and associated topography providing abundant habitats which are occupied by extremely diverse aquatic faunas and represent important commercial and recreational fisheries (TVA 2005). These aquatic habitats have been affected by varying levels of agricultural, residential, and industrial land uses. A description of the aquatic communities within the Tennessee River system is provided in Section 4.6 of the *Final Programmatic Environmental Impact Statement for TVA's Natural Resource Plan* (TVA 2011b).

3.7.2 Environmental Consequences

Aquatic life could be affected by the future development of proposed solar facilities. Potential impacts could occur directly or indirectly due to modification of the riparian zone and stormwater runoff resulting from construction activities, as described in Section 3.1 and 3.2. 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. A potential indirect effect of routine maintenance includes potential herbicide runoff into streams.

As necessary, appropriate BMPs such as those described by Muncy (2012) would be implemented to avoid potential adverse effects to water quality and aquatic life. Specifically, these BMPs provide guidance for activities occurring in or around Streamside Management Zones (SMZs) to minimize the amount and length of disturbance to water bodies and maintain natural stream buffers. As mentioned in Sections 3.1 and 3.2, an NPDES stormwater construction permit would likely apply to most prospective solar facilities. This permit requires the preparation of a Stormwater Pollution Prevention Plan that outlines measures that would be implemented to avoid or reduce adverse effects to local waters. Additionally, TVA would routinely require the implementation of the measures stated in Section 2.3, which include implementing precautionary measures to avoid release of herbicides and discharges to surface waters.

Given TVA's recent experience and near term forecast, solar projects covered in the scope of this assessment are expected to require an estimated additional 200 to 500 acres, or equivalent rooftop space, each year over the entire PSA. TVA would require suppliers of solar power to obtain all applicable permits for any stream alterations located within the project area, and the terms and conditions of these permits could require mitigation. Minor temporary direct adverse impacts during construction are possible. However, because appropriate BMPs and SMZs would be implemented during construction, operation, and maintenance, and because all appropriate permits would be obtained, any direct, indirect, or cumulative impacts to aquatic life are anticipated to be minor. Because rivers, streams, wetlands, and floodplains would typically be avoided during construction of solar projects, no cumulative impacts to aquatic ecology are anticipated.

3.8 Threatened and Endangered Species

3.8.1 Affected Environment

Under the ESA, endangered species are those determined to be in danger of extinction throughout all or a significant portion of their range. Threatened species are those determined to be likely to become endangered within the foreseeable future. A review of the TVA heritage database indicates183 species of animals and plants inhabiting the TVA Power Service Area are federally listed (i.e., listed under the ESA) as threatened or endangered (see Appendix B). Of these,

108 are aquatic animals
- 87 are listed as endangered
- 18 are listed as threatened
- 3 are candidate species

34 are terrestrial animals
- 16 are listed as endangered
- 7 are listed as threatened
- 9 are candidate species
- 1 is a proposed endangered taxon
- 1 is a federally-protected species

41 are plant species
- 20 are listed as endangered
- 14 are listed as threatened
- 3 are candidate taxa
- 2 are proposed endangered species
- 1 is a proposed threatened taxon
- 1 delisted species in need of management

3.8.1.1 Federally Listed Threatened and Endangered Species

Over 90 percent of the federally listed species occur within five of the nine ecoregions in the TVA PSA. A majority of federally listed animal species are found in the Interior Plateau, the Ridge and Valley, Southwest Appalachians, and Southeastern Plains Ecoregions. However, the Blue Ridge, Interior Plateau, and Southwest Appalachians contain the most rare plant species. Table 3-2 depicts the distribution of federally listed species found in each of the nine ecoregions in the TVA PSA.

Table 3-2. Distribution of Federally Listed Species by Ecoregion

Ecoregion	Percent Share[1]
Blue Ridge	17.4
Central Appalachians	3.8
Interior Plateau	38.0
Interior River Valley and Hills	7.6
Mississippi Alluvial Plain	3.2
Mississippi Valley Loess Plain	1.1
Ridge and Valley	43.2

Ecoregion	Percent Share[1]
Southeastern Plains	31.7
Southwestern Appalachians	27.3

[1]Percent share represents the percent of all presently known listed species within the TVA PSA that occur within a given ecoregion. Because a listed species may occur in multiple ecoregions, the percentages do not total 100 percent.

Aquatic Species

Habitat requirements for species in the PSA are described for insects and crayfish in NatureServe (2013), for fishes in Boschung and Mayden (2004), Etnier and Starnes (1993), and Ross (2001), for mussels in Parmalee and Bogan (1998) and Williams et al. (2008). The following provides a brief description of federally listed aquatic species known from the PSA that could be affected by the proposed action because of their use of ephemeral aquatic habitats. Of the federally listed aquatic animal species present in the PSA, potential impacts could occur to the Nashville crayfish and slackwater darter.

The Nashville crayfish is a federally endangered crayfish known to occur only in Mill Creek and its tributaries in Davidson and Williamson Counties, Tennessee, in the Cumberland River basin and the Interior Plateau Ecoregion. It lives in moderate flow streams with firm, rocky bottom and requires clean, high quality water to survive. The breeding season is in the spring (O'Bara 1999). The Mill Creek drainage lies in the Nashville Basin of the Interior Plateau Ecoregion, and originates in mixed forest and agricultural lands. However, a large portion of the watershed lies in urban and suburban environments. Although the Nashville crayfish is thought to be fairly tolerant of adverse conditions, its limited range renders it vulnerable to catastrophic events, and continuing urbanization, and development may exceed the tolerance limits of this species (O'Bara 1999).

The slackwater darter is a federally threatened fish endemic to tributaries of the Tennessee River in Alabama and Tennessee. The species is known from the Buffalo River and Shoal Creek, Tennessee; from Cypress Creek and Brier Fork, Alabama and Tennessee; and Limestone Creek and Swan Creek, Alabama. The tributaries where slackwater darters are found lie primarily within the Highland Rim of the Interior Plateau Ecoregion in Alabama and Tennessee. The species has distinct breeding and non-breeding habitats, and migrates from resident stream habitats, where it is often found in leaf packs and moves onto breeding sites in winter months. Breeding habitat is characterized by areas of seepage water, either in small streams of typically agricultural areas or in seasonally flooded fields. Slackwater darters attach their eggs to vegetation, and adults and juveniles migrate downstream to larger streams in spring (Boschung and Neiland 1986). Loss of connectivity between breeding and nonbreeding sites and destruction of seepage areas are considered detrimental to successful reproduction of this species. Critical habitat has been designated in the Cypress Creek and Buffalo River systems for the slackwater darter (USFWS 1984).

Terrestrial Animal Species

Terrestrial animals addressed in this section include amphibians, reptiles, birds, mammals, and terrestrial invertebrates with federal status, either under the ESA or other regulatory protection. For the purpose of discussing affected environment, these 34 terrestrial animal species with federal status have been grouped into the following six categories, primarily based on habitat use:

1) montane habitat
2) aquatic features (river, lakes, mudflats, wetlands)
3) caves/subterranean/karst
4) mature pine-savannah woodlands
5) widespread/woodland/forest
6) widespread, but likely extirpated

Montane Habitat

Relatively moist, cool, upland slopes below forest cover that is dominated by large coniferous trees generally characterizes montane habitat. Four federally listed terrestrial animal species associated with this type of habitat have been documented within TVA's PSA. These include one mammal (i.e., the Carolina northern flying squirrel) and three invertebrates (the spruce-fir moss spider, the painted snake coiled forest snail, and the noonday globe).

Mesic, high-elevation spruce-fir forest communities with an understory that supports the growth of lichens or moss are an optimal component of habitat for both Carolina and Virginia northern flying squirrel and for the spruce-fir moss spider. Both of the snail species inhabit areas with mesic cliffs and exposed rock. A forest floor with a thick humus layer also is important to the painted snake coiled forest snail (NatureServe 2013). With the exception of painted snake coiled forest snail, records for which are limited to the Southwestern Appalachian Ecoregion, documented occurrence of these species is limited to the Blue Ridge Ecoregion. The availability of sites within this habitat type that would be suitable for solar generation (i.e., generally level and with sufficient solar exposure) is probably very limited given the prevalence of steep slopes, but perhaps there is some potential in areas where exposed summits are relatively level and easily accessible.

Aquatic Features

Twelve federally listed terrestrial animal species primarily associated with aquatic habitat (e.g., rivers, lakes, reservoirs, mudflats, wetlands) have been documented in the TVA PSA. These include five birds (interior least tern, piping plover, whooping crane, and the wood stork), the Louisiana black bear, one amphibian (the Black Warrior waterdog), four reptiles (the bog turtle, flattened musk turtle, ringed map turtle, and yellow-blotched map turtle), and two invertebrates (Mitchell's satyr and Hine's emerald dragonfly).

Records of these species within the TVA region occur within seven of the nine ecoregions. These include the Blue Ridge, Ridge and Valley, Southwestern Appalachian, Interior Plateau, Interior River Valley and Hills, Southeastern Plains, and Mississippi Alluvial Plain Ecoregions. This illustrates the geographic extent of aquatic habitat present across the region and associated scattered presence of these rare species. Areas persistently wet or with a long annual hydroperiod likely would provide a poor setting for access to, and establishment of, equipment used for solar generation. However, wet habitats may occur adjacent to brownfield or greenfield sites selected for use of solar projects (TVA 2013).

Caves/Subterranean/Karst

As noted in the previous section, karst habitat is prevalent throughout much of the TVA region. Ten terrestrial animals with federal status and that are considered cave obligate species have been documented within the TVA region. These include the gray bat, the Virginia big-eared bat, the Berry Cave salamander, and seven beetles (*Pseudanophthalmus inexpectatus*, Baker Station Cave beetle, Coleman Cave beetle, Fowler's Cave beetle, Inquirer Cave beetle, Noblett's cave beetle and Indian Cave Point Cave beetle).

Many of these species occur only within a single cave or one particular cave system, and thus would be potentially affected only if a greenfield site were situated on the landscape above that specific cave system. Other species, such as gray bat, occur throughout the PSA, inhabiting caves throughout the year, migrating between those used as summer roosts and/or maternity colonies and those used as winter hibernacula[6], and foraging over water (Tuttle 1976). With the exception of the gray bat, which has been documented in seven of the nine ecoregions, records of species with federal status and associated with karst habitat occur within the Blue Ridge, Ridge and Valley, and Interior Plateau Ecoregions. Because caves are scattered across the PSA and occur in areas already cleared and either historically or currently in use for agricultural purposes, solar facilities at greenfield or brownfield sites could potential be sited in the vicinity of caves inhabited by listed species.

Mature Pine-Savannah Woodlands

One federally listed terrestrial animal species that is primarily associated with mature pine-savannah woodlands (the red-cockaded woodpecker) has been documented in the TVA PSA. Optimal habitat for this woodpecker occurs in mature longleaf and loblolly pine forests. Clans excavate nests in a cluster of one to several in mature pine trees with an open understory (Nicholson 1997). Only a small percentage of suitable habitat remains for this species throughout its range, and is limited, in most cases, to that which occurs on lands (e.g., U. S. Forest Service, national wildlife refuges or state-managed park property) that are specifically managed for this species, within the TVA region. Known colonies of red-cockaded woodpecker are relatively stationary and are located in the Ridge and Valley, Southwestern Appalachian, Interior Plateau, Southeastern Plains Ecoregions. Based on the stationary nature of these colonies, the respective land ownership where these colonies occur, and the current monitoring and management targeted for these species, sites selected for solar generation are not likely to co-occur with red-cockaded woodpecker.

Widespread/Woodland/Forest

Three terrestrial animal species with federal status (i.e., the federally protected bald eagle, federally endangered Indiana bat, and the northern long-eared bat, which has been proposed for listing as federally endangered) are widespread in their occurrence across the TVA region. Each of these species requires habitat that includes some level of tree cover, which can range from single, scattered trees across the landscape to contiguous forest. Bald eagles in the TVA region typically select large, tall trees for nesting that have prominent views and that are fairly close to rivers, lakes and reservoirs, over which they forage (Hudson 2006). Indiana bats hibernate during winter in caves and migrate to roost in trees during spring and summer. Roosting during spring and summer primarily occurs under exfoliating bark or cracks and crevices of snags, but use of exfoliating bark, cracks, crevices, and hollows of live trees also has been documented. Indiana bats change roost trees frequently within an area during summer months, yet maintain some site fidelity to areas used during the summer, returning to those areas in subsequent years (USFWS 2007b). Northern long-eared bats similarly hibernate and caves and then migrate to roost in trees. Northern long-eared bats appear to be more opportunistic in selection of roost trees. With the exception of the Mississippi Valley Loess Plain, these species have been documented in all ecoregions. There is potential for habitat suitable for each of these species to be present at potential brownfield or greenfield solar facility sites.

[6] *Hibernacula* are locations, such as caves, where bats regularly hibernate.

Widespread but likely extirpated

Bachman's warbler, the American burying beetle, and the eastern cougar are federally listed terrestrial animal species that have been documented within the TVA PSA. These species were historically widespread, and records within the PSA for each species are considered historic in nature, such that the species are no longer present in the location where each was recorded. Throughout its range, American burying beetle has been documented across a variety of habitat types, but it is thought that optimal habitat is mature forest. The beetle feeds upon carrion and burrows in soil (NatureServe 2013). One record occurs for the American Burying beetle within the PSA and is located in the Interior Plateau ecoregion. Eastern cougar, with records in the Blue Ridge Ecoregion, occupied a wide variety of habitats, ranging from bottomland hardwood swamps to mountainous country with enough ground cover to illusively move with little detection (NatureServe 2013). Bachman's warbler is considered extirpated and is likely extinct within the TVA PSA. Given the possible extirpation and limited documented occurrence of these species, they are very unlikely to occur within prospective brownfield or greenfield solar sites.

Numerous terrestrial animal species across the seven-state TVA PSA have been determined at the state level to be rare and in need of protection. Many of these species generally are associated with one or more of the habitat types as defined above and, thus, have potential to be present within prospective brownfield and greenfield solar sites, depending on suitability and availability of habitat within the project footprint. One additional type of habitat not discussed above is early-successional (herbaceous or scrub-shrub, open) habitat, which perhaps has the greatest potential to be present within prospective sites due to the likely reduced extent of vegetative clearing or grading that would be required to prepare such as site for use. Many species with state-level rare and/or protected status and that are associated with early-successional habitat have been documented in the TVA PSA. These include a large number of grassland breeding and/or overwintering birds, amphibians, mammals, reptiles, and a variety of invertebrates (e.g., butterflies, dragonflies, and crickets).

Plant Species

Based on habitat evaluations of the 41 federally listed plant species found within the TVA PSA, 12 species have the potential to be affected by actions associated with solar facilities and are discussed further in this section. The species described below occur in rare plant communities that have the greatest potential to be affected by solar projects. Fleshy-fruit gladecress, leafy prairie clover, lyre-leaf bladder pod, Pyne's ground plum, Short's bladder-pod, and Tennessee coneflower are found in cedar glade habitats. Alabama leather flower, Mohr's Barbara's buttons, and whorled sunflower are found in prairie openings. Price's potato bean and green pitcher plant can occur within transmission line rights-of-way and other open spaces.

The Alabama leather flower is known from six populations, with five in Alabama and one in Georgia (USFWS 2010). Natural habitats are open grass-rush prairie areas and adjoining hardwood swamp forests. Populations continue to be threatened by habitat destruction and adverse habitat modification. Herbicide usage continues to be a concern for those populations near roadsides and near power line rights-of-way (USFWS 2010).

Fleshy-fruit gladecress, known from six populations in two northern Alabama counties, grows in limestone cedar glades that exhibit various degrees of disturbance, including pastures, roadside rights-of-way, and cultivated or plowed fields (USFWS 2012b). As with other species endemic to cedar glades, threats include habitat loss or alteration of habitat due to commercial/private development, encroachment of competing vegetation, livestock grazing, intensive right-of-way maintenance activities, off-road vehicle traffic, and trash dumping. According to USFWS (2013a), critical habitat designations have been proposed for the fleshy-fruit gladecress.

Green pitcher plant is restricted to northeastern Alabama, north Georgia, and southwestern North Carolina. Of the 36 occurrences, 33 occur in Alabama (NatureServe 2013). Three distinct habitat types have been described for the green pitcher plant. These include: sandstone stream banks, mixed oak or pine flatwoods, and seepage bogs. All habitats involve sandy and highly acidic soils. Land use changes, especially commercial and residential development, agriculture, and recreation, along with the suppression of fire, pose threats to these populations (NatureServe 2013).

Leafy prairie clover, found in Alabama, Illinois, and Tennessee, has declined by over 45 percent from historic occurrences. Habitat includes limestone cedar glades and barrens, and mesic to wet-mesic dolomite prairies (USFWS 1996). Causes of its decline include habitat destruction and alteration due to commercial and industrial development, overgrazing, lack of fire, and encroachment of woody non-native species such as Chinese privet, bush-honeysuckle, and sericea lespedeza (NatureServe 2013).

Lyre-leaf bladder pod**,** endemic to three counties in north Alabama, inhabits limestone outcrops supporting cedar glades (USFWS 2007a). Currently, only three populations are known to exist. The main threat to lyre-leaf bladder pod is from human encroachment from agriculture and residential development.

Mohr's Barbara's buttons is known from 67 occurrences in Alabama and Georgia where it inhabits moist to wet prairie-like openings in woodlands and meadows. It also has been located along shale-bedded streams and swales on roadside rights-of-way. Threats include conversion of habitat to pasture and competition from shrubs and trees (NatureServe 2013).

Price's potato bean, known to occur in Alabama, Mississippi, Kentucky, and Tennessee, inhabits open, rocky, wooded slopes and floodplain edges. Threats include: habitat loss and degradation from heavy or clear-cut logging, highway and transmission line right-of-way maintenance, commercial and residential development, and encroachment of non-native plant species (NatureServe 2013).

Pyne's ground plum, which is endemic to limestone cedar glades and open areas in surrounding cedar woodlands, is currently known from only eight extant populations in Rutherford County, Tennessee (USFWS 2011a). Five of the eight occurrences are found on public lands. Primary threats to this species are habitat loss or alteration of habitat due to commercial/private development, encroachment of competing vegetation, livestock grazing, intensive right-of-way maintenance activities, off-road vehicle traffic, and trash dumping (USFWS 2011a).

Short's bladderpod is closely associated with calcareous outcrops found in the Interior Low Plateau Ecoregion of Indiana, Kentucky, and Tennessee (USFWS 2012c). Currently, only 29 of the 57 reported populations are extant. Threats include habitat destruction and modification due to road construction and maintenance, impoundments and artificial water level manipulation along the Cumberland River, commercial and residential development, and encroachment of invasive species (USFWS 2012c). According to USFWS (2013a), critical habitat designations have been proposed for Short's bladderpod.

The Spring Creek bladderpod is known from 22 occurrences with the floodplain of three creeks in and around Lebanon, Tennessee (USFWS 2011b). Threats include habitat destruction or modification due to development, cattle grazing, and incompatible agricultural management.

Tennessee coneflower, an endemic species found on cedar glades in middle Tennessee, was delisted by USFWS in 2011. Monitoring of populations will continue for 5 years post-delisting (USFWS 2011c). Prior to delisting, it was determined that 83 percent of the occurrences would be protected and managed to maintain cedar glade habitat. Threats to unprotected populations are similar to other glade species.

Whorled sunflower was recently proposed to be listed as endangered (USFWS 2012a). This species is known from four populations found in moist, prairie-like openings in woodlands and along adjacent creeks in Alabama, Georgia, and Tennessee. Threats include destruction, modification or curtailment of habitat and over collecting by poachers. According to USFWS (2013a), critical habitat designations have been proposed for whorled sunflower.

Designated Critical Habitat
Many species listed as endangered or threatened under the ESA have had areas of habitat designated as "critical" for the survival of that species. Within the TVA PSA, designated critical habitat (DCH) has been created for one spider, 18 bivalves (mussels), one crustacean, 13 fishes, one gastropod, and one plant. USFWS (2013a; 2013b) proposes DCH for four additional plant species found within the PSA. Animals and plants with DCH are noted with an asterisk in Appendix B.

3.8.1.2 State-listed Species

Based on TVA's Natural Heritage database, almost 1,850 species determined to be rare and in need of protection at the state level have also been documented within the TVA PSA. A listing of state-level endangered, threatened, and species of conservation concern within the TVA PSA can be found in Appendix J of the *Final Programmatic Environmental Impact Statement for TVA's Natural Resource Plan* (TVA 2011b). Each of the seven states within the TVA PSA maintains databases of listed species. Websites for these databases are provided in Table 3-3 below. TVA would utilize these resources in the site-specific screening process to determine the potential for effects to state-listed species.

Table 3-3. Internet Websites for State-listed Species within the TVA PSA

State	Web Address
Alabama	http://www.alnhp.org/
Georgia	http://georgiawildlife.com/
Kentucky	http://naturepreserves.ky.gov/Pages/default.aspx
Mississippi	http://www.mdwfp.com/seek-study/heritage-program.aspx
North Carolina	http://portal.ncdenr.org/web/nhp/database-search
Tennessee	http://www.tn.gov/environment/natural-areas/natural-heritage-inventory-program.shtml
Virginia	http://www.dcr.virginia.gov/natural_heritage/infoservices.shtml#lists

3.8.2 Environmental Consequences

The ESA requires federal agencies to conserve endangered and threatened species and to determine the effects of their proposed actions on endangered and threatened species and their DCH. Section 7 of the ESA requires TVA to consult with the USFWS when proposed actions may affect endangered or threatened species and their DCH.

TVA would evaluate each individual proposed solar project. An assessment of habitat availability and potential presence of either state- or federally listed species would be conducted as part of that site-specific review. If habitat suitable for rare or protected species is identified within the project area, and if TVA determines there is potential to adversely affect listed species, mitigation measures to eliminate the potential for adverse impacts would be developed and implemented. However, in the event TVA determines that these measures would not be practicable or effective in eliminating the potential for adverse effects to listed species (e.g., resulting in the potential take[7] of a federally listed species), TVA would conduct a separate environmental assessment or environmental impact statement for that solar facility. That environmental review could incorporate relevant parts of this PEA. The following sections describe the potential impacts to endangered and threatened aquatic species, terrestrial animals, and plants in more detail.

Aquatic Species

As stated above, TVA would require appropriate BMPs, and SMZs would be implemented to minimize the amount and length of disturbance to water bodies and to maintain natural stream buffers. Thus, no direct, indirect, or cumulative impacts are likely to occur to state-listed aquatic species listed in the TVA NRP Final EIS (2011b). Based on TVA's recent experience and near term forecast, an additional 200 acres or equivalent rooftop space would be required each year over the entire PSA to site the projects covered in the scope of this assessment. That acreage could increase over time, but it is not likely to exceed 500 acres per year.

Habitat evaluations of the 108 federal listed aquatic species found within the TVA PSA indicate that two species (one fish and one crayfish) may potentially be impacted by TVA actions associated with solar facilities. The slackwater darter uses floodplain habitats for reproduction in winter and spring and has DCH that includes streams, fields, and wooded areas which are seasonally variable and may be dry during portions of the year. Critical habitat for the slackwater darter could occur in potential greenfield areas and may be impacted if solar power development occurs within the Cypress Creek system in Lauderdale County, Alabama, and Wayne County, Tennessee and the Buffalo River watershed in Wayne County, Tennessee.

Although the Nashville crayfish has a very restricted distribution, the dominant substrate of the Mill Creek drainage is bedrock, potentially limiting its capability to burrow during periods of drought (O'Bara 1999). Nashville crayfish are primarily a stream-dwelling species, but because of their mobility, crayfish often use floodplain and other terrestrial habitats as a means of dispersal when streams are dry (Lodge et al. 2000). Solar development on brownfield sites in the lower reaches and tributaries of the Mill Creek watershed and greenfield solar development in the upper reaches and tributaries of the Mill Creek watershed could potentially affect the Nashville crayfish.

Currently, nonpoint pollution from construction sites and industrial and municipal runoff are the primary threats to the Nashville crayfish in the Mill Creek watershed. Destruction of breeding sites by drainage and nonpoint pollution from solar facility construction sites could potentially pose primary threats to the slackwater darter and its DCH. Construction activities related to solar power development in the Mill Creek, Cypress Creek, or Buffalo River watersheds could potentially cause injury, mortality, and reproductive loss during the reproductive periods for the slackwater darter.

[7] *Take*, as defined by the Endangered Species Act, means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

As stated in Section 2.1.2, TVA would independently determine if a prospective solar project would adversely affect protected species. For those projects that would cause adverse effects such species, mitigation measures to eliminate the potential for any significant impacts to listed aquatic species, including the slackwater darter and the Nashville crayfish, would be developed and implemented. With the implementation of these measures, no significant effects to listed aquatic species are expected.

Terrestrial Animals

Construction associated with ground-mounted systems at brownfield or greenfield sites may include clearing of vegetation, grading, digging to install support structures, and trenching to install underground wiring and cable to a depth of up to 3 feet. Rooftop installations typically would not involve any such vegetation removal or ground disturbance. Extent of disturbance would be site-specific and would vary depending on topography, current landscape practice, size and number of solar panels, and the extent of vegetation to be cleared to accommodate installation of the solar panels and associated equipment.

Among federally listed or protected terrestrial animal species documented within the TVA PSA, the greatest potential for adverse effects is to those species that either are widespread across the TVA PSA (e.g., the bald eagle, Indiana bat, northern long-eared bat) or species that typically inhabit early-successional habitat (e.g., state-listed grassland breeding birds and/or overwintering birds, amphibians, mammals, reptiles, and a variety of invertebrates, such as butterflies, dragonflies, and crickets).

Prospective solar sites near nesting bald eagles may be subject to seasonal restrictions on construction and/or acquisition of a permit for removal of a nest tree. Seasonal construction conducted in compliance with the National Bald Eagle Management Guidelines (USFWS 2007c) is not expected to have adverse impacts to the bald eagle. Removal of nest trees (active or inactive) would be considered an adverse impact. Sites with presence of suitable summer roosting habitat for Indiana or northern long-eared bat, and for which the removal of such habitat would not be avoidable, may be subject to seasonal surveys to determine bat presence prior to construction actions (USFWS 2014). Results of habitat assessments and/or bat surveys would be used to determine site-specific impacts.

Construction activities at prospective sites with habitat suitable for grassland breeding birds and other rare species associated with early-successional habitat may have adverse impacts on survival by impacting food sources (removal of plants or impacts to availability of insects), breeding opportunities (physical barriers caused by the panels), or shelter (removal of dense ground cover).

Plants

Although state and federally listed species occur across the valley in various habitats, determinations based on locations of rare plant communities within the nine ecoregions spanning the TVA PSA were made to identify areas having the greatest potential to be affected adversely. High-elevation sites (spruce-fir forest, old growth forest, and grassy balds) found in the Blue Ridge Ecoregion harbor the greatest diversity of rare plant communities and rare species. Federally listed species found at these high-elevation sites include Blue Ridge goldenrod, Heller's blazing star, mountain bluet, rock gnome lichen, spreading avens, and swamp pink. These habitats are not likely to serve as appropriate locations for solar power projects.

The communities having the highest potential to be negatively affected by solar facilities are potential greenfield sites on the Interior Low Plateau of Alabama, Kentucky, and Tennessee where cedar glades/barrens and grassland prairies occur, and sites within the prairie and flatwood areas of the Southeastern Coastal Plain in Mississippi and Tennessee. These open glades, barrens, prairies and grasslands have been severely altered by agricultural practices, commercial and urban development, and encroachment of non-native species. Species that could be affected by solar projects constructed in these areas include the Alabama leather flower, fleshy-fruit gladecress, leafy prairie clover, lyre-leaf bladderpod, Pyne's ground plum, Short's bladderpod, Spring Creek bladderpod, Tennessee coneflower, and whorled sunflower.

3.9 Managed Areas and Ecologically Significant Sites

3.9.1 Affected Environment

The TVA PSA encompasses a region that is rich in both biological diversity and areas that are designated to protect and promote the public enjoyment of these natural resources. The following non-exhaustive list includes examples of properties and designations at the federal, state, and local level that are considered as Managed Areas and Ecologically Significant Sites.

Federal
- National Parks
- National Parkways
- National Scenic Trails
- National Preserves
- National Monuments
- National Battlefields and Historic Sites
- Streams listed on the Nationwide Rivers Inventory
- National Wildlife Refuges
- National Forests
- Wilderness Areas
- Wild and Scenic Rivers

State
- State Parks
- Wildlife Management Areas
- State Natural Areas/Preserves
- State Forests

Local
- Parks
- Greenways
- Blueways

3.9.2 Environmental Consequences

Direct adverse impacts, such as adverse visual effects, to managed areas or ecologically significant sites have the highest potential of occurring in situations where solar facilities would be constructed on greenfield sites containing these resources or on sites near such resources. Indirect impacts are possible if a solar installation were to be constructed adjacent to an area managed for wilderness or scenic qualities, such as a Wild and Scenic River or a National Scenic Trail. Potential indirect impacts to ecologically significant sites depend on the nature of biological, aesthetic, and other resources that warrant their recognition or protection status, such as species or ecological communities of conservation concern.

Following a site-specific review, in the event TVA determines that a proposed solar project would adversely affect managed areas or significant ecological sites, measures to avoid these effects or to reduce the potential for such effects would be developed. With the implementation of these measures, direct, indirect, and cumulative impacts to managed areas or ecologically significant sites related to the establishment of solar facilities would be minor.

3.10 Land Use and Prime Farmlands

3.10.1 Affected Environment

Major land uses in the TVA region include forestland, farmland, as well as urban, suburban, and industrial property. About three percent of the area of the TVA region is water, primarily lakes and rivers. This proportion has increased slightly since 1982, primarily due to the construction of small lakes and ponds. About 5.5 percent of the land area is federal land, and this proportion has also increased slightly since 1982. Of the remaining non-federal land area, about 12 percent is classified as developed, and 88 percent as rural. Rural undeveloped lands include farmlands (28 percent of the land area) and forestland (about 60 percent of the land area). The greatest change since 1982 has been in developed land, which almost doubled in area due to high rates of urban and suburban growth in much of the TVA region. Forestland increased in area throughout much of the 20th century. However, this rate of increase has slowed and/or reversed in parts of the TVA region in recent years. Both cropland and pastureland have decreased in area since 1982 (TVA 2011a). Additional information about vegetative land cover is contained in Section 3.6.

Ground-mounted solar facilities could be constructed on a variety of sites. However, sites that are relatively level or that have gently rolling topography tend to be preferred based on ease of access and lower construction costs. Agricultural lands or other open sites are also preferred because minimal site clearing and site preparation is required. For similar practical reasons, sites in wetlands or floodplains, areas dissected by streams, and rocky sites are not preferred, as access to the site may be difficult and additional site preparation or special permits could be required, thereby increasing project costs and time requirements.

The federal Farmland Protection Policy Act was passed to minimize the amount of land irreversibly converted from prime farmland[8] due to federal actions. Proposed ground-mounted solar power facilities built on greenfield sites, including agricultural areas, covered under this document would not exceed 10 acres. Solar facilities proposed at brownfield sites considered under this PEA could occupy as much as 20 acres. However, brownfield sites do not typically conform to the definition of prime farmland. In compliance with the Farmland Protection Policy Act, TVA would determine on a case-by-case basis if prospective solar facility sites contain prime farmland. TVA would complete Form AD-1066 (Farmland Conversion Impact Rating). A score exceeding 160 indicates that the subject farmland needs further consideration for protection.

[8] *Prime farmland* as defined in the Farmland Protection Policy Act is "land that has the best combination of physical and chemical characteristics for producing food, feed, fiber, forage, oilseed, and other agricultural crops with minimum inputs of fuel, fertilizer, pesticides, and labor, and without intolerable soil erosion, as determined by the Secretary. Prime farmland includes land that possesses the above characteristics but is being used currently to produce live stock and timber. It does not include land already in or committed to urban development or water storage." Likewise, unique farmland is defined as: "land other than prime farmland that is used for production of specific high-value food and fiber crops, as determined by the Secretary. It has the special combination of soil quality, location, growing season, and moisture supply needed to economically produce sustained high quality or high yields of specific crops when treated and managed according to acceptable farming methods. Examples of such crops include citrus, tree nuts, olives, cranberries, fruits, and vegetables."

3.10.2 Environmental Consequences

This PEA addressed potential effects of ground-mounted solar facilities that occupy 10 acres or less of greenfield site and ground-mounted solar facilities that occupy 20 acres or less of a brownfield site. Installation of building-mounted solar facilities, regardless of their size, is not expected to affect land use directly, indirectly or cumulatively.

Potential ground-mounted solar facilities considered in this PEA could be located on either greenfield sites or on brownfield sites, and potential changes in land use could occur in either situation. Installation of a solar facility on a greenfield site would change the land use of that site from the site's original use as an undeveloped parcel (most likely used for agricultural or forestry uses) to developed land that would likely be considered industrial or commercial land. Because most brownfield sites were previously developed, typically for commercial or industrial uses, solar projects sited on greenfield sites would likely have a higher potential to affect land use than similar facilities located on brownfield sites.

As part of establishing and finalizing a PPA, TVA would require prospective solar power developers to seek concurrence with the relevant local/state land use planning/zoning authorities. The developer would be required to provide TVA with proof of such zoning approvals or verify that such approvals are not required. Likewise, TVA would comply with relevant zoning requirements for TVA-owned solar facilities.

PV facilities typically have a lifetime of about 25 years, but likely no more than 40 years. Construction and operation of a solar facility presents virtually no potential to contaminate the site. Likewise, onsite structures do not involve extensive site preparation or changes to the site, and the equipment could be removed completely at the end of its life cycle. Thus, the use of a site for solar facilities at either greenfield or brownfield sites is not likely to preclude the use of the site for other purposes at the end of the life of the solar project. Use of a site for a solar facility is not expected to indirectly affect the land use on adjoining or other local parcels to any noticeable extent.

As stated previously, an estimated additional 100 to 500 acres per year across the TVA PSA could be required for the solar projects considered under this PEA. Although the existing land use on greenfield sites would usually change once a solar facility is located onsite, this acreage would constitute an extremely minor cumulative change in the amount of undeveloped land compared to the long-term, cumulative losses of undeveloped land due to residential growth, the spread of municipal boundaries, and industrial growth.

Solar facilities mounted on existing buildings would not affect any prime farmlands. However, as stated above, TVA would complete Form AD-1066 for those prospective ground-mounted solar sites containing prime farmland. A score of 160 or less indicates that the site either contains a minor amount of prime farmland or that the farmland in question is not sufficiently important in the regional setting. In situations where the score for a prospective solar site exceeds 160, appropriate measures, such as avoidance of certain onsite areas, to reduce the potential effects to onsite prime farmlands would be developed and implemented. Thus, potential effects to prime farmlands at any particular prospective solar site considered under this PEA are expected to be minor.

Over time, cumulative effects to prime farmlands could occur, as multiple sites, each containing either a small amount of prime farmland or prime farmlands that are not considered important are converted to non-agricultural uses for the lifespan of the solar facility. Because of the limited acreage involved (i.e., approximately 200 to 500 acres total per year) and because

measures would be taken to reduce adverse effects to prime farmlands, any cumulative effects to farmland resources are expected to be minor. Irreversible effects to land use and prime farmlands are described in Section 3.15.

3.11 Cultural Resources

3.11.1 Affected Environment

Cultural resources include, but are not limited to prehistoric and historic archaeological sites, districts, buildings, structures, and objects, as well as locations of important historic events that lack material evidence of those events. Cultural resources that are listed on, or considered eligible for listing on, the National Register of Historic Places (NRHP) maintained by the National Park Service are called historic properties. The eligibility of a resource for listing is based on the Secretary of the Interior's criteria for evaluation, which state that significant cultural resources possess integrity of location, design, setting, materials, workmanship, feeling, and association, and:

- are associated with important historical events; or
- are associated with the lives of significant historic persons; or
- embody distinctive characteristics of a type, period, or method of construction or represent the work of a master, or have high artistic value; or
- have yielded or may yield information important in history or prehistory.

Human occupation in the Eastern Woodlands began at the end of the Ice Age with the Paleo-Indian Period (13,500 – 11,000 years before present, or "B.P."). In the Tennessee Valley, prehistoric archaeological chronology is generally broken into four broad time periods: following the Paleo-Indian Period are the Archaic (11,000 – 3,000 B.P.), Woodland (3,000 – 1,100 B.P.), and Mississippian (1,100 – 500 B.P.) periods. Prehistoric land use and settlement patterns vary during each period, but short- and long-term habitation sites are generally located on flood plains and alluvial terraces along rivers and tributaries. Specialized campsites tend to be located on older alluvial terraces and in the uplands. European interactions with Native Americans in the southeastern U.S. began in the middle of the 17th century with the rise of the fur trading industry. Due in part to the introduction of infectious diseases to which Native Americans lacked natural immunity, these interactions resulted in a rapid population collapse, the cessation of elaborate ceremonialism and mound building, the rise of political networks between native groups and European colonists, and intense inter-tribal warfare.

Archaeological sites from all these periods, as well as from the historic period, are very numerous throughout TVA's PSA. They occur on a variety of landforms and in a variety of environmental contexts, with some exceptions. Sites are rarely found on steep slopes, with the exception of rockshelters, which have been used throughout the prehistoric and historic periods and often contain artifacts and features with value to archaeology and/or history. Areas affected by construction, mining, civil works projects, highways, etc. tend to be lacking in significant archaeological resources due to modern ground disturbing activities. The most reliable information about the locations of archaeological sites is produced during Phase I archaeological surveys conducted for compliance with Section 106 of the NHPA. In the Tennessee Valley, numerous surveys have been conducted along reservoir shorelines, within reservoirs, and within power plant reservations. However, large areas remain that have not been surveyed. Some TVA transmission line corridors and many highways have also been surveyed, but outside of TVA reservoirs and plant reservations, the density of surveys is relatively low, and relatively little is known about archaeological site distributions.

Historic architectural resources are found throughout TVA's PSA and can include houses, barns, and public buildings. Many historic structures in the PSA have been either determined eligible for listing or have been listed, on, the NRHP. However, historic architectural surveys have been conducted in only a fraction of the land area within the PSA.

TVA is in the process of developing a database of archaeological sites, but currently has no comprehensive database of archaeological sites or historic architectural properties. Prior to all TVA actions subject to NEPA and/or NHPA, TVA conducts a review of the resources present within the project Area of Potential Effect (APE). This review may consist of a desktop review using TVA's existing data sources or may be performed under contract to a professional consultant, who examines records and archives maintained by the SHPO of the state(s) involved, museums, libraries, and online sources to determine what (if any) resources have been identified previously within the APE and vicinity.

Area of Potential Effects (APE)
The Advisory Council on Historic Preservation defines APE as "the geographic area or areas within which an undertaking may directly or indirectly cause changes in the character or use of historic properties, if such properties exist" (36 CFR Part 800.16(d)). In federal undertakings, the APE for cultural resources is defined by the lead federal agency in consultation with the appropriate consulting parties. In defining the APE, the agency head must consider both direct and indirect consequences of the undertaking that could affect historic properties.

For future solar projects covered under this PEA, the APE for archaeological resources would consist of the area within which ground disturbing work (such as grading, excavation, installation of solar panels, and construction of access roads) could take place and any other areas where a buried historic property could be disturbed, directly or indirectly, as a result of project activities. The APE for historic architectural resources would generally consist of the area within a 0.5-mile radius of the project boundary that would be within a direct line of sight to the proposed project.

3.11.2 Environmental Consequences

TVA would evaluate potential effects to historic properties (archaeological sites and historic districts, structures, or objects listed or eligible for listing in the National Register of Historic Places) for proposed solar projects on a case-by-case basis. Possible effects to archaeological sites include physical damage due to grading, excavation, panel installation, and the construction of access roads, utilities, and staging areas. TVA would seek ways to avoid or minimize such effects whenever possible. For example, avoidance may be possible by redesigning a project so that no ground disturbance occurs within the boundary of an NRHP-listed or eligible site. TVA will follow the NHPA Section 106 process for the identification of historic properties, assessment of effects, and avoidance of adverse effects to historic properties. TVA will consult with the appropriate SHPO and federally-recognized tribes throughout the process and will take their comments into consideration.

Possible effects to historic architectural resources include changes to their integrity of setting or feeling resulting from the introduction of PV panels and associated equipment, and could also include effects to their structural integrity resulting from vibrations. As with archaeological sites, TVA will follow the Section 106 process for the identification of historic properties, assessment of effects, and avoidance, minimization, and mitigation of adverse effects to historic properties. TVA will consult with the appropriate SHPO and federally-recognized tribes throughout the process and will take their comments into consideration. Avoiding or minimizing visual effects to historic architectural resources may involve measures such as planting vegetation as a screen between the proposed solar project and the resource(s) in question.

As stated earlier, each proposed solar facility would be evaluated for its potential to have adverse environmental effects, including direct, indirect, and cumulative effects to historic properties. In situations where there would be potential effects, TVA would encourage the developer to modify the proposal to satisfactorily avoid adverse effects. Any proposed solar project expected to result in adverse effects to an NRHP-listed or eligible archaeological site or historic resource would be the subject of a project-specific environmental assessment or environmental impact statement in accordance with TVA's NEPA procedures. Thus, no significant effects to cultural resources are expected from developing the solar facilities considered under this PEA.

3.12 Visual Resources

3.12.1 Affected Environment

Visual resources are the visual characteristics of a place and include both natural and man-made attributes. To many observers, including residents and visitors, visual resources of a particular location provide the context of historical and culturally significant settings. The human response to visual changes in the landscape can vary dramatically depending on the setting. For example, changes in agricultural and rural settings solicit different feelings in an observer than those in urban or industrial areas.

The landscape of the TVA region varies from rivers and valleys to rolling hills and mountains. Because solar facilities must be placed in open areas with direct access to sunlight, when introduced into existing landscapes, solar power facilities can potentially result in visual impacts to immediate and surrounding areas. Because of the experiential nature of visual resources, the human response to visual changes in the landscape cannot be quantified, even though the visual changes associated with a proposed utility-scale solar energy development can be described (Hankinson 1999). However, there are commonly held visual values that can be examined to assess potential impacts to visual resources (Bureau of Land Management (BLM) and DOE 2010).

As described below, some characteristics that can be considered in assessing potential visual impacts of solar facilities include visibility, color, atmospheric conditions, fractality, and concurrence between types of solar panels (Torres-Sibille et al. 2009).

Visibility may be measured in a variety of ways. Significance of a visual impact can be related to the proportion of the landscape that is visible and may be altered, the level of detail visible in the landscape, the context of the viewer, the duration of the view, and the number of anticipated viewers.

The consideration of color when assessing visual impacts is also important. For instance, impacts may vary depending on the proximity of the panels to the ground, the contrast between the panels and the ground, the contrast between the panels and the sky, and the position of the viewer (Torres-Sibille et al. 2009). Impacts due to color are greater when there is a high contrast between the panels and the ground and/or sky. Conversely, visual effects are lessened when the colors are camouflaged into the background or ground (Torres-Sibille et al. 2009). Atmospheric conditions relating to visual impacts relate to the conditions between the object and the observer (Torres-Sibille et al. 2009). Information concerning rain, fog, etc. and how often those conditions are likely to occur can be taken into consideration.

Fractality is "a measure of artificiality in the geometry of a pattern" and is based on the concept that nature does not contain straight lines (Torres-Sibille et al. 2009). Therefore, a solar facility

with arrays situated in very straight lines tends to generate an impact because the contrast to the background draws an observer's attention (Torres-Sibille et al. 2009). When placed in a natural, rural or agricultural landscape, the fractality of a solar array is likely a more noticeable characteristic than if it were placed in an industrial or other developed setting where horizontal, vertical and diagonal lines are common in the visual setting.

Concurrence refers to the similarity in concentration for types of panels or arrays within a solar facility (Torres-Sibille et al. 2009). Panels and arrays can vary in size, color, spacing, and arrangement. Generally, visual impact increases with the number of spatial and visual inconsistencies in a facility (see Figure 3-2).

Picture taken from Torres-Sibille et al. 2009.

Figure 3-2. Non-concurrence in Solar Panels

Solar power projects installed at or near airports must take into consideration special criteria. Projects must meet standards to protect air navigation and existing aviation activities (FAA 2010). Several factors that must be considered include consistency of a project with aviation activities and approved airport master plans, potential environmental issues associated with project siting alternatives, and the need to obtain approvals from the FAA (2010). The FAA has broad authority to approve the placement of specific structures and activities relative to their potential impact on aviation. As of October 2013, the FAA continues to develop its technical guidance for evaluating solar facilities at airports (FAA 2013).

3.12.2 Environmental Consequences

Solar projects considered under this PEA are expected to be relatively small-scale facilities. The acreage limits of 10 acres for greenfields and 20 acres for brownfield sites tend to lessen the potential for adverse visual effects. The location and context of the setting, whether urban or rural, flat or mountainous, affect the visual experience. Although the extent of visual impacts would vary from site to site, general visual effects from solar projects within the TVA PSA are discussed below.

Visibility

When a solar project is constructed, changes to the visible environment occur. Effects would vary depending on a number of factors such as site location, time viewed, and colors and materials used. Visual impacts of a solar facility on an existing landscape are reduced when views of the facility are masked with topography, vegetation or structures that effectively screen the view (BLM and DOE 2010). For example, forested areas can provide better visual screens by hiding the solar panels versus open areas with little or no vegetation. The Tennessee PSA is rich in forested areas and vegetation that could provide such screening. Solar projects in flat

areas may be entirely screened by forests and other vegetation. Areas with rolling hills or mountains, found mostly in the eastern portion of the TVA region, can provide topographic barriers to reduce visual impacts. Conversely, mountainous areas could increase visibility of a facility by elevating it and making it visible to a larger area, thus having a greater visual effect (BLM and DOE 2010).

Visual impacts that are viewed for a long period of time are generally thought to be greater than those viewed briefly. For example, a solar power facility that is constructed next to a residential neighborhood could have a greater overall visual effect than a similar facility built next to a freeway and seen for only a few seconds at a time. The duration of the view for the residents would be longer than the duration for a vehicle passing by on a freeway. Visual impacts are reduced when projects are not a permanent visual element.

Introduction of visual changes (such as a solar facility) have greater effects when the visibility of a landscape is part of a viewer experience. For example, a hiking trail located in a mountainous area may be established for its view of the valley below. Construction of a nearby solar facility would affect the visual quality in this location because the value of the hiking experience would be lessened. Visual impacts are reduced by avoiding areas where changes to the visual landscape would compromise an experience or the value of a natural asset. Visual effects can be especially relevant when facilities are located within viewing distance of culturally significant sites or areas. Refer to Section 3.10 for information addressing culturally significant sites.

Visual impacts can be greatly reduced or avoided by careful project siting (BLM and DOE 2010). Practicable measures to minimize the visibility of solar facilities would be developed and implemented. These measures include taking advantage of topography and vegetation to restrict the views of projects from visually sensitive areas.

The visibility of PV panels in rooftop installations depends on factors such as slope of the roof, color choice, reflectivity, type of building materials, and architectural details. Rooftop installations, especially in urban settings, are generally located above the streetscape and are would be less visible than ground installed systems. Building-mounted systems in the TVA region would be designed to blend into the existing architecture when possible.

Colors and Atmospheric Conditions

Visual impacts due to color involve contrast between the panels and the surrounding landscape and atmosphere. Visual impacts are greater when there is high contrast and are less when the panels and support buildings “blend” or “fade” into the background or ground. Applying paintings and coatings on PV panels and support buildings may minimize contrast. Impacts are reduced when materials and surface treatments blend with existing forms, lines, color and texture of the landscape and are chosen to reduce reflectivity (BLM and DOE 2010).

In areas where regularly occurring atmospheric conditions can change the colors of the landscape, visual impacts are lessened when colors are chosen accordingly. The presence of snow cover, fall-winter coloration of foliage, and leaf drop may alter color and texture properties of vegetation and soil, thereby altering visual contrasts between a proposed project and the landscape (BLM and DOE 2010).

The visual effects of building-mounted solar facilities can be minimized when choices of materials and colors are designed to blend with the existing architecture. Higher contrast typically results in a higher visual impact. For example, dark grey solar panels installed on a dark grey roof will have less visual impact than dark grey solar panels on a red roof.

Fractality and Concurrence
Fractality refers to the geometry of patterns (Torres-Sibille et al. 2009). Solar panels are designed with straight lines and have an industrial look, which contrasts with natural landscapes especially in rural areas. Straight line panels set against rolling hills or mountains in green and natural areas have a greater visual impact than straight line panels in developed areas where buildings and other structures have already introduced straight lines into the landscape. Rooftop installations have low visual impacts due to fractality, because most rooftops already have straight lines and similar geometry to rectangular solar panels.

Solar power facilities installed in developed and/or urban areas of the TVA region are likely to have fewer impacts due to fractality than facilities located in rural and undeveloped areas. Where modifications repeat the general forms, lines, colors, and textures of the existing landscape, the degree of visual contrast is lower, and the impacts are generally perceived less negatively (BLM and DOE 2010). Visual impacts can be lessened if solar panels are consistent per each facility. Non-concurrence between panels would be less noticeable in urban areas. However, as groups of panels vary, visual impacts become greater.

Construction Activities
Potential visual impacts resulting from construction activities would be temporary. Construction activities introduce contrasts in form, line, color, and texture resulting from vegetation clearing of the site. Likewise, worker presence and activity, dust emissions, associated vegetation and ground disturbances, dust, and emissions would have cause local visual effects. Construction times for proposed projects covered under this document would likely be short in duration. Thus, visual effects from the construction of solar facilities would be temporary and minor.

Airport Reviews
Recently, the FAA (2013) announced the development of a policy regarding the development of solar energy facilities located on federally obligated airports. This policy addresses glint (a momentary flash of bright light) and glare (a continuous source of bright light) and the potential for effects to aviation safety. However, solar energy systems located on an airport that is not federally-obligated or located outside the property of a federally-obligated airport are not subject to this policy. Thus, no defined thresholds for project size, type, or distance from the airport are currently available that automatically trigger FAA airspace review. However, information obtained through TVA's relationships with solar industry experts suggest that if a solar facility is planned within five miles of an airport, coordination with FAA may be necessary. Thus, coordination with the FAA would occur for solar projects within a 5-mile radius of an airport in the TVA PSA to ensure that any applicable FAA procedures are followed.

Cumulative Visual Effects
As previously stated, ground-mounted solar facilities can cause changes in the local visual character, but with the implementation of appropriate screening measures (as necessary) and the use of good site selection, adverse visual effects of these facilities would be minor. Projects covered in the scope of this assessment are expected to require an additional 200 to 500 acres of land or equivalent rooftop space each year. Because of their limited size and the fact that ground-mounted solar facilities would likely be dispersed at various separate locations, cumulative changes in local visual characteristics would be minor.

In some cases, building-mounted solar installations, such as those mounted horizontally on a flat roof on a large building, are not necessarily visible from the ground in the vicinity of the building. Other such installations often tend to blend in with the structural features of the building. Thus, installation of building-mounted solar facilities typically causes only minor

changes in the local visual character. Because of these minor changes and because they would likely tend to installed at dispersed locations, any cumulative visual effects of additional structure-mounted solar facilities are likely to be minor.

3.13 Socioeconomics and Environmental Justice

3.13.1 Affected Environment

Local economic conditions vary widely across the TVA PSA, and solar sites could be sited in a variety of locations. However, because of acreage requirements (as much as 10 acres for greenfield sites and 20 on brownfields) solar facilities are not likely to be sited in areas having unusually high real estate prices.

EO 12898 (Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations) directs federal agencies to identify and address, as appropriate, the effects of their programs, policies, and activities, including potential disproportionately high and adverse human health and environmental impacts on minority and low-income populations. Although TVA is not subject to this order, TVA regularly considers potential environmental justice impacts in its NEPA reviews. Examples of disproportionate adverse effects to minority or low-income populations include actions such as the placement of unsightly, noisy, odorous, or otherwise nuisance facilities in low-income or minority neighborhoods.

In identifying minority and low-income populations, the following definitions of minority individuals and populations and low-income populations were used.

- *Minority Individuals* – This category includes individuals who identify themselves as members of the following population groups: American Indian or Alaskan Native, Asian, Native Hawaiian or Other Pacific Islander, Black, Hispanic, or two or more races.

- *Minority Populations* - Minority populations are identified where (1) the minority population of an affected area exceeds 50 percent or (2) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis.

- *Low-Income Populations* - Low-income populations in an affected area are identified with the annual statistical poverty thresholds from the Census Bureau's Current Population Reports, Series P-60, on Income and Poverty.

3.13.2 Environmental Consequences

Installation of a solar facility would likely have only minor effects on the local economy. Funds expended for the purchase of property, easements or the right to mount solar facilities on existing buildings could affect the local area economically, but any such benefits would be minor. Construction of solar facilities would tend to be of limited duration (i.e., a few weeks), and local labor may or may not be used. Thus, any local economic gains related to construction would likely be minor.

Siting a solar facility could change the property assessment for the site. However, any resultant changes in the local tax base would be small. Expenditures for the routine maintenance and upkeep of solar facilities are not expected to have any noticeable effect to local economic conditions.

Solar facilities do not generate noise or cause odors nor do they pose any immediate health or safety risks. The proposed solar facilities are highly unlikely to displace existing residences, businesses or community facilities. Placement and operation of solar facilities is very unlikely to result in the loss of local jobs, including jobs typically held by low-income groups. During operation, such facilities do not generate waste byproducts and pose no noticeable health risks to the local population. Although some smaller solar facilities could be located within residential areas, large-scale solar facilities are not especially likely to be placed in existing residential areas for a variety of reasons including acreage requirements, cost of residential real estate, and potential zoning issues. For these reasons, the potential for solar facilities to adversely affect local property values is low.

Depending on local circumstances, ground-mounted facilities could be visible to local residents. However, they could be screened with vegetation or fencing (see Section 3.12). Roof-mounted facilities would tend to blend into urban and commercial/industrial settings.

TVA would identify groups or clusters of minority or low-income persons in the area of proposed solar sites. As part of the case-by-case review of proposed solar projects, TVA would determine if each project would disproportionately affect minority or low-income populations. If TVA determines that a proposed solar facility would cause adverse disproportionate effects, the proposed facility would either be relocated to a more suitable location or appropriate measures would be taken to avoid these effects.

Due to their nature, the type of solar facilities considered in this environmental review have a low potential to cause adverse socioeconomic effects, including effects related to environmental justice. In situations where environmental justice-related effects could occur, appropriate, feasible avoidance measures could be implemented. Provided such measures are implemented when necessary, any socioeconomic effects, including those related to environmental justice, from the solar facilities considered under this PEA would be minor.

3.14 Unavoidable Adverse Environmental Impacts

Solar power facilities of the type and size of those considered in the PEA typically do not present conditions that would cause unavoidable adverse environmental impacts. The projects covered under this document have been limited to 10 acres for a greenfield site and 20 acres for a brownfield site, and all proposed projects would be screened to identify potential environmental impacts. In situations where TVA determines that significant environmental effects would occur, effective avoidance and mitigative measures to reduce the level of effects to insignificant levels would be developed and implemented. Provided appropriate effective measures are implemented, any potential environmental effects would be minor. Thus, no unavoidable adverse environmental effects are anticipated from TVA purchasing power from the solar facilities considered in the PEA.

3.15 Irreversible and Irretrievable Commitments of Resources

Irreversible commitments of resources include the use or consumption of non-renewable resources as a result of a decision or implementing a proposed action. For example, extraction of ore is an irreversible commitment. Once the ore is mined, it cannot be replaced, and that resource has been committed irreversibly.

Irretrievable commitments involve the use or commitment of resources for a long period of time. An example of an irretrievable resource commitment is the loss of timber production on a newly cleared transmission line right-of-way through a forested area. Forest productivity would be

foregone for the life of the transmission line. However, the eventual removal of the right-of-way at the end of the life cycle of the transmission line would result in the restoration of forest land and timber productivity.

Irreversible commitments of resources include the materials (e.g., metal for racking systems, the PV materials in the panels, and fuel for mechanized equipment) required for construction, maintenance, and operation of solar PV systems. This would apply to solar facilities utilizing either ground-mounted or building-mounted arrays. Disposal and recycling of PV panels themselves is a developing science. Solar modules contain potentially hazardous materials, and cannot be safely disposed of in landfills (Clean Energy Authority.com 2011). Toxic materials such as cadmium, silicon tetrachloride and indium are used in solar panels (Clean Energy Authority.com 2011). Recycling these materials can be an expensive process; however, as more solar panels reach the end of their life span, costs to recycle the materials will likely decrease. According to the Solar Energy Industries Association (SEIA), PV panels are designed to last more than 25 years (SEIA 2014). Many solar producers have not yet reached the end-of-life, and panels that were installed in the early 1980s are still performing at levels nearly equal to their installation performance level (SEIA 2014). Many solar companies are addressing recycling concerns in the U.S. and abroad through membership in PV Cycle, a European-based voluntary agreement which facilitates collection and recycling of modules at end-of-life (SEIA 2014).

With respect to ground-mounted solar projects, the land use for a solar facility would be irretrievably committed for the life of the facility. Specifically, use of the site for agriculture (including the use of onsite prime farmlands), forest production or related purposes would be precluded for the life of the particular solar project. However, at some point, likely 25 or more years after the solar project goes online, the solar equipment would likely be dismantled and removed. Because removal of the solar arrays and associated onsite infrastructure could be accomplished rather easily and the facility would not irreversibly alter the site, most sites could be returned to their original condition or used for other productive purposes. Solar projects involving building-mounted arrays are not likely to involve irretrievable commitments of resources.

CHAPTER 4 – LIST OF PREPARERS

4.1 NEPA Project Management

Ashley R. Farless

Position:	NEPA Compliance Specialist, III
Education:	B.S. Civil Engineering
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Involvement:	NEPA Compliance and Document Preparation, Visual Impacts

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Involvement:	NEPA Compliance

James F. Williamson Jr.

Position:	Contract Senior NEPA Specialist
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Experience:	10 years in Forest Management, Inventory, and Software Development; 23 years in NEPA Compliance
Involvement:	Document Preparation and Environmental Justice

4.2 Other Contributors

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Education:	B.S., Environmental Science; B.S., Geology
Experience:	17 years in Environmental Analysis, Surface Water Quality, and Groundwater Hydrology Evaluations
Involvement:	Geology and Groundwater

Stephen C. Cole

Position:	Contract Archaeologist
Education:	Ph.D., Archaeology; M.A. and B.A., Anthropology
Experience:	11 years in Cultural Resources; 4 years teaching at university level
Involvement:	Cultural Resources Compliance

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Experience:	32 years in Plant Taxonomy; 10 years in Rare Species Monitoring, Environmental Assessment, and NEPA Compliance
Involvement:	Threatened and Endangered Plant Species, Invasive Plant Species

Andrew Henderson
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Education: M.S. and B.S., Fisheries Biology
Experience: 10 years in Impact Assessment and Endangered Species Conservation
Involvement: Aquatic Life

Charles S. Howard
Position: Aquatic Endangered Species Biologist
Education: M.S., Zoology; B.S., Biology
Experience: 20 years in Aquatic Ecology Research, Impact Assessment, and Endangered Species Conservation
Involvement: Aquatics

Holly G. LeGrand
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Experience: 8 years in Biological Surveys, Natural Resource Management, and Environmental Reviews
Involvement: Terrestrial and Threatened and Endangered Terrestrial Species

Heather L. Montgomery
Position: Senior Program Manager, Special Land Use Initiatives
Education: B.S., Environmental Biology
Experience: 14 years in Environmental Impact Assessment, Planning, and Land Management
Involvement: Land Use

Kim Pilarski-Hall
Position: Wetlands and Natural Areas Specialist
Education: M.S., Geography, Minor Ecology
Experience: 18 years in Wetlands Assessment and Delineation
Involvement: Wetlands and Natural Areas

A. Chevales Williams, P.E.
Position: Specialist, Water and Waste Compliance
Education: B.S., Civil Engineering
Experience: 11 years in Civil/Site, Structural, and Highway Engineering
Involvement: Surface Water and Waste Water

CHAPTER 5 – ENVIRONMENTAL ASSESSMENT RECIPIENTS

5.1 Federal Agencies

U.S. Army Corps of Engineers
- Commanding Officer, Mobile, Alabama
- District Commander, Nashville, Tennessee
- Louisville District, Louisville, Kentucky
- South Atlantic Division, Atlanta, Georgia
- Vicksburg District, Vicksburg, Mississippi

U.S. Fish and Wildlife Service
- Alabama Ecological Services Field Office, Daphne, Alabama
- Asheville Ecological Services Field Office, Asheville, North Carolina
- Georgia Ecological Services Field Office, Athens, Georgia
- Kentucky Ecological Services Field Office, Frankfort, Kentucky
- Mississippi Ecological Services Field Office, Jackson, Mississippi
- Sam D. Hamilton Noxubee National Wildlife Refuge, Brooksville, Mississippi
- Southeast Regional Director, Atlanta, Georgia
- Southwestern Virginia Ecological Field Services Office, Abingdon, Virginia
- Tennessee Ecological Services Field Office, Cookeville, Tennessee
- Wheeler National Wildlife Refuge Complex, Decatur, Alabama

U.S. Forest Service
- Forest Supervisor, Montgomery, Alabama
- Forest Supervisor, Gainesville, Georgia
- Forest Supervisor, Winchester, Kentucky
- Forest Supervisor, Asheville, North Carolina
- National Forest Supervisor’s Office, Cleveland, Tennessee
- National Forest Supervisor’s Office, Jackson, Mississippi
- National Forest Supervisor’s Office, Roanoke, Virginia
- Regional Forester, Atlanta, Georgia

U.S. National Park Service
- Andrew Johnson National Historic Site, Greeneville, Tennessee
- Big South Fork National River and Recreation Area, Oneida, Tennessee
- Chickamauga and Chattanooga National Military Park, Ft. Oglethorpe, Georgia
- Cumberland Gap National Historical Park, Cumberland Gap, Kentucky
- Fort Donelson National Battlefield, Dover, Tennessee
- Great Smoky Mountains National Park, Gatlinburg, Tennessee
- Mammoth Cave National Park, Mammoth Cave, Kentucky
- Natchez Trace Parkway, Tupelo, Mississippi
- Rivers, Trails, and Conservation Assistance Program, Chattanooga, Tennessee

Russell Cave National Monument, Bridgeport, Alabama
Shiloh National Military Park, Shiloh, Tennessee
Southeast Regional Director, Atlanta, Georgia
Stones River National Battlefield, Murfreesboro, Tennessee

5.2 Federally Recognized Tribes

Absentee Shawnee Tribe of Oklahoma
Alabama-Coushatta Tribe of Texas
Alabama-Quassarte Tribal Town
Cherokee Nation
The Chickasaw Nation
Choctaw Nation of Oklahoma
Eastern Band of Cherokee Indians, Cherokee, North Carolina
Eastern Shawnee Tribe of Oklahoma
Jena Band of Choctaw Indians
Kialegee Tribal Town
Mississippi Band of Choctaw Indians
Muscogee (Creek) Nation of Oklahoma
Poarch Band of Creek Indians
Seminole Nation of Oklahoma
Shawnee Tribe
Thlopthlocco Tribal Town
United Keetoowah Band of Cherokee Indians in Oklahoma

5.3 State Agencies

Alabama

Alabama Department of Conservation and Natural Resources, Montgomery
Alabama Department of Environmental Management, Montgomery
Alabama Historical Commission, Montgomery

Georgia

Georgia Department of Natural Resources, Atlanta
Georgia Department of Natural Resources, Historic Preservation Division, Atlanta
Georgia Department of Natural Resources, Environmental Review and Preservation Planning, Atlanta

Kentucky

Kentucky Department for Environmental Protection, Frankfort
Kentucky Department for Natural Resources, Frankfort
Kentucky Department of Fish and Wildlife Resources, Frankfort
Kentucky Energy and Environment Cabinet, Frankfort
Kentucky Heritage Council, Frankfort
Kentucky State Clearinghouse, Frankfort

Mississippi

Mississippi Department of Archives and History, Historic Preservation Division, Jackson

Mississippi Department of Environmental Quality, Jackson

Mississippi Department of Wildlife, Fisheries and Parks, Jackson

North Carolina

North Carolina Department of Environment and Natural Resources, Raleigh

North Carolina Department of Environment and Natural Resources, Office of Land and Water Stewardship, Raleigh

North Carolina Division of Archives and History, Raleigh

North Carolina State Clearinghouse, Raleigh

North Carolina State Historic Preservation Office, Raleigh

North Carolina Wildlife Resources Commission, Raleigh

Tennessee

Tennessee Department of Environment and Conservation, Nashville

Tennessee Division of Archaeology, Nashville

Tennessee Historical Commission, Nashville

Tennessee Wildlife Resources Agency, Nashville

Virginia

Virginia Department of Aviation

Virginia Department of Conservation and Recreation, Richmond

Virginia Department of Environmental Quality, Richmond

Virginia Department of Forestry, Richmond

Virginia Department of Game and Inland Fisheries, Richmond

Virginia Department of Health, Richmond

Virginia Department of Historic Resources, Richmond

Virginia Department of Transportation, Richmond

Virginia Marine Resources Commission, Newport News

Virginia Office of Environmental Impact Review, Richmond

Virginia Office of Preservation Incentives, Richmond

5.4 Individuals and Organizations

Gary Bullwinkel

Southern Alliance for Clean Energy, Knoxville, Tennessee

Tennessee Clean Water Network, Knoxville, Tennessee

Tennessee Chapter of the Sierra Club

Tennessee Solar Energy Industries Association, Knoxville, Tennessee

Tennessee Wildlife Federation, Nashville, Tennessee

Various local power companies were contacted directly via the TVA Customer Connections electronic newsletter.

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CHAPTER 6 – LITERATURE CITED

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Appendix A – Comments Received on the Draft PEA and Responses

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Commenter: Michael Butler
Affiliation: Tennessee Wildlife Federation

[Comment 1:]
These are the initial comments of the Tennessee Wildlife Federation regarding the draft programmatic environmental assessment for TVA solar photovoltaic projects. We were not informed that TVA undertook the required scoping process, and therefore missed the opportunity to identify issues that should have been covered in this EA. Thus, it is possible, from our perspective, that this draft EA has not examined all of the issues necessary to move forward.

[Comment 2]
Based upon our review of the draft EA, we would ask that TVA prohibit constructing new PV projects on any greenfield project sites. This request for prohibition is for both public and private land greenfield sites that TVA may be evaluating.

[Comment 3]
With regards to TVA public lands, the reality is that TVA-owned public lands serve a much greater and diverse set of purposes and benefits collectively as they currently exist, and that placing any of those lands in greenfield PV power generation facilities would limit the uses of said public land to that single use; thus restricting other varied and traditional uses. Building PV capacity in greenfield settings will, beyond impacting possible recreational uses of lands, also increase the use of pesticides, significantly impact vegetation and wildlife habitat, and will require additional infrastructure to be brought in to allow electricity produced by PV projects to be transmitted to the TVA transmission grid. Thus, the impacts of PV projects are not just the site for the project impact, but all of the associated impacts required to get the production of electricity off the project site and to the end user.

[Comment 4]
Secondly, we feel that there are many opportunities that TVA can take advantage of by placing PV generation on existing brownfields and man-made infrastructures across the state. These opportunities also allow TVA to utilize existing industrial and commercial partners, and can lessen the overall infrastructure cost of PV projects. Utilizing brownfields and existing man-made structures should not require the cost or disturbance associated with transmission of PV generated electricity since they exist in prior developed areas.

Thus, in conclusion we would ask that TVA include the following determinations in its revised draft programmatic EA for PV projects.

1. That TVA will not pursue greenfield PV projects - on TVA public lands or undeveloped private lands.
2. That TVA will aggressively pursue building PV projects on existing man-made infrastructures - both public and private.
3. That TVA aggressively pursue building PV projects on existing brownfield sites - both public and private.

[Comment 5]
Lastly, we find this EA to be deficient in its assessment and analysis of impacts that will be created by PV projects. Specifically, we are concerned about impacts which are not directly

attributable to the physical PV generation site. In our opinion, the draft EA does not adequately address the considerations of transmission infrastructure, the long-term maintenance and impacts of this infrastructure, and how PV projects will cumulatively impact and expand these directly related, and caused, but uniquely separate impacts.

We request the draft EA be revised to expand upon the direct and cumulative impact of all support services required to create a PV project, which should include, but is not limited to the creation of necessary roads, transmission corridors, maintenance of said roads and corridors and other unidentified impacts.

Thank you for this opportunity to comments on this draft EA, and we would enjoy the opportunity to sit down and discuss these items further with your staff.

Response to Comment 1:
The subject programmatic environmental assessment (PEA) was prepared in accordance with Section 5.3.3 (EA Preparation) of the TVA Procedures for Compliance with the National Environmental Policy Act. While the Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act require federal agencies to publish a notice of intent in the Federal Register to prepare an environmental impact statement, that requirement does not apply to environmental assessments. Scoping for this PEA was adequate and consistent with the CEQ and TVA regulations. Nevertheless, the letter dated June 24, 2014 that the Tennessee Wildlife Federation received stated that TVA would appreciate any comments you may have on the subject draft document. TVA welcomes any comments on the document and its contents, including the environmental resources that might be affected and the alternatives considered.

Response to Comment 2:
TVA does not have legal authority to dictate where an independent power producer's project must be located on private property. TVA, however, works with prospective PV power suppliers in the siting of proposed facilities and in developing ways to avoid or minimize adverse environmental effects.

Response to Comment 3:
TVA recognizes the various benefits that public lands, including those held by TVA, provide to the public. TVA periodically reviews and updates its land use plans for its public lands lying along the reservoirs. Those plans document appropriate uses for these shoreline properties. At this time, TVA does not plan to use any of its reservoir properties for the development of solar farms. If TVA were to decide to construct solar facilities, the most likely sites would be at generating or transmission facilities such as portions of generating plant sites and substations. Such locations would afford convenient access to TVA's transmission system, would be compatible with existing land use, and would require minor site preparation.

Response to Comment 4:
TVA agrees that brownfields and existing structures are good potential sites for solar facilities. About 36 percent of solar projects with a capacity of at least 50 kW and providing power to TVA are building-mounted. TVA is currently purchasing power from three solar farms constructed on capped landfills and from several solar farms on other brownfield sites. TVA encourages solar developers to consider the use of brownfield sites and buildings and will consider these sites for TVA-initiated solar projects.

Response to Comment 5:
The final PEA has been revised to better address indirect and cumulative impacts. The solar facilities considered in the PEA would produce relatively small amounts of power that would supplement the available electric power in a local area. The subject solar facilities would likely be connected to local power distribution systems via conductors (i.e., power lines) mounted on poles. Local distribution lines are normally 13-kV or less and require a minimal right-of-way. Such lines are common in neighborhoods and are usually supported by wooden poles. Thus, construction of new high-voltage transmission lines to accommodate power supplied from the proposed solar facilities considered in the PEA is highly unlikely. Additional discussion of infrastructure connections has been included in Section 2.1.2 of the final PEA. Additional information has been incorporated into Chapter 3 of the final PEA to describe potential effects to local infrastructure.

Commenter: Greg Williamson
Affiliation: Mississippi State Historic Preservation Office
Comment:

We concur with a finding of no significant impact as long as Section 106 procedures for Mississippi are followed. Remember that adding solar devices to existing structures or in developed areas such as parking lots may have an adverse visual effect to eligible structures or historic districts in the immediate vicinity.

Response:
As stated in the EA, TVA would review proposals on a case-by-case basis, which would include following appropriate requirements under Section 106 of the National Historic Preservation Act. Potential offsite visual effects to historic properties would be addressed in those reviews.

Commenter: Roberta Hylton
Affiliation: Southwest Virginia Field Office, U.S. Fish and Wildlife Service
Comment:

We have received a letter dated June 23, 2014, from Ms. Susan Jacks of the Tennessee Valley Authority regarding referenced draft programmatic environmental assessment (EA). Thank you for making us aware of the draft EA.

As noted in the letter and the draft EA, "TVA will consider proposed solar projects on a case-by-case basis and will make determinations and findings regarding the potential to affect various resources, including…threatened and endangered species…" For the cases involving proposed photovoltaic projects in Virginia, TVA should utilize our on-line review process, at http://www.fws.gov/northeast/virginiafield/endangered/projectreviews.html, to assess potential effects to federally listed species and coordinate with the Fish and Wildlife Service in accordance with the Endangered Species Act of 1973 (16 U.S.C. 1531-1544, 87 Stat. 884), as amended, and Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c, 54 Stat. 250) as amended.

If you have any questions regarding our project review process, please contact Troy Andersen at (804) 693-6694, extension 2428, or via email at troy_andersen@fws.gov.

Roberta Hylton
Supervisor
Southwestern Virginia Field Office
U.S. Fish and Wildlife Service
330 Cummings Street
Abingdon, Virginia 24210
Phone: 276-623-1233
Fax: 276-623-1185

Response:
Comments noted. TVA will utilize the USFWS online Information, Planning, and Consultation system in assessing the potential effects of proposed solar farms.

Commenter: Lee Anne Wofford
Affiliation: Alabama Historical Commission
Comment:

STATE OF ALABAMA
ALABAMA HISTORICAL COMMISSION
468 SOUTH PERRY STREET
MONTGOMERY, ALABAMA 36130-0900

FRANK W. WHITE
EXECUTIVE DIRECTOR

TEL: 334-242-3184
FAX: 334-240-3477

July 2, 2014

Susan R. Jacks
TVA
400 West Summit Hill Drive
Knoxville, TN 37902

Re: AHC 14-1185
Construction of solar photovoltaic systems
Statewide

Dear Ms. Jacks:

We look forward to reviewing the projects on a case by case basis.

We appreciate your commitment to helping us preserve Alabama's non-renewable resources. Should you have any questions, the point of contact for this matter is Amanda McBride at 334-230-2692 or Amanda.McBride@preserveala.org. Please have the AHC tracking number referenced above available and include it with any correspondence.

Sincerely,

Lee Anne Wofford
Deputy State Historic Preservation Officer

LAW/AMH/amh

THE STATE HISTORIC PRESERVATION OFFICE
www.preserveala.org

Response: *Comment noted.*

Commenter: Lindsey Bilyeu
Affiliation: Choctaw Nation of Oklahoma
Comment:

The Choctaw Nation of Oklahoma thanks TVA for the correspondence regarding the above referenced project. The Choctaw Nation of Oklahoma has areas of historic interest in Alabama, Kentucky, Mississippi, and Tennessee. Will the projects that take place be reviewed on an individual basis or will they be covered by one Programmatic Agreement? Because of the large area and number of sites that could potentially be affected, sending our office the GIS shapefiles for the proposed project areas will be extremely helpful in our review. Also, please keep in mind that the Choctaw Nation of Oklahoma may have records of sites that are culturally significant to the Tribe that may not be known by the SHPO's and may not have been evaluated for the NRHP. If you have any questions, please feel free to give me a call at 580-924-8280 ext. 2631.

Response:
Proposed projects will be reviewed on a case-by-case basis for compliance with respect Section 106. The environmental analysis documented in this PEA, which was prepared under NEPA, addressed potential effects of PV facilities that could be located across the TVA Power Service Area. Locations of privately-owned and operated proposed solar facilities are determined by their developers. Thus, TVA does not know the locations of such future facilities at this time. However, as developers submit proposals to TVA, TVA will consider each facility and will coordinate its assessment of the environmental impacts with all appropriate parties. Compliance with Section 106 will be fulfilled on a case-by-case basis, not through the development of a programmatic agreement.

Commenter: Ethel R. Eaton
Affiliation: Virginia Department of Historic Resources
Comment:

COMMONWEALTH of VIRGINIA

Department of Historic Resources

Molly Joseph Ward
Secretary of Natural Resources

2801 Kensington Avenue, Richmond, Virginia 23221

Julie V. Langan
Director

Tel: (804) 367-2323
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www.dhr.virginia.gov

July 25, 2014

Susan R. Jacks, Senior Manager
Project Environmental Planning
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

Re: Draft Programmatic Environmental Assessment
Tennessee Valley Authority Solar Photovoltaic Projects
DHR File No. 2014- 0573

Dear Ms. Jacks:

Thank you for your letter of June 23, 2014 requesting our comments on the draft programmatic environmental assessment prepared for the proposed actions. I am pleased to inform you that we fully support the Tennessee Valley Authority's preferred alternative, the Action Alternative. It is our understanding from the discussion in Section 3.11.2 that TVA will follow the process outlined in the regulations implementing Section 106 of the National Historic Preservation Act in indentifying historic properties, assessing effects, and considering ways to reduce, avoid or mitigate any adverse effects and will do this in consultation with the appropriate SHPO and federally recognized tribes. We have no further comments on the draft document

If you have any questions concerning our comments, or if we may provide any further assistance, please do not hesitate to contact me at (804) 482-6088; fax (804) 367-2391; e-mail ethel.eaton@dhr.virginia.gov . We look forward to working with you on these projects.

Sincerely,

Ethel R Eaton

Ethel R. Eaton, Ph.D., Senior Policy Analyst
Review and Compliance Division

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Northern Region Office
5357 Main Street
PO Box 519
Stephens City, VA 22655
Tel: (540) 868-7029
Fax: (540) 868-7033

Response: *Comments noted.*

Commenter: Stephen A. Smith
Affiliation: Southern Alliance for Clean Energy
Comment:

cleanenergy.org
Southern Alliance for Clean Energy

1.866.522.SACE
www.cleanenergy.org

P.O. Box 1842
Knoxville, TN 37901
865.637.6055

46 Orchard Street
Asheville, NC 28801
828.254.6776

250 Arizona Avenue, NE
Atlanta, GA 30307
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P.O. Box 1833
Pittsboro, NC 27312
919.360.2492

P.O. Box 310
Indian Rocks Beach, FL 33785
954.295.5714

P.O. Box 13673
Charleston, SC 29422
843.225.2371

James F. Williamson, Senior NEPA Specialist
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, Tennessee 37902

July 23, 2014

Re: Draft Programmatic Environmental Assessment, TVA Solar PV Projects

Dear Mr. Williamson,

The Southern Alliance for Clean Energy (SACE) commends the Tennessee Valley Authority (TVA) for preparing a draft programmatic environmental assessment (PEA) to identify and document, at a programmatic level, the potential environmental effects of developing and operating qualifying solar photovoltaic (PV) facilities, as well as TVA's purchase of power from these facilities. As a Tennessee-based organization with over 25 years of supporting clean energy throughout the Southeast, SACE is a well-qualified regional stakeholder to provide comments on this draft PEA.

SACE supports TVA's preferred alternative, the "Action Alternative," as described in TVA's draft PEA. Establishing the Action Alternative will reduce time and costs associated with PV development in TVA's service territory, while remaining in compliance with the National Environmental Policy Act and not compromising the environmental integrity of the region. TVA, its customers, the local solar industry and other stakeholders stand to benefit from this effort.

Thank you for your consideration of these comments.

Sincerely,

Stephen A. Smith
Executive Director

Response: *Comments noted.*

Commenter: Craig Potts
Affiliation: Kentucky State Historic Preservation Office
Comment:

STEVEN L. BESHEAR
GOVERNOR

TOURISM, ARTS AND HERITAGE CABINET
KENTUCKY HERITAGE COUNCIL

BOB STEWART
SECRETARY

THE STATE HISTORIC PRESERVATION OFFICE
300 WASHINGTON STREET
FRANKFORT, KENTUCKY 40601
PHONE (502) 564-7005
FAX (502) 564-5820
www.heritage.ky.gov

CRAIG A. POTTS
EXECUTIVE DIRECTOR AND
STATE HISTORIC PRESERVATION OFFICER

July 22, 2014

James F. Williamson
NEPA Compliance
Tennessee Valley Authority
400 West Summit Hill Drive, WT11 D
Knoxville, TN 37902

Re: Draft Programmatic Environmental Assessment TVA Solar Photovoltaic Projects – Alabama, Georgia, Kentucky, Mississippi, North Carolina, Tennessee and Virginia

Dear Mr. Williamson,

On June 26, the State Historic Preservation Office received information on the above referenced draft document for review and comment. In Section 3.11.2, the draft document notes that, under the preferred Action Alternative, TVA will follow the National Historic Preservation Act's Section 106 process to address identification of historic properties, assessment of effects, and avoidance of adverse effects. We look forward to working with TVA on Section 106 compliance for any undertaking planned in Kentucky.

We offer the following comments/observations on the draft document:

- While it is clear that TVA intends to utilize the Section 106 process in the Action Alternative, Section 2.1.2 of the draft document discusses the information that would be requested from developers under a power purchase agreement for proposed facilities. It goes on to say that "TVA would screen each proposed project to determine the potential for adverse environmental effects to the resources listed above," including cultural resources, and that "the findings of this site-specific environmental review would be documented using TVA's Categorical Exclusion Checklist."

  Because Section 106 compliance is often still required even when categorical exclusions apply under NEPA, it is important to note that general information about cultural resources provided by developers may inform review to some extent, but it is unlikely to supply sufficient information to properly screen for impacts to cultural resources. In our experience to date consulting on solar undertakings in Kentucky, we find developers often do not have the resources or experience to comment accurately on the presence of onsite archaeological resources and historic structures or districts within the viewshed. We caution against relying too heavily on cultural resources information that has not been prepared or vetted by someone meeting the appropriate Secretary of the Interior's professional qualification standards.

[Comment 1]

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James Williamson
7/22/2014

[Comment 2]

- In Section 3.11.1, the draft document proposes generally acceptable areas of potential effect (APE) for direct and indirect effect. As potential for impacts to cultural resources can be location- and project-specific, though, we recommend these APEs be confirmed as part of the Section 106 process whenever undertakings are established.

[Comment 3]

- We ask that consideration be given to how cultural resource surveys are conducted and presented for review. Our office reviews reports against the most current version of our *Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports* (available on our website at http://heritage.ky.gov/siteprotect/.) If there is any potential for future undertakings to cross state lines, and TVA plans to submit cultural resource surveys with combined information, we encourage TVA or their consultants to coordinate with the appropriate states on what information will be presented and how it will be formatted to minimize the chance there would be delay in review.

While the draft document is geared toward the Action Alternative, Section 106 would still apply in the No Action Alternative. As already noted, we have consulted on other federal undertakings involving installation of solar arrays. In some of these cases, developers have stated an intention to sell excess power to TVA, and we have made previous inquiries to TVA as to the agency's compliance responsibilities in relation to these new installations. If for some reason TVA is not able to pursue the preferred Action Alternative, we request an opportunity to consult further on Section 106 as it relates to TVA's present practice of purchasing power from suppliers.

If you have questions regarding these comments, please contact Jill Howe of my staff at (502) 564-7005, extension 121.

Sincerely,

Craig A. Potts
Executive Director and
State Historic Preservation Officer

CP:jh

Response to Comment 1:
TVA recognizes its responsibility to make objective determinations of potential effects to cultural resources and to consult with the appropriate state historic preservation office to obtain concurrence with those determinations. TVA uses only qualified firms to perform cultural resources surveys.

Response to Comment 2:
In conducting case-by-case reviews, TVA would determine and document the respective archaeological and architectural areas of potential effect.

Response to Comment 3:
In the event TVA proposes to construct and operate solar facilities in Kentucky, TVA would ensure that the Kentucky Specifications for Conducting Fieldwork and Preparing Cultural Resource Assessment Reports would be utilized. In cases where TVA is involved with independent power producers, TVA would require those developers to follow these standards.

Commenter: Michelle B. Walker
Affiliation: Office of Policy and Planning, Tennessee Department of Environment and Conservation
Comment:

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
NASHVILLE, TENNESSEE 37243-0435

ROBERT J. MARTINEAU, JR.
COMMISSIONER

BILL HASLAM
GOVERNOR

July 28, 2014

Via First Class and Electronic Mail to jfwilliamson@tva.gov
James F. Williamson
NEPA Compliance
Tennessee Valley Authority
400 West Summit Hill Drive, WT11 D
Knoxville, Tennessee 37902

Mr. Williamson:

The Tennessee Department of Environment and Conservation (TDEC) appreciates the opportunity to provide comments on the Tennessee Valley Authority's (TVA) Draft Programmatic Environmental Assessment (PEA) for potential construction and operation of solar photovoltaic (PV) systems and/or purchase of electric power from such facilities in its 170-county power service area (PSA), for the purpose of increasing the amount of renewable energy in its energy portfolio. Power generated by solar PV facilities would be delivered to TVA's electric grid by direct connection or via interconnections with local power companies (LPCs) that distribute TVA power.

Solar power facilities within the scope of this Draft PEA would be located on existing buildings, developed sites including "brownfields," and undeveloped "greenfield" sites in public or private ownership within the TVA PSA.[1] Qualifying solar facilities include: ground-mounted PV facilities that occupy 10 acres or less of a greenfield site; ground-mounted PV facilities that occupy 20 acres or less of a brownfield site; and building-mounted PV facilities, regardless of size. The projects considered in the Draft PEA are expected to occupy an area of no more than 200 acres of land or equivalent rooftop space per year.

A no action alternative and an action alternative (the preferred alternative) are discussed within the Draft PEA. Regardless of the alternative selected, TDEC understands that TVA would continue to participate in current renewable energy programs and would pursue the addition of PV-generated power to its portfolio in order to meet renewable capacity targets identified within its current Integrated Resource Plan.

Under the no action alternative, TVA would continue its current practice of assessing the environmental impacts of each PV project on a case-by-case basis by preparing an individual environmental assessment under the National Environmental Policy Act (NEPA). Under the action alternative, TVA would utilize a streamlined NEPA review process for proposed PV projects and purchases within the PSA as follows:

[1] Projects participating in the Green Power Providers program are not within the scope of the assessment.

- For proposed PV facilities constructed and owned by TVA, an environmental review in accordance with TVA's existing NEPA procedures would be conducted on a case-by-case basis.
- For the proposed purchase of power from existing PV facilities which would cause environmental consequences, an environmental review in accordance with TVA's NEPA procedures would be conducted. For proposed purchase of power from existing PV facilities with no anticipated environmental effects, no further review would be required.
- For the intended acquisition of power from proposed non-TVA PV facilities, TVA would require developers with qualifying projects to supply specific environmental information about the site characteristics of the proposed facility, including cultural resources, threatened and endangered species, wetlands, unique natural features, floodplains, prime farmlands, and waste materials or contamination. This information would be used by TVA to determine the potential for adverse environmental effects. In such instances where adverse environmental effects may occur, TVA would encourage or require the developer to employ measures to avoid adverse effects or reduce them to minor and insignificant levels as described in the Draft PEA. In instances where TVA determines there is no potential for significant effects on resources, no further action would be required. Should TVA determine that proposed avoidance or mitigation measures are not feasible or practicable, such measures would not eliminate the potential for adverse effects, or if there is substantial controversy over the significance of the environmental impacts, the project would be subject to a project-specific environmental review process consistent with TVA NEPA procedures.

TDEC acknowledges TVA's consideration of potential environmental consequences that may result from solar PV projects or purchases. TDEC further recognizes and appreciates that TVA is taking steps to improve the efficiency and reduce the administrative burden of the NEPA review process for TVA solar PV projects, which will ultimately result in lower per watt "soft costs" associated with installation of solar PV projects under TVA's Solar Solutions Initiative and Renewable Standard Offer programs. It is also anticipated that these projects, regardless of the alternative selected, will reduce Tennessee's reliance on non-renewable energy sources and contribute to air quality improvements and economic development within TVA's PSA.

[Comment 1] TDEC observed that the Draft PEA does not specifically consider potential energy infrastructure impacts associated with solar PV projects or purchases, specifically those that may affect electricity system transmission, distribution, reliability and/or economic impacts. TDEC recommends that TVA include some discussion of these impacts, if any, at the programmatic level and/or outline requirements for these considerations in NEPA documents that tier back to this PEA and/or provide a reference to the appropriate TVA NEPA document that does provide this type of impact assessment for the these programs.

[Comment 2] Additionally, TDEC noted that the Draft PEA does not explicitly consider potential cumulative impacts associated with solar PV projects or purchases. Regulations pertaining to the NEPA process define cumulative effects as: "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.[2]" Based on this definition, the analysis of cumulative effects for proposed solar PV installations and purchases would not be limited to activities authorized by this PEA or undertaken by TVA. Therefore, TDEC suggests that TVA include in the Final PEA a cumulative effects analysis that focuses on particular categories of resources impacted by

[2] See 40 CFR 1508.7.

July 28, 2014
James F. Williamson
Page 3

the proposed action and identification of the stressors that cause degradation of those resources, including those caused by actions unrelated to the proposed action.[3] TVA includes some discussion of categories of potential impacts resulting from the proposed action on pages 10, 14, 15 and throughout Chapter 3 of the Draft PEA. However it is recommended that a separate section be created specifically for the purpose of discussing cumulative effects as it is defined. This will assist in examining cumulative impacts within future NEPA documents that tier back to the Final PEA, which ultimately results in a further streamlined process.

TDEC appreciates the opportunity to comment on the Draft PEA. Please contact me should you have any questions regarding these comments.

Sincerely,

Michelle B. Walker
Director, Office of Policy and Planning
Phone: (615) 532-9668

cc: Molly Cripps, TDEC, Office of Energy Programs

[3] This approach has been used by the U.S. Army Corps of Engineers in assessment of cumulative impacts during its Nationwide Permit PEA as well as the National Park Service in its Planning processes.

3

Response to Comment 1:
Chapter 3 of the final PEA has been revised to reflect potential effects to local infrastructure, including the local power distribution networks and the TVA transmission system. The solar facilities addressed in this PEA are relatively small. Thus, incremental additions of power from these solar facilities would constitute a relatively small contribution to the overall power supply in the local power company distribution system or TVA transmission system. TVA maintains its transmission system in accordance with standards established by the North American Reliability Council. The addition of solar-generated power from facilities considered in the programmatic EA is not expected to negatively affect reliability by overloading the existing transmission

system. However, placement of solar facilities near areas likely to experience high peak power demands could benefit the transmission system in that a portion (although only a small amount) of the peak power demand could be supplied locally rather than being transmitted over longer distances, thereby increasing the likelihood of creating transmission reliability issues.

Response to Comment 2:
The final PEA has been revised to further describe potential cumulative effects. Potential cumulative effects were identified as appropriate for the respective potentially affected resources.

Commenter: Mary Shaffer Gill
Affiliation: Tennessee Solar Industries Association
Comment:

TenneSEIA
Tennessee Solar Energy Industries Association

Making Tennessee a Solar Industry Leader!

July 23, 2014

James F. Williamson, Senior NEPA Specialist
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, Tennessee 37902

Re: Draft Programmatic Environmental Assessment, TVA Solar PV Projects

Dear Mr. Williamson,

Tennessee Solar Energy Industries Association (TenneSEIA) members have reviewed the Tennessee Valley Authority (TVA) draft Programmatic Environmental Assessment (PEA) for solar technology in the valley and support the Action Alternative, the TVA's Preferred Alternative. We believe that this assessment could radically reduce soft costs for solar projects in the Tennessee valley.

We appreciate TVA staff's efforts to assess and understand the environmental impact of solar technology in the valley. Thank you for your consideration of these comments.

Sincerely,

Mary Shaffer Gill
President
Tennessee Solar Energy Industries Association

www.tenneseiasolar.com

***Response**: Comment noted.*

Commenter: Mary M. Mastin
Affiliation: Tennessee Chapter of the Sierra Club
Comment:

On behalf of the Tennessee Chapter of the Sierra Club and our more than six thousand members and supporters across the state, I want to thank the Tennessee Valley Authority (TVA) for its work in preparing a programmatic environmental assessment (PEA) that focuses on smaller-scale renewable energy projects. The PEA explores opportunities to construct and operate solar photovoltaic (PV) systems on "greenfield" and brownfield sites and purchasing electricity from solar facilities located in the TVA service area.

The Sierra Club supports the direction that TVA is moving on renewable energy with this PEA. Identifying proper sites when renewable energy can be prioritized at the outset is a solid approach to solar development. Such a program will help to avoid the problems endemic in other regions of the country that have hampered solar growth or damaged the environment.

The Tennessee Chapter's top priority is confronting climate change and shifting from dirty, polluting energy sources to clean energy. We recognize that greenfield and brownfield renewable energy project development and acquiring more clean power from solar projects can and should play a role in that transition. For that reason, we support the action alternative to increase the amount of solar-generated power in TVA's energy portfolio without jeopardizing necessary environmental reviews by the public.

Solar development across the U.S. is well off the ground, including in the Tennessee Valley, and is diversifying our energy portfolio. Within the last decade smaller-scale renewable energy projects have reliably generated clean, safe energy with an abundant, no cost fuel source. Solar projects also create jobs. As of 2012, almost 250 companies located in Tennessee are involved in the state's solar industry.

Tennessee has some of the best solar resources in the southeast, and TVA would benefit from developing solar projects across the state or purchasing power from existing systems in the Valley. But we cannot harness the full potential of solar to generate clean energy without taking steps outlined in the PEA to create predictable, repeatable processes for permitting projects.

That being said, even smaller-scale renewable energy projects can disturb lands which may contain potential wildlife habitat, air and water quality, wetlands, and agricultural crops. That is why we agree with the position taken in the PEA that while some projects will not likely trigger a full environmental review under the National Environmental Policy Act (NEPA), TVA will conduct a more thorough review if concerns are presented during specific site-screenings to avoid potential impacts or provide mitigation. It is vital that solar projects aimed at cleaning up our region's energy portfolio also protect water and air, preserve natural habitat for recreation, and protect wildlife and natural systems.

The Sierra Club is committed to working with TVA to solve our most pressing energy and environmental challenges in a thoughtful manner. Renewable energy, particularly solar PV systems on greenfield and brownfield sites, can be developed in a way that balances environmental protection with our energy needs. We are confidant the Tennessee Valley's solar resources can be harnessed in a way that safeguards water resources, habitat and wildlife, and TVA's PEA and the action alternative will help all of us achieve this goal.

Thank you for the opportunity to comment on the PEA. Should you have any questions, please contact me by email at marymastin@twlakes.net or (931)268-2938.

Response: *Comments noted.*

Commenter: Crystal Best
Affiliation: North Carolina Environmental Review Clearinghouse

The North Carolina State Environmental Review Clearinghouse supplied comments from the state agencies listed below.

Commenter: Allison (Schwartz) Weakley (North Carolina Natural Heritage Program)
Comment:
Thank you for the opportunity to provide information from the North Carolina Natural Heritage Program (NCNHP) database for the proposed project referenced above. The NCNHP database has numerous records for rare species, important natural communities, natural areas, and conservation/managed areas within the areas covered by the Draft Programmatic Environmental Assessment (Draft PEA) in Cherokee, Clay, and Avery counties in North Carolina. We note that the Draft PEA includes a list of Federally-listed Endangered, Threatened, Candidate and Proposed Endangered/ Threatened Animal and Plant Species known from counties in the TVA power service area; it is our understanding that these lists have been compiled using data available from NatureServe and the TVA natural heritage database. The Draft PEA does not seem to directly address state-protected species within the project area.

We recommend that element occurrence records of rare species (including federally- and state-protected species) and important natural communities (including G1 natural communities), natural areas, and existing conservation/managed areas be accessed from the NCNHP database in consideration of the Draft PEA and in review of individual projects that may be considered in North Carolina. The NCNHP database is dynamic, and data distributions are updated quarterly (in January, April, July, October) every year. These data can be accessed on the NCNHP website at www.ncnhp.org under Data Services – GIS Download. We also offer a Database Search option to access lists of documented rare species and important natural communities by county or topographic quad. It is our understanding that TVA natural heritage project staff also has direct access to the NCNHP database through a data *sharing agreement.*

In addition, if site-specific information is needed, requests for information from the NCNHP database may be made directly to the NCNHP to assist in review of individual projects (see Data Services – Request Information on our website).

Please note that the use of Natural Heritage Program data should not be substituted for actual field surveys if needed, particularly if the project contains suitable habitat for rare species.

Feel free to contact me at 919-707-8629 or Allison.Weakley@ncdnr.gov if you *have questions or need additional information.*

Response:
The final PEA has been revised to address state-listed and protected species. TVA maintains a database of occurrences of listed species and other sensitive natural resources and has data sharing agreements with states in the Power Service Area. TVA welcomes the opportunity to access and use data in the North Carolina Natural Heritage Program database.

Commenter: Lyn Hardison (Division of Environmental Assistance and Customer Service)
Comment:
The Department of Environment and Natural resources has completed its review. Based on the information provided, our agencies have identified permits that may be required.

"The Sedimentation Pollution Control Act of 1973 must be properly addressed for any land disturbing activity. An erosion & sedimentation control plan will be required if one or more acres to be disturbed Plan filed with proper Regional Office (Land Quality Section) At least 30 days before beginning activity. A fee of **$65** for the first acre or any part of an acre. An express option is available with additional fees."

"Notification of the proper regional office is requested if "orphan" underground storage tanks (USTS) are discovered during any excavation operation."

"Review of trout buffer impacts if any (25-feet from TOB of trout classified streams), and submit request for variance if required. NPDES Construction stormwater application in conjunction with erosion and sedimentation control plan submittal if more than one acre is disturbed. If in HQW or ORW watershed, as state stormwater permit may be required."

Response:
Comments noted. In cases where TVA would construct and operate a proposed PV facility, TVA would acquire all applicable permits. In situations where TVA would purchase power from an independently-developed PV facility, TVA would require the developer to obtain all applicable permits.

Commenter: Catherine Bryant (Department of Transportation)
Comment:
No comment

Commenter: Carolyn Penny (Division of Emergency Management, Floodplain Management Program)
Comment:
No comment

Commenter: Renee Gledhill-Earley (State Historic Preservation Office)
Comment:
No comment

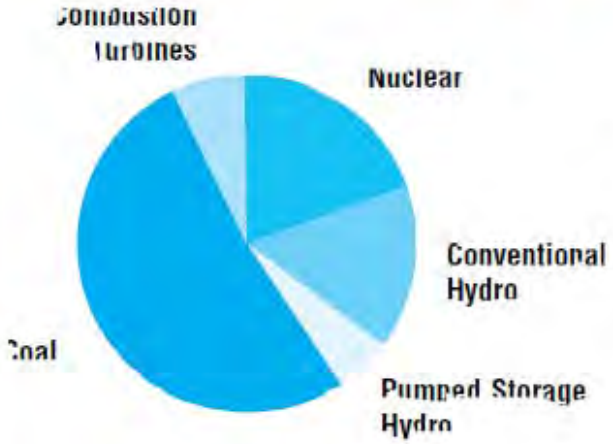
Commenter: Gary Bullwinkel
Affiliation: Member of the Sierra Club and the Tennessee Clean Water Network
Comment:

The following figures were taken from a TVA technical document from the Energy 2020 study.

http://www.tva.gov/environment/reports/energyvision2020/ev2020_vol2td3.pdf

These present TVA Power Generation and Environmental details not presented or discussed in relation to TVA's consideration of the socio/economic and environmental effects of Solar Power Generation in the Programmatic Environmental Assessment

FIGURE T3-1. **Projected System Capacity in 2005**



	MW	%
Pumped-Storage Hydro	1,532	5
Combustion Turbines	1,952	7
Conventional Hydro	4,404	17
Nuclear	5,517	20
Coal	14,590	51
Total	**27,995**	**100**

This figure shows TVA's generating mix and the percentage supplied by each type of generating resource.

FIGURE T3-5. Coal-Fired Plant Emissions

	Sulfur Dioxide				Nitrogen Oxides				Carbon Dioxide			
	AVERAGE 1990-1994		ESTIMATED CY95		AVERAGE 1990-1994		ESTIMATED CY95		AVERAGE 1990-1994		ESTIMATED CY95	
Plant/ CAAA Phase	Tons SO_2	LB SO_2/ MMBTU	Tons SO_2	LB SO_2/ MMBTU	Tons NO_X	LB NO_X/ MMBTU	Tons NO_X	LB NO_X/ MMBTU	Tons CO_2	LB CO_2/ MMBTU	Tons CO_2	LB CO_2/ MMBTU
Allen Phase I	66,120	3.34	25,205	1.00	33,729	1.70	42,849	1.70	4,094,359	205	5,167,025	205
Bull Run Phase II	45,087	1.75	77,775	2.50	15,659	0.60	18,666	0.60	5,317,540	205	6,377,550	205
Colbert Phase I	74,605	2.30	97,892	2.89	28,442	0.84	16,918	0.50	6,775,078	205	6,936,175	205
Cumberland Phase I	325,956	4.48	28,334	0.29	97,119	1.36	127,017	1.30	15,257,644	205	20,518,050	210
Gallatin Phase I	129,241	4.24	82,335	3.30	18,345	0.60	11,228	0.45	6,307,466	205	5,114,750	205
Johnsonville Phase I	95,044	2.79	94,908	3.30	26,518	0.83	13,674	0.48	7,064,874	205	5,895,800	205
John Sevier Phase II	57,549	2.35	57,450	2.50	15,308	0.64	13,788	0.60	5,045,858	205	4,710,900	205
Kingston Phase II	87,630	1.86	90,252	2.60	33,013	0.70	90,252	0.70	9,651,209	205	90,252	205
Paradise 1&2 Ph II, 3 Ph I	138,684	2.45	177,349	2.50	120,247	1.74	127,638	1.80	14,543,214	205-210	14,729,700	208
Shawnee 1-9 Ph II, 10 Ph I	55,117	1.62	71,330	1.46	29,803	0.88	40,578	0.83	7,330,461	205-210	10,044,600	206
Widows Creek Phase II	32,685	0.77	54,777	0.95	31,955	0.79	43,316	0.75	8,893,920	205-210	11,938,700	208

This figure shows the historical average for calendar years 1990 - 1994 and 1995 estimate of sulfur dioxide, nitrogen oxides, and carbon dioxide in tons per year and annual average pounds per million Btu by plant. The average is for calendar years 1990 - 1994 with the tons per year being a simple average and the pounds per million Btu being a weighted average.

FIGURE T3-9. Nuclear Generating Units

Nuclear Generating Plants	Location	Units	1996 Plant Summer Net Capacity (MW)	Commercial Operation Date (First Unit) (Last Unit)	Comments
Browns Ferry	Near Athens, AL	2 [1]	2,130	1975 1977	General Electric Boiling Water Reactors
Sequoyah	Near Chattanooga, TN	2	2,217	1981 1982	Westinghouse Pressurized Water Reactors
Watts Bar	Near Spring City, TN	1 [2]	1,170	Projected COD in FY 1996	Westinghouse Pressurized Water Reactor
TOTAL		**5**	**5,517**		

[1] Browns Ferry Unit 1 has been idled since 1983. Major modifications are required to bring the plant to current standards. Recovery of this unit is included as a supply-side option within the IRP.

[2] Watts Bar Unit 2 is approximately 68 percent complete. Completion of this unit is included as a supply-side option within the IRP.

Five nuclear units are expected to provide 5,517 megawatts of TVA's generating capacity.

From the Introduction of the PEA:

"TVA was created as a federal agency to improve the quality of life for residents of the Tennessee Valley, to foster economic development, and to promote conservation and wise use of the region's natural resources. One way that TVA fulfills this mission is by investing in renewable energy technologies located within its PSA."

Comments:

1. The PEA as presented shows that a full Environmental Impact Statement should be done on the use of Solar Power in the TVA Service region.
    a. TVA did not present a proper scope and context as to the use of Solar Energy as a REPLACEMENT strategy for the current power generation portfolio of major pollutant (coal and natural gas) and risk bearing (aging nuclear) generating plants. This alternative strategy is a reasonable approach and cannot be dismissed by omission.
    b. TVA did no life cycle comparision between the current technologies and Solar Power with the corresponding elimination of the mass quantities of local and regional pollutants generated by coal, the local damage strip mining does to communities and rural areas in the TVA region and outside the TVA Region and to the depletion of coal reserves that future generations could use for energy or other less polluting reasons.
    c. TVA did no life cycle socio economic cost/benefits and environmental effects on the reasonable alternative of large scale distributed nature of solar energy with its corresponding effects of decentralizing energy management, providing energy security and environmental benefits to the region and adding value to rooftops, brownfields and non producing or isolated rural land.
    d. TVA did no discussion, numerical analysis or even broach the subject of distributed Solar Energy that would be owned or developed by the 155 coops and municipal distributors and that could substantially supplant or replace TVA as the sole provider of electricity in urban and rural areas far from its generating network of costly, risky and environmentally damaging coal, natural gas and nuclear plants.
    e. TVA did not technical analysis of the technical barriers to implementing a program of solar implementation, empowerment to the local coops, commercial and residential users that would localizer power generation and apply technology and market pricing to those local markets and the corresponding reduction of negative environmental effects of the supplanted or replaced fossil fuel and nuclear power generation plants. Such technology and market pricing effects will create a socio/economic boom in local construction, energy management and point source management products such as panel arrays, local grid management, innovative and market tested storage systems and corresponding conservation strategies that would optimize the use of free fuel, the sun, and minimize the drawbacks of cloudy days and sunless nights.

2. TVA arbitrarily presents no increased use of solar panel technologies as alternatives to the very narrow scope of its tiny solar initiative (in comparison to its major power portfolio) thus ignoring the effect of reducing or eliminating the deadly, pervasive and otherwise deleterious effects of its fossil fuel and nuclear based generation scheme.
3. TVA, with no explanation and in an arbitrary manner, does not present in qualitative or quantitative terms the extent of the deadly and deleterious effects on the human environment of fossil fuel extraction, transportation, emissions and fly ash storage in this assessment. TVA should expand its scope and present in real terms what would be the environmental effects of

replacing fossil fuel and nuclear generation. The sun is free and gives its power without any negative environmental effects inherent in the extraction, transportation, emissions, and fly ash and nuclear waste storage of fossil fuel and nuclear fueled facilities. These facts are not discussed or scoped in this document and should be raised in a larger more expansive EIS.

4. TVA does not discuss, support or challenge its current business model of a heavily fossil fuel and nuclear base of power generation and how that business model serves the TVA mission statements as presented at the top of these comments. i.e, "TVA was created as a federal agency to improve the quality of life for residents of the Tennessee Valley, to foster economic development, and to promote conservation and wise use of the region's natural resources." This arbitrary lack of consideration of alternative business model methods of serving the public in regards to energy, conserving resources and increasing the quality of life, including reducing negative environmental effects such as the significant air and water pollution caused by TVA's power generation activities leaves no basis for the use of this PEA as an adequate or well scoped and considered NEPA assessment.
5. TVA did not adequately scope, encourage internal and external world class expertise and in a required, expanded EIS, discuss the reasonable alternative of TVA using its financial and energy management expertise to utilize and optimize the financing, use of purchase power agreements, distributive grid management, application of proven and current solar production and management techniques to replace the damaging fossil fuel technologies and the risky and aging nuclear power generation technologies. Without this expanded scope and reasoned discussion by qualified staff and other scientific sources, decision makers, stakeholders and the public (including interests outside the TVA region) cannot determine whether TVA's next 50 years will besubject to increasing risks of further environmental and economic failures or give the public a reasonable path to sustainability, sound economic management with risk aversion strategies and benefits to its customer base.
6. , TVA should discuss the possibilities inherent in the socio/economic life cycle of the next 50 years of what adapting its current power generation business model to an energy management public service model that would serve TVA's mission. The use of fossil fuels such as coal and natural gas have an extraction, transportation, emissions and fly ash storage environmental effects problem. They also carry the risk of unforeseen circumstances raising the price of fuel or costs of financing to unmanageable levels and thereby affecting environmental concerns of having to resort to a policy of desperate, environmentally harmful decisions. These risks are not discussed in this document but are inherent to the consideration of the environmental effects of solar which are few, the socio/economic effects of solar generation which have the benefits of no fuel costs thereby fixing that cost, a decreasing cost of installation, an increasing level of efficiency and therefore payback, depreciation and tax benefits as well as fixed financing at now attractive levels as opposed to the unspoken and undetermined and in some cases incalcuable deleterious effects of TVA's current power generation activities. These facts and forseeable effects of local, regional and global economic and environmental conditions are a vital component of TVA's solar power policy. This programmatic assessment fails by omission and does not serve the public interest.
7. TVA is a global leader in energy technology, energy management, resource management and the generation of significant amounts air and water pollution. The public, internal TVA experts and other interested parties should treat these facts in a well scoped, adequately described time life\cycle and a realistic and honest quantification and qualification of the benefits and costs of solar power as opposed to fossil fuel and nuclear generation.
8. TVA presents an inadequate and arbitrary approach to the placement of Solar facilities on farmland. By using the technical and narrow approach of a score of 160 on a Farmland

Protection Act worksheet as a basis for determing what action to do next is an inadequate methodology of raising alternatives and programmatic guidance in the use of productive farmland to place solar panels. This could contribute to the additive loss of productive farmland needlessly. TVA should have a deeper analysis and policy concerning the replacement of economically beneficial productive farmland with solar panels when adequate acreage can be found on non-productive, heavily sloped or isolated lands not available to current farm practices.

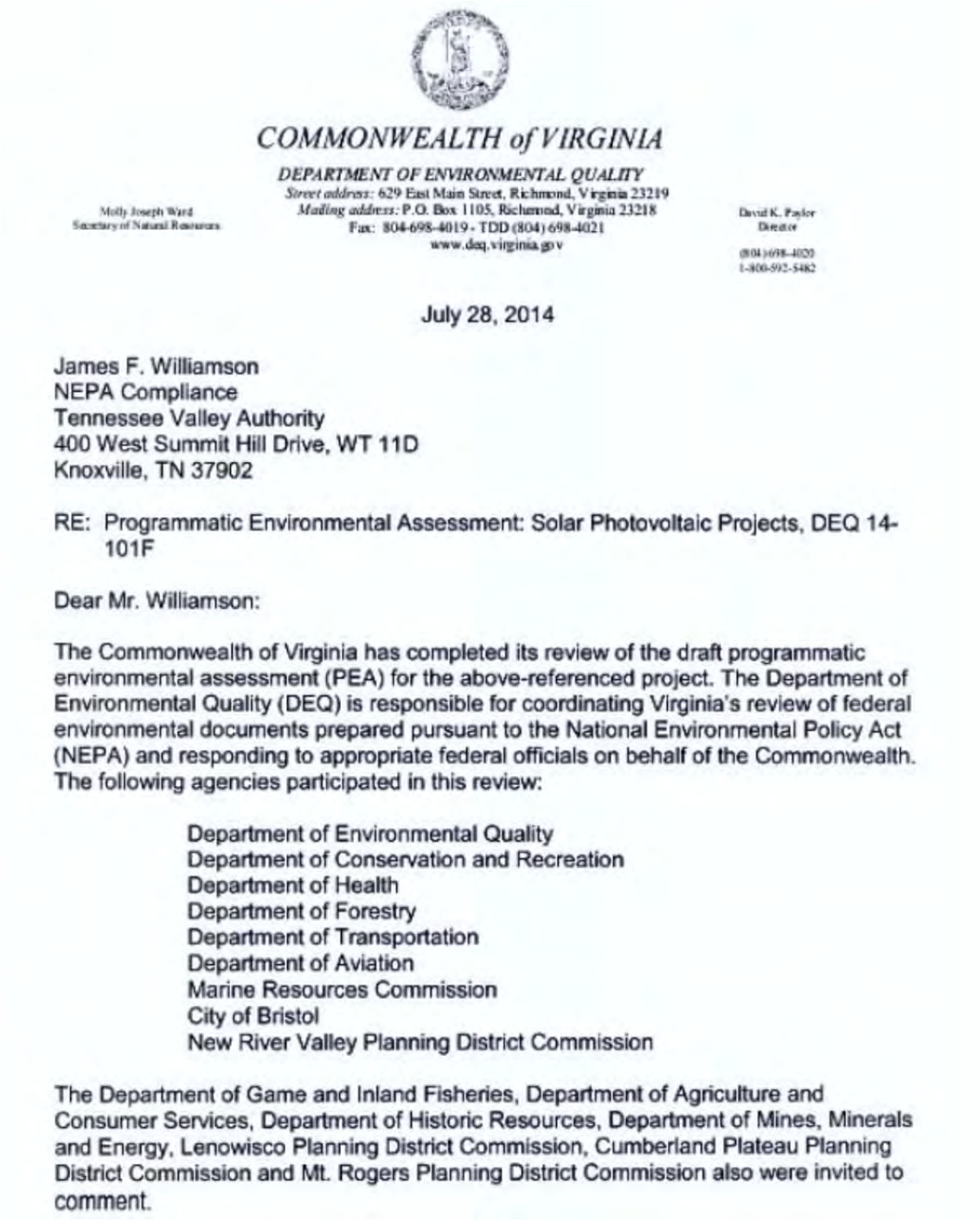
Response to Comments 1 through 7:
The cited Energy Vision 2020 was prepared in 1995; at that time, due to the state of technology development, TVA did not anticipate the incorporation of significant amounts of non-hydroelectric renewable generation into its power supply. Energy Vision 2020 was replaced by the 2011 Integrated Resource Plan (IRP) and associated Environmental Impact Statement. The 2011 IRP anticipates greatly increased use of non-hydroelectric renewable generation, including that generated by solar facilities. The 2011 IRP and EIS evaluate many of the environmental and economic impacts of increased solar generation and reduced coal-fired generation that are mentioned in Comments 1-7.

In 2013, TVA began development of a new IRP and associated EIS which is scheduled for completion in 2015. The topics mentioned in Comments 1-7 are being addressed in this planning process, and the topics in Comments 5-7, in particular, are being analyzed in much greater detail due to the current rapid changes in the electric utility industry associated with these topics.

Response to Comment 8:
As stated in the PEA, TVA could construct and operate small-scale PV facilities. However, TVA expects that most of the power acquired under this initiative would come from solar facilities constructed and operated by independent power producers. The fact that some of the facilities could be located on land currently used for agriculture is acknowledged in the PEA. Nevertheless, TVA cannot dictate where an independent power producer's proposed facility must be located. As stated in Section 3.10 of the PEA, the federal Farmland Protection Policy Act requires federal agencies to identify effects of federal programs on the conversion of farmland to nonagricultural uses. This Act is administered by the Natural Resources Conservation Service (NRCS), which uses federal form AD-1006, Farmland Conversion Impact Rating to determine the potential for impact on the local agricultural economy if land is converted to non-farm use and the compatibility with existing agricultural use. In situations where the rating calculated in form AD-1006 equals or exceeds a score of 160, the federal agency should consider alternative actions or implement measures that could reduce adverse impacts. The cumulative loss of farmlands is acknowledged in Section 3.10.2 of the PEA.

Commenter: Ellie Irons
Affiliation: Virginia Department of Environmental Quality
Comment:

The Virginia Department of Environmental Quality serves as the clearinghouse for environmental reviews. The document below provides a summary of comments provided from the various agencies contacted.



COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY

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July 28, 2014

James F. Williamson
NEPA Compliance
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, TN 37902

RE: Programmatic Environmental Assessment: Solar Photovoltaic Projects, DEQ 14-101F

Dear Mr. Williamson:

The Commonwealth of Virginia has completed its review of the draft programmatic environmental assessment (PEA) for the above-referenced project. The Department of Environmental Quality (DEQ) is responsible for coordinating Virginia's review of federal environmental documents prepared pursuant to the National Environmental Policy Act (NEPA) and responding to appropriate federal officials on behalf of the Commonwealth. The following agencies participated in this review:

Department of Environmental Quality
Department of Conservation and Recreation
Department of Health
Department of Forestry
Department of Transportation
Department of Aviation
Marine Resources Commission
City of Bristol
New River Valley Planning District Commission

The Department of Game and Inland Fisheries, Department of Agriculture and Consumer Services, Department of Historic Resources, Department of Mines, Minerals and Energy, Lenowisco Planning District Commission, Cumberland Plateau Planning District Commission and Mt. Rogers Planning District Commission also were invited to comment.

PROJECT DESCRIPTION

The Tennessee Valley Authority (TVA) submitted a PEA to consider increasing the amount of renewable energy in its energy portfolio by constructing and operating solar photovoltaic (PV) systems and/or purchasing electric power from such facilities located in its 170-county power service area, portions of which include southwest Virginia. The power generated by these solar PV facilities would typically be delivered to TVA's electric grid by direct connection or via interconnections with local power companies (i.e., municipal utilities and cooperatives) that distribute TVA power. Solar power facilities would be located on existing buildings and developed and undeveloped sites in public or private ownership within the TVA power service area.

ENVIRONMENTAL IMPACTS AND MITIGATION

1. Renewable Energy Permit by Rule.

1(a) Agency Jurisdiction. DEQ implements the Small Renewable Energy Projects (Solar) Permit by Rule regulations 9VAC15-60. DEQ's authority over renewable energy projects is set forth in the 2009 Small Renewable Energy Projects statute, which directed DEQ to develop permit by rule (PBR) regulations for wind, solar, combustion based and water-related resources if DEQ determined that one or more such permits by rule would be necessary for the construction and operation of small renewable energy projects.

[Comment 1]

1(b) Agency Comments. DEQ states that it is likely that the solar photovoltaic (PV) projects that are being proposed by TVA to be located in Virginia should be consistent with DEQ's Small Renewable Energy Projects (Solar) Permit-by-Rule (PBR) Regulation, primarily 9VAC15-60-130. Section 130 applies to so-called "de minimis" projects that are not required to undergo the full PBR process. Although each proposed project will need to be evaluated on an individual basis, Section 130 is likely to be relevant to most or all of the proposed projects for the reasons summarized below.

TVA states that potential locations for the proposed PV facilities include existing buildings, previously developed sites of 20 acres or less, and undeveloped sites of 10 acres or less.

Projects meeting these criteria may fall within the provisions of 9VAC15-60-130.A, which exempt from all notification and certification requirements a solar energy project that meets any <u>one</u> of the following requirements:

- A.1: Rated capacity ≤ 500 kilowatts
- A.1: Disturbance zone ≤ 2 acres

- A.2.b: Mounted on a building < 50 years old or, if ≥ 50 years, has been evaluated and determined by the Virginia Department of Historic Resources within the preceding 7 years to be not Virginia Landmarks Register-eligible
- A.2.c: Mounted over existing parking lots, existing roads, or other previously disturbed areas and any impacts to undisturbed areas do not exceed an additional 2 acres

Projects meeting the criteria of Section 130.A do not have to meet any requirements under DEQ's PBR Regulation; however, they are deemed to be covered by the PBR (*cf.* 9VAC15-6-20.C). DEQ staff can write a letter acknowledging that a project meets requirements for PBR coverage, upon request of the applicant. In requesting such a letter, the applicant should state the reasons that the project qualifies under Section 130.A.

If any of TVA's proposed projects does not qualify for the complete exemption provided in Section 130.A, the project may be consistent with the provisions of Section 130.B, which merely require notice to DEQ and submission of certification from the local government that the project complies with applicable land use ordinances (9VAC15-60-130.B). After DEQ receives a notice complying with the guidelines set forth in agency guidance, as well as the local-government certification, DEQ staff will issue a letter acknowledging that the project is covered by 9VAC15-60-130.B. (Note: Since local governments do not have land-use authority over federally-owned property, there is no local-government certification requirement for such projects. The applicant merely submits notice and states that the project is located on federal property.)

If a project does not qualify for any of the provisions of either Section 130.A or B, then it is likely that the project will need to be consistent with the criteria for the full PBR, as set forth in the remainder of the regulation, 9VAC15-60-10 *et seq*. These criteria focus primarily on protection of threatened and endangered wildlife and on historic resources.

The applicant will need to evaluate PBR application requirements separately for each project. Pursuant to the regulation's definition of "small solar energy project" (9VAC15-60-10), each project is connected to the electrical grid under a single interconnection agreement.

Virginia's renewable energy PBR regulation does not abrogate an applicant's responsibility to apply for and obtain (or be consistent with) all other applicable permits, at the federal, state, and local levels.

2. Subaqueous Lands Management. The PEA does not address subaqueous lands.

2(a) Agency Jurisdiction. The Virginia Marine Resources Commission (VMRC) regulates encroachments in, on or over state-owned subaqueous beds as well as tidal wetlands pursuant to Virginia Code § 28.2-1200 through 1400.

The VMRC serves as the clearinghouse for the Joint Permit Application (JPA) used by the:

- U.S. Army Corps of Engineers (Corps) for issuing permits pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act;
- DEQ for issuance of a Virginia Water Protection (VWP) permit;
- VMRC for encroachments on or over state-owned subaqueous beds as well as tidal wetlands; and
- local wetlands board for impacts to wetlands.

The VMRC will distribute the completed JPA to the appropriate agencies. Each agency will conduct its review and respond.

2(b) Agency Recommendations.

[Comment 2]

- Coordinate with VMRC if any portion of a future construction project in Virginia involves any encroachments channelward of ordinary high water along natural rivers and streams above the fall line or mean low water below the fall line since a permit may be required from VMRC.
- Ensure that site-specific NEPA assessments for projects in Virginia address potential impacts to subaqueous lands.

3. Water Quality and Wetlands. The PEA (page 22) states that potential direct effects to wetlands are unlikely.

3(a) Agency Jurisdiction. The State Water Control Board promulgates Virginia's water regulations, covering a variety of permits to include Virginia Pollutant Discharge Elimination System Permit, Virginia Pollution Abatement Permit, Surface and Groundwater Withdrawal Permit, and the Virginia Water Protection (VWP) Permit. The VWP Permit is a state permit which governs wetlands, surface water and surface water withdrawals/impoundments. It also serves as § 401 certification of the federal Clean Water Act § 404 permits for dredge and fill activities in waters of the United States. The VWP Permit (VWPP) Program is under the Office of Wetlands and Water Protection/Compliance within the DEQ Division of Water Quality Programs. In addition to central office staff who review and issue VWP permits for transportation and water withdrawal projects, the six DEQ regional offices perform permit application reviews and issue permits for the covered activities.

[Comment 3] ***3(b) Agency Comments.*** The DEQ Water Division is unable to determine if any projects covered under this draft PEA would result in impacts to any wetland or stream resources in the Commonwealth. If the project requires stream and/or wetland impacts, including temporary impacts, then a wetland delineation should be conducted to fully determine the location, extent and type of wetlands present. The improvements should be designed to avoid and minimize temporary impacts to surface waters to the greatest extent practicable. Once the U.S. Army Corps of Engineers (Corps) provides confirmation of the delineation, a determination is then made concerning if a Corps permit and VWP Permit from DEQ may be necessary for the project. Compensation for currently unforeseen, unavoidable permanent impacts to streams or wetlands may also be required.

3(c) Agency Findings. Ensure that site-specific NEPA assessments for project in Virginia address potential impacts to water quality and wetlands, mitigation and necessary permitting and coordination.

4. Erosion and Sediment and Stormwater Management Controls. The PEA (page 20) indicates ground-mounted facilities may disturb more than 1 acre of land.

4(a) Agency Jurisdiction. Effective July 1, 2013, the DEQ Water Division (WD) Office of Stormwater Management (OSM) administers the Virginia Erosion and Sediment Control Law and Regulations (VESCL&R) and the Virginia Stormwater Management Law and Regulations (VSWML&R).

[Comment 4] ***4(b) Agency Recommendations.*** Ensure that site-specific NEPA assessments for projects in Virginia include descriptions of land-disturbing activities, related mitigation measures or planned implementation of best management practices, and necessary erosion and sediment control and stormwater management plans or permits.

5. Air Pollution Control. The PEA (page 17) indicates that air quality is not likely to be affected by construction of solar PV systems.

5(a) Agency Jurisdiction. DEQ's Division of Air Quality is responsible for carrying out the mandates of the Virginia Air Pollution Control Law, as well as meeting Virginia's federal obligations under the Clean Air Act. The objective is to protect and enhance public health and the environment by controlling present and future sources of air pollution. The division ensures the safety and quality of the air in Virginia by monitoring and analyzing air quality data, regulating sources of air pollution, and working with local, state and federal agencies to plan and implement strategies to protect Virginia's air quality.

5(b) National Ambient Air Quality Standards. The primary goals of the Federal Clean Air Act are the attainment and maintenance of the National Ambient Air Quality

Standards (NAAQS) and the prevention of significant deterioration of air quality in areas cleaner than the NAAQS. The NAAQS establish the maximum limits of pollutants that are allowed in the outside ambient air. The Environmental Protection Agency (EPA) requires the submission of a State Implementation Plan (SIP) that includes laws and regulations necessary to enforce the plan and shows how the air pollution concentrations will be reduced to levels at or below these standards (attainment). Once pollution levels are within the standards, the SIP must also demonstrate how the state will maintain the air pollution concentrations at the reduced levels (maintenance).

The standards have been attained for most pollutants in most areas. However, attainment for the pollutant, ozone, has proven problematic. While ozone is needed at the earth's outer atmospheric layer to protect us from the sun's ultraviolet and other harmful rays, excess concentrations at the surface have an adverse effect on animal and plant life. Ozone is formed by a chemical reaction between volatile organic compounds (VOCs) and nitrogen oxides (NO_X) in the presence sunlight. When VOC and NO_X emissions are reduced, ozone is reduced.

5(c) Ozone Attainment Area. The DEQ Air Division states that the proposed project is located in an ozone attainment area.

[Comment 5] ***5(d) Agency Recommendations.*** Ensure that a site-specific assessment for future construction addresses the applicable air quality-related regulatory requirements, including 9VAC5-50-60 *et seq.* governing fugitive dust emissions and 9VAC5-130 *et seq.* for open burning.

6. Solid and Hazardous Waste Management. The PEA does not address solid waste issues.

6(a) Agency Jurisdiction. Solid and hazardous wastes in Virginia are regulated by DEQ, the Virginia Waste Management Board and the Environmental Protection Agency (EPA). They administer programs created by the federal Resource Conservation and Recovery Act (RCRA), Comprehensive Environmental Response Compensation and Liability Act (CERCLA), commonly called Superfund, and the Virginia Waste Management Act. DEQ administers regulations established by the Virginia Waste Management Board and reviews permit applications for completeness and conformance with facility standards and financial assurance requirements. All Virginia localities are required, under the Solid Waste Management Planning Regulations, to identify the strategies they will follow on the management of their solid wastes to include items such as facility siting, long-term (20-year) use, and alternative programs such as materials recycling and composting.

[Comment 6] ***6(b) Agency Comments.*** The DEQ Division of Land Protection and Revitalization (DLPR) (formerly known as the DEQ Waste Division) states that the EA does not

address potential solid and/or hazardous waste issues or include results from DEQ's databases.

6(c) Agency Recommendations.

- Ensure that future site-specific NEPA assessments include an environmental investigation on and near the property to identify any hazardous waste sites or issues by searching the state and federal waste-related database (details attached).
- Ensure that future site-specific NEPA assessments discuss measures proposed to reduce, reuse and recycle solid waste that will be generated during construction, and applicable regulations and laws related to solid and hazardous waste management.

7. Natural Heritage Resources. The PEA (page 31) states that TVA would take site-specific measures to avoid or minimize adverse impacts to sensitive habitats.

7(a) Agency Jurisdiction.

7(a)(i) Natural Heritage Resources. The mission of the DCR is to conserve Virginia's natural and recreational resources. DCR supports a variety of environmental programs organized within seven divisions including the Division of Natural Heritage (DNH). DNH's mission is conserving Virginia's biodiversity through inventory, protection, and stewardship. The Virginia Natural Area Preserves Act, 10.1-209 through 217 of the *Code of Virginia*, was passed in 1989 and codified DCR's powers and duties related to statewide biological inventory: maintaining a statewide database for conservation planning and project review, land protection for the conservation of biodiversity, and the protection and ecological management of natural heritage resources (the habitats of rare, threatened and endangered species, significant natural communities, geologic sites, and other natural features).

7(a)(ii) Threatened and Endangered Plant and Insect Species. The Endangered Plant and Insect Species Act of 1979, Chapter 39, §3.1-102- through 1030 of the *Code of Virginia*, as amended, authorizes the Virginia Department of Agriculture and Consumer Services (VDACS) to conserve, protect and manage endangered species of plants and insects. VDACS Virginia Endangered Plant and Insect Species Program personnel cooperates with the U.S. Fish and Wildlife Service (FWS), DCR DNH and other agencies and organizations on the recovery, protection or conservation of listed threatened or endangered species and designated plant and insect species that are rare throughout their worldwide ranges. In those instances where recovery plans, developed by FWS, are available, adherence to the order and tasks outlined in the plans should be followed to the extent possible. VDACS has regulatory authority to conserve rare and endangered plant and insect species through the Virginia

Endangered Plant and Insect Species Act. Under a Memorandum of Agreement established between the VDACS and DCR, DCR has the authority to report for VDACS on state-listed plant and insect species.

7(b) Agency Findings. According to the information currently in DCR DNH's files, natural heritage resources have been documented in the Tennessee Valley Authority (TVA) service area (see attached table).

7(c) Natural Area Preserves. DCR states that there are State Natural Area Preserves documented in the TVA service area under DCR's jurisdiction. In addition, some sections of the rivers within the TVA service area have been designated as scenic rivers in the state of Virginia.

7(d) Agency Recommendations. DCR DNH has the following recommendations:

[Comment 7]

- Contact the DCR DNH to re-submit project information and map for an update on this natural heritage information if the scope of the project changes and/or six months has passed before it is utilized.
- Coordinate with DCR DNH upon identification of project locations in Virginia for determination of impacts to these natural heritage resources.
- Ensure that site-specific NEPA assessments identify and address potential impacts to natural heritage resources and state-listed threatened and endangered plant and insect species.

8. Wildlife Resources. The PEA (page 39) states that a site-specific review would include an assessment of protected species in the project area.

8(a) Agency Jurisdiction. The Department of Game and Inland Fisheries (DGIF), as the Commonwealth's wildlife and freshwater fish management agency, exercises enforcement and regulatory jurisdiction over wildlife and freshwater fish, including state- or federally-listed endangered or threatened species, but excluding listed insects (Virginia Code Title 29.1). DGIF is a consulting agency under the U.S. Fish and Wildlife Coordination Act (16 U.S.C. sections 661 *et seq.*) and provides environmental analysis of projects or permit applications coordinated through DEQ and several other state and federal agencies. DGIF determines likely impacts upon fish and wildlife resources and habitat, and recommends appropriate measures to avoid, reduce or compensate for those impacts.

8(b) Agency Comments. DGIF did not respond to DEQ's request to comment.

[Comment 8] ***8(c) Agency Recommendation.*** Ensure that a site-specific NEPA assessment includes potential impacts to wildlife resources and state- and federally-listed species in Virginia.

8(d) Additional Information. DGIF maintains a database (*http://vafwis.org/fwis/)* of wildlife locations, including threatened and endangered species, trout streams and anadromous fish waters.

9. Historic and Archaeological Resources. The PEA (page 46) indicates that TVA would consult with the Department of Historic Resources (DHR).

9(a) Agency Jurisdiction. DHR conducts reviews of projects to determine their effect on historic structures or cultural resources under its jurisdiction. DHR, as the designated State's Historic Preservation Office, ensures that federal actions comply with Section 106 of the National Historic Preservation Act of 1962 (NHPA), as amended, and its implementing regulation at 36 CFR Part 800. The NHPA requires federal agencies to consider the effects of federal projects on properties that are listed or eligible for listing on the National Register of Historic Places. Section 106 also applies if there are any federal involvements, such as licenses, permits, approvals or funding. DHR also provides comments to DEQ through the state environmental impact report review process.

9(b) Requirement. Section 106 of the National Historic Preservation Act (as amended) and its implementing regulations codified at 36 CFR Part 800 require federal agencies to consider the effects of their undertakings on historic properties.

[Comment 9] ***9(c) Agency Recommendation.*** Coordinate with DHR as necessary to ensure compliance with the National Historic Preservation Act and address potential impacts to historic and archaeological resources within Virginia as a part of future site-specific NEPA assessments.

10. Public Water Supply.

10(a) Agency Jurisdiction. The Virginia Department of Health (VDH) Office of Drinking Water (ODW) reviews projects for the potential to impact public drinking water sources (groundwater wells, springs and surface water intakes). VDH administers both federal and state laws governing waterworks operation.

10(b) Agency Comments. VDH ODW states that it has no comments at this time.

10(c) Requirement. VDH ODW states that potential impacts to public water distribution systems must be verified by the local utility.

[Comment 10 ***10(d) Agency Recommendation.*** Ensure that site-specific NEPA assessments address potential impacts to public water supplies and mitigation measures as appropriate.

11. Transportation.

11(a) Agency Jurisdiction. The Virginia Department of Transportation (VDOT) provides comments pertaining to potential impacts to existing and future transportation systems.

[Comment 11] ***11(b) Agency Comments.*** The VDOT Bristol District states that each location must have separate entrance permits and meet all the minimum standards.

11(c) Agency Recommendations. Ensure that site-specific NEPA assessments address transportation-related requirements.

12. Aviation Impacts.

12(a) Agency Jurisdiction. The Virginia Department of Aviation (DOAv) is a state agency that plans for the development of the state aviation system; promotes aviation; grants aircraft and airports licenses; and provides financial and technical assistance to cities, towns, counties and other governmental subdivisions for the planning, development, construction and operation of airports, and other aviation facilities.

12(b) Agency Findings. DOAv states that there appears to be a small portion of the project area that may have potential impacts in Washington and Lee counties. If photovoltaic solar arrays are to be erected in these counties, DOAv requests to review the proposed sites in greater detail. If sites in these counties are selected, DOAv will require that 7460 forms be submitted to the Federal Aviation Administration for evaluation of potential hazards to air navigation. These forms must be submitted for any array to be located within 20,000 linear feet of any public-use airport.

[Comment 12] ***12(c) Agency Recommendations.*** Ensure that site-specific NEPA assessments identify and address potential impacts to airports and associated requirements.

13. Forestry Impacts.

13(a) Agency Jurisdiction. The mission of the Department of Forestry (DOF) is to protect and develop healthy, sustainable forest resources for Virginians. DOF was established in 1914 to prevent and suppress forest fires and reforest bare lands. Since the Department's inception, it has grown and evolved to encompass other protection and management duties including: protecting Virginia's forests from wildfire, protecting Virginia's waters, managing and conserving Virginia's forests, managing state-owned lands and nurseries, and managing regulated incentive programs for forest landowners.

[Comment 13] ***13(b) Agency Comments.*** DOF has no objection to TVA assessing the generic impact of future acquisitions of PV-generated power through a programmatic environmental review for the following reasons as identified in the proposal:

- The portion of Virginia that is in the TVA service area is limited to a very small section in the southwestern corner of the Commonwealth. While that corner is heavily forested, TVA provided information in its submittal notes that (a) its overall affected service area includes over 30 million acres of forested land; and (b) the installation of multiple solar facilities could result in a conversion of approximately 200 acres of forest per year. Therefore, the impact to Virginia forestland is likely to be miniscule.
- Even under the PEA option, provisions are in place to allow for a case by case NEPA review if warranted.
- Qualifying solar facilities within the scope of the PEA include ground-mounted PV facilities that occupy 10 acres or less of a greenfield site.
- Given the relative ease of preparing open lands for use as solar farms (i.e., reduced clearing and grading compared to sites with forest cover, karst features or steep gradients), open lands will likely be a common feature among greenfield and brownfield sites selected.

Contact DOF (Gregory Evans at *Gregory.Evans@dof.virginia.gov*) for additional information.

14. Pollution Prevention. DEQ advocates that principles of pollution prevention be used in all construction projects as well as in facility operations. Effective siting, planning, and on-site Best Management Practices (BMPs) will help to ensure that environmental impacts are minimized. However, pollution prevention techniques also include decisions related to construction materials, design, and operational procedures that will facilitate the reduction of wastes at the source.

[Comment 14] ***14(a) Recommendations.*** We have several pollution prevention recommendations that may be helpful in planning future construction projects:

- Consider environmental attributes when purchasing materials. For example, the extent of recycled material content, toxicity level, and amount of packaging should be considered and can be specified in purchasing contracts.
- Consider contractors' commitment to the environment when choosing contractors. Specifications regarding raw materials and construction practices can be included in contract documents and requests for proposals.
- Choose sustainable materials and practices for building construction and design.
- Integrate pollution prevention techniques into the facility maintenance and

operation, to include inventory control for centralized storage of hazardous materials. Maintenance facilities should have sufficient and suitable space to allow for effective inventory control and preventive maintenance.

DEQ's Office of Pollution Prevention provides information and technical assistance relating to pollution prevention techniques and EMS. If interested, please contact DEQ (Sharon Baxter at 804-698-4344).

15. Regional and Local Comments. As customary, the City of Bristol, New River Valley Planning District Commission (PDC), Lenowisco Planning District Commission, Cumberland Plateau Planning District Commission and Mt. Rogers Planning District Commission were invited to comment.

15(a) Agency Jurisdiction. In accordance with the Code of Virginia, Section 15.2-4207, planning district commissions encourage and facilitate local government cooperation and state-local cooperation in addressing, on a regional basis, problems of greater than local significance. The cooperation resulting from this is intended to facilitate the recognition and analysis of regional opportunities and take account of regional influences in planning and implementing public policies and services. Planning district commissions promote the orderly and efficient development of the physical, social and economic elements of the districts by planning, and encouraging and assisting localities to plan, for the future.

[Comment 15] ***15(b) Local Recommendation.*** Coordinate with the City of Bristol regarding any site-specific plans proposed within the city.

15(c) Regional Comments. The New River Valley PDC states that the PEA does not affect any jurisdiction within its district. The Lenowisco Planning District Commission, Cumberland Plateau Planning District Commission and Mt. Rogers Planning District Commission did not respond to DEQ's request for comments.

REGULATORY AND COORDINATION NEEDS

1. Renewable Energy Permit By Rule. Contact DEQ (Beth Major at *Mary.Major@deq.virginia.gov*) for additional information about the solar PBR.

2. Water Quality and Wetlands. A VWP Permit or approval may be required from DEQ pursuant to Virginia Code §62.1-44.15:20 *et seq.* and Virginia regulations 9VAC25-210-10 *et seq.* if site-specific projects affect wetlands or surface waters. If applicable, permitting action commences with the receipt of a complete Joint Permit Application (JPA). A JPA may be obtained from and submitted to the VMRC, which serves as a clearinghouse for the joint permitting process involving the VMRC, DEQ, Corps and local wetlands boards. Contact VMRC (Mike Johnson at 757-247-2255 or *Mike.Johnson@mrc.virginia.gov*) regarding the submission of a JPA. Contact DEQ BRRO (Mark Trent at 276-676-4804 or *Mark.Trent@deq.virginia.gov*) for additional information regarding VWP permitting requirements.

3. Subaqueous Lands. The VMRC, pursuant to Virginia Code § 28.2-1200 through 1400, regulates encroachments in, on or over any state-owned bays, rivers, streams or creeks throughout the Commonwealth. If any project includes proposed impacts to resources under VMRC's jurisdiction, coordinate with VMRC (Mike Johnson at 757-247-2255 or *Mike.Johnson@mrc.virginia.gov*).

4. Air Quality Regulations. According to the DEQ Air Division, the following regulations may apply to site-specific construction projects:

- 9VAC5-50-60 *et seq.* of the regulations governing fugitive dust.
- 9VAC5-130 *et seq.* of the regulations governing open burning.

Coordinate with DEQ SWRO (Crystal Bazyk at *Crystal.Bazyk@deq.virginia.gov* or 276-676-4829) for information on air quality regulations.

5. Erosion and Sediment Control and Stormwater Management. Specific questions regarding the Stormwater Management Program requirements should be directed to DEQ (Holly Sepety at 804-698-4039 or *Holly.Sepety@deq.virginia.gov*). General questions on erosion and sediment control may be directed to DEQ (Larry Gavan at 804-698-4040 or *Larry.Gavan@deq.virginia.gov*).

6. Solid Waste and Hazardous Substances. All solid waste, hazardous waste, and hazardous materials must be managed in accordance with all applicable federal, state, and local environmental regulations.

Applicable state regulations may include:

- Virginia Waste Management Act (*Code of Virginia* section 10.1-1400 *et seq.*);
- Virginia Hazardous Waste Management Regulations (VHWMR) (9VAC20-60);
- Virginia Solid Waste Management Regulations (VSWMR) (9VAC20-81); and
- Virginia Regulations for the Transportation of Hazardous Materials (9VAC20-110).

Applicable federal regulations may include:

- Resource Conservation and Recovery Act (RCRA) (42 U.S.C. section 6901 *et seq.*), and the applicable regulations contained in Title 40 of the Code of Federal Regulations; and
- U.S. Department of Transportation Rules for Transportation of Hazardous Materials, 49 CFR Parts 107, 171.1-172.558.

For additional information on waste management, contact DEQ SWRO (Allen Newman, Regional Director, at 276-676-4800).

7. Natural Heritage Resources. DCR DNH (804-371-2708) for an update on natural heritage information if a significant amount of time passes before the project is implemented and for additional information.

8. Protected Species and Wildlife Resources.

- DGIF's database may be accessed at *http://vafwis.org/fwis/* or by contacting DGIF (Shirl Dressler at 804-367-6913).
- Coordinate with DGIF (Amy Ewing at *Amy.Ewing@dgif.virginia.gov*) for additional information if necessary.

9. Water Supply Protection. Contact VDH (Barry Matthews at *Barry.Matthews@vdh.virginia.gov*) for additional information as necessary.

10. Historic Resources. Contact DHR (Roger Kirchen at *Roger.Kirchen@dhr.virginia.gov*), as necessary, pursuant to Section 106 of the National Historic Preservation Act (as amended) and its implementing regulations codified at 36 CFR

Part 800 which require federal agencies to consider the effects of their undertakings on historic properties.

11. Transportation. Contact VDOT (Donny Necessary, Jr., VDOT Bristol District Planner, at 276-669-9956) for additional information on transportation requirements if necessary.

12. Aviation. Contact DOAv (Scott Denny at 804-236-3632, extension 110) for additional information on aviation-related concerns as applicable.

13. Local Coordination. Coordinate with the City of Bristol (G. Wallace McCulloch, City Engineer, at 276-642-2316) regarding future site-specific plans proposed within the city.

Thank you for the opportunity to comment on the draft PEA. Detailed comments of reviewing agencies are attached for your review. If you have questions, please do not hesitate to call me at (804) 698-4325 or Julia Wellman at (804) 698-4326.

Sincerely,

Ellie Irons, Program Manager
Environmental Impact Review

Enclosures

cc: Tabitha Crowder, Bristol
Kevin Byrd, NRV PDC
Glen Skinner, Lenowisco
Jim Baldwin, Cumberland
Dave Barrett, Mount Rodgers

ec: James F. Williamson, TVA
Amy Ewing, DGIF
Keith Tignor, VDACS
Robbie Rhur, DCR
Barry Matthews, VDH
Steve Coe, DEQ DLPR
Kotur Narasimhan, DEQ DAPC
Larry Gavan, DEQ
Holly Sepety, DEQ
Shantelle Nicholson, DEQ
Chris Egghart, DEQ

TVA Solar Photovoltaic Projects PEA
DEQ 14-101F
Page 16

Teresa Frazier, DEQ SWRO
Roger Kirchen, DHR
David Spears, DMME
Greg Evans, DOF
Mike Johnson, VMRC
James Cromwell, VDOT
Alfred Ray, VDOT
Liz Jordan, VDOT
Scott Denny, DOAv
Carol Wampler, DEQ
Beth Major, DEQ

Response to Comment 1:
Section 1.7 of the PEA has been revised to acknowledge Virginia's Permit by Rule regulations for small renewable energy projects. TVA would require developers in Virginia to consult with the Department of Environmental Quality to determine the applicability of the proposed project to the Permit by Rule regulations.

Response to Comment 2:
In its site-specific screening of proposed solar projects, TVA would determine if the project would affect streams or submerged property. Such sites are typically not suitable for solar facilities. In the event a proposed project would involve such effects, the developer would be responsible for acquiring appropriate permits.

Response to Comment 3:
In the screening process, TVA would determine the potential for effects to surface waters, including wetlands. As stated above, developers would be required to secure all appropriate permits and approvals.

Response to Comment 4:
Comment noted.

Response to Comment 5:
Site-specific reviews would include determining potential effects to air quality, including effects from open burning.

Response to Comment 6:
Section 2.1.2 of the PEA acknowledges that buried waste materials or contamination may be present on brownfield sites and that TVA would require developers to determine the presence of any onsite buried wastes or contaminants and the likelihood of the release or dispersion of contaminants from the project. Solar facilities do not normally generate any hazardous materials during operation. TVA anticipates that at the end of life of a facility, the developer would dispose of all materials in landfills permitted for that purpose and in accordance with appropriate regulations. Information about the disposal and recycling of PV panels is provided in Section 3.15 of the PEA.

Response to Comments 7 and 8:
In the site-specific review process, TVA would utilize its natural heritage databases and would contact the Virginia Department of Natural Heritage as necessary to determine potential effects to natural heritage resources and protected species, including both state-listed and federally listed species.

Response to Comment 9:
As stated in the PEA, TVA would consult as appropriate with the Department of Historic Resources.

Response to Comment 10:
As stated in Section 3.1.2 of the PEA, adverse effects to groundwater quantity and quality are expected to be minor. However, TVA would consider such effects in its site-specific screening process.

Response to Comment 11:
Developers of proposed solar facilities would be responsible for obtaining entrance permits, and TVA would require developers to present proof of such permits.

Response to Comment 12:
As stated in Section 3.12 of the PEA, coordination with the Federal Aviation Administration would occur for solar projects within a 5-mile radius of an airport.

Response to Comment 13:
Comment noted.

Response to Comment 14:
Comment noted.

Response to Comment 15:
TVA will coordinate with the City of Bristol, Virginia regarding any proposed solar facilities within the city.

Commenter: Leopoldo Miranda
Affiliation: Southeast Regional Office, U.S. Fish and Wildlife Service
Comment:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1875 Century Boulevard
Atlanta, Georgia 30345

In Reply Refer To
FWS/R4/ES

James F. Williamson, Senior NEPA Specialist
Tennessee Valley Authority
400 West Summit Hill Drive, WT 11D
Knoxville, Tennessee 37902

Dear Mr. Williamson,

The U. S. Fish and Wildlife Service (Service) has reviewed Tennessee Valley Authority's (TVA) Draft Programmatic Environmental Assessment (DPEA) for Solar Photovoltaic Projects in Alabama, Georgia, Kentucky, Mississippi, North Carolina, and Tennessee. The DPEA evaluates the potential effects of solar photovoltaic projects located on existing buildings, previously developed sites of 20 acres or less in size, and undeveloped sites of 10 acres or less in size, within the TVA power service area.

The DPEA provides a general overview of the proposed activities; however, details such as the types, numbers, locations, and scope of the activities proposed are not included in the DPEA. Therefore, lacking specificity associated with the proposed action the Service is unable to concur that all of the proposed actions outlined in the DPEA (i.e., clearing up to 10 acres in undeveloped sites), would not have a significant effect on species that the Service has statutory and trust responsibility to protect[1].

General Comments

[Comment 1] The DPEA does not mention if the photovoltaic projects would use polarized (reflective) or non-polarized (anti-reflective) solar panels. The Service recommends the use of non-polarized panels to reduce the potential for migratory birds to "mistake" them for water resulting in bird fatalities.

[Comment 2] The Service recommends including a list of potential effects to sensitive aquatic species adjacent to newly cleared areas for solar panels (e.g., the effects of sedimentation in streams, alteration of riparian buffers, introductions of invasive species). This section should also include a list of general Best Management Practices that will be required (e.g., stream buffers, avoid steep terrain, and ensuring equipment is cleared of all potential invasive species).

[1]The Service's has responsible for the implementation of its regulations and where applicable, in accordance to the following laws: the Endangered Species Act of 1973, as amended (87 Stat. 884; 16 U.S.C. § 1531 et seq.); the Migratory Bird Treaty Act of 1918, as amended (40 Stat. 755; 16 U.S.C. § 703 et seq.); the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668–668d); and the Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661–667e; the Act of March 10, 1934; Ch. 55; 48 Stat. 401).

Section 3.8.2 of the DPEA, provides a general outline of the screening TVA would use to evaluate each individual proposed solar photovoltaic project. Projects located on existing buildings and previously developed sites of 20 acres or less in size, and which TVA finds there is no potential for significant effects to sensitive resources, the Service concurs that the process outlined in the DPEA would meet the standards under NEPA for categorical exclusion of further environmental review.

Specific Comments
Page 10, last paragraph, states the following: "In cases where sensitive resources are present on the site or the project has the potential to significantly affect one or more of those resources listed above, TVA would encourage or require the developer, as necessary, to develop appropriate measures to avoid adverse effects or to reduce them to minor and insignificant levels."

[Comment 3] The Service recommends deleting "would encourage" and adding the following language. "In cases where sensitive resources are present, such as federally protected species, TVA will request concurrence for their effects determination from the appropriate Ecological Service Field Office to ensure the project is in compliance with the Endangered Species Act."

If you need any additional information, please contact Christine Willis, Regional Energy Coordinator, Southeast Region, at (404) 679-7310.

Sincerely yours,

Leopoldo Miranda
Assistant Regional Director
Ecological Services

Response to Comment 1:
The glass surface of solar panels reflects some amount of light, and this reflected light tends to be aligned along a plane (i.e., polarized). Apparently, many insects and some birds can detect polarized light, such as the light reflected from flat water surfaces, and use this ability to locate open water or aquatic habitats. Some recent research indicates that reflected polarized light can attract insects and birds, especially in arid portions of the western United States, where open water is uncommon.

Additional research indicates that the use of white frames for the solar panels and other measures can disrupt insects' perception of polarized light reflections, thereby resulting in decreased attractiveness of PV facilities to insects.

New technologies in glass making are being developed, and low-reflective glass and glass coating are available commercially. However, these specialty products tend to be more expensive than the standard types of glass currently used in solar panels. The effectiveness of

using these materials in solar panels to prevent polarized light reflections and in preventing bird strikes has not been tested extensively.

Thus far, TVA is not aware of any noticeable number of bird fatalities at solar facilities beyond coincidental accidental bird strikes.

Response to Comment 2:
Section 3.8.2 of the final PEA has been revised to include ways in which sensitive aquatic species can be affected. Typical best management practices that TVA would require to reduce potential effects to water quality are listed in Section 3.1.2.

Response to Comment 3:
In situations where the screening process indicates that federally listed or protected species, or designated critical habitats, are present on the site of a proposed solar facility or if TVA determines that the proposed facility has the potential to affect such resources, TVA would consult with the appropriate Ecological Field Service Office of the U.S. Fish and Wildlife Service. In cases where a proposed solar facility has the potential to affect those resources listed in Table 2-1, TVA would consult with the appropriate state or federal regulatory authority.

Commenter: Bill Lorenz
Affiliation: Daniel Boone National Forest, Kentucky
Comment:

USDA United States Department of Agriculture | Forest Service | Daniel Boone National Forest | 1700 Bypass Road Winchester, KY 40391 859-745-3100

File Code: 1950
Date: JUL 31 2014

James F. Williamson
Tennessee Valley Authority
400 West Summit Drive
WT11 D
Knoxville, TN 37902

Dear Mr. Williamson:

Thank you for the opportunity to review to the Draft Environmental Assessment analyzing the impacts of the programmatic proposal to increase the amount of renewable energy within the TVA's 170-county power service area (PSA). My staff and I have reviewed the proposal to purchase and/or construct and operate solar photovoltaic systems. Forest Service GIS data indicates approximately 3,200-acre of national forest system (NFS) lands overlap with the PSA located in Whitley County, Kentucky within the national forest system lands managed by the Daniel Boone National Forest. I have included a map below illustrating this overlap. The 2004 *Land and Resource Management Plan for the Daniel Boone National Forest* includes goals that both directly and indirectly support the exploration and development of energy resources.

- Forestwide Goal 7 - Provide a sustainable mix of desired uses, valued characteristics, and services to improve the long-term benefit to local communities and the public.
- Forestwide Goal 16.2 Help rural communities develop and implement natural resource solutions to economic, environmental, and social problems.

Your proposal indicates there would be three actions possible if a decision to implement the proposed action captured in the programmatic EA.

1. Environmental Review of PV Facilities Built and Owned by TVA
2. Environmental Review of Acquiring Power from Existing PV Facilities
3. Environmental Review of Acquiring Power from Proposed Non-TVA PV Facilities

Proposals resulting from Item #1 are likely the only portion of this proposal that could affect NFS lands under my management. I support this programmatic proposal to diversify energy sources to provide quality service to the PSAs. I have neither objections nor further comments on this proposal and additional correspondence regarding this programmatic EA is not necessary. If, however, a future project proposal is developed that would involve the construction a new facility on NFS lands managed by the Daniel Boone National Forest, please notify me so my staff and I may review such a proposal, and provide site-specific information regarding natural resource matters within NFS lands. If you have any questions, please contact Forest Planner Elizabeth Robinson at (859) 745-3151 or elizabethlrobinson@fs.fed.us.

Sincerely,

BILL LORENZ
Acting Forest Supervisor

Attachment (1)

Caring for the Land and Serving People

Printed on Recycled Paper

Response: *Comment noted.*

Commenter: Ben West
Affiliation: Southeast Regional Office, National Park Service
Comment:

United States Department of the Interior

NATIONAL PARK SERVICE
Southeast Regional Office
Atlanta Federal Center
1924 Building
100 Alabama St., SW.
Atlanta, Georgia 30303

IN REPLY REFER TO:
SER PC

August 4, 2014

Ms. Susan R. Jacks
Tennessee Valley Authority
400 West Summit Hill Drive
Knoxville, TN 37902

Dear Ms. Jacks:

The National Park Service (NPS) has reviewed the Tennessee Valley Authority's (TVA) Solar Photovoltaic (PV) Projects Draft Programmatic Environmental Assessment (PEA). The PEA would potentially allow TVA to acquire power from existing PV facilities without preparing an Environmental Assessment or Environmental Impact Statement and instead tier or incorporate findings from the PEA if there are potential environmental consequences. The PEA would apply to individual PV facilities occupying 10 acres or less on greenfield sites or PV facilities occupying 20 acres or less on brownfield sites. The PEA would also apply to building-mounted PV facilities regardless of building size.

We commend TVA for its efforts to increase the amount of renewable energy in its energy portfolio. The NPS supports renewable energy projects so long as such projects: 1) do not adversely affect NPS units and affiliated sites; and 2) can be constructed and operated in an environmentally responsible manner to protect natural and cultural resources and important landscapes. The NPS strongly supports comprehensive planning efforts in siting renewable energy projects and strives to provide expertise and practical and specific feedback early in the planning process in order to avoid adverse impacts to NPS units and affiliated sites.

General Comments

[Comment 1] The NPS is concerned that TVA's proposed action would not adequately provide the ability of the NPS to provide comments to TVA on future projects that may pose impacts to any NPS units or other interests. To address this concern, it will be important for TVA to coordinate and consult with the NPS to ensure that adverse impacts to NPS units and affiliated sites are avoided. Without collaboration or consultation with the NPS, a project could be approved by TVA in the vicinity of a park unit that could degrade natural resources inside and connected to the park, including park scenery, landscapes and wildlife corridors, night skies, wilderness, ecosystem processes, habitat and "critical habitat," wetlands, geologic and hydrologic features, migratory pathways and stopover

sites, and listed species. Likewise, impacts to cultural resources could include archeological resources, cultural landscapes, ethnographic resources, and historic and pre-historic structures.

The NPS Organic Act of 1916 requires the NPS "…to conserve the scenery and the natural and historic objects and wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." (16 U.S.C. 1) The NPS Management Policies (2006) also direct the management of units of the National Park System to prohibit the "impairment" of park resources and values. According to Management Policies Section 1.4.5, impairment can "result from sources or activities outside the park" and is an impact:

> …that, in the professional judgment of the responsible NPS manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts.

Thus, it is of critical importance that, early in the planning process, TVA coordinates and consults with the NPS. An additional approach to encourage this early outreach would be for TVA to add "protected areas" as a new category under the list of resource topics used for screening projects on page 10. There are a variety of designations managed by the NPS that could be listed under protected areas. They include National Parks, National Historic Sites, National Monuments, National Historical Parks, National Memorial, National Preserves, National Recreation Areas, National Battlefields, National Wild and Scenic Rivers and Riverways, National Military Parks, National Rivers, National Parkways, National Battlefield Parks, National Scenic Trails, National Reserves, National Battlefield Site, and other designations. Consideration should also be given to potential impacts to lands and resources in the vicinity of NPS units and affiliated sites that could also be impacted by new PV facilities. Furthermore, other federal, state, and county parks, forests, refuges, and other sites could be listed as an additional screen under a new protected area category. We believe the protected area category will support TVA's efforts to identify poor siting locations for proposed PV facilities and allow for a more expedient permitting process.

[Comment 2] The NPS encourages TVA to list visual impacts under the "protected area" category, as well as under "cultural resources" and "unique natural features." In many cases, visual simulations may be warranted to better understand potential impacts on historic landscapes. This may be especially important in working to understand impacts from glare reflected from solar panels on NPS units located on elevated terrain. This could be an issue, in particular, at NPS units like Chickamauga and Chattanooga National Military Park that are located high on ridges and mountaintops and provide popular and historic viewpoints that are cherished by park visitors. The NPS has considerable expertise in helping agencies develop realistic visual resource simulations to help ensure projects are properly sited and mitigated.

The selection of the action alternative also increases the importance of initiating Section 106 consultation early in the planning process so that TVA can be made aware of any cultural resource concerns while screening projects. Likewise, the importance of defining an appropriate Area of

Potential Effects (APE) under 36 CFR Part 800.16(d) will grow. As such, under most circumstances the 0.5-mile APE radius, which is used for consultation described in the Draft PEA, would be insufficient and many NPS units and affiliated sites with Civil War and other historic resources could be impacted without ever being consulted. We look forward to consulting with TVA to ensure historic resources are taken into thoughtful consideration through the Section 106 process.

Close coordination with the NPS is also important due to the number of affiliated and related NPS sites in the TVA power service area. We encourage TVA to consult the NPS's "find your park" tool at www.nps.gov to learn where NPS and affiliated sites are located for future project planning. Each state page provides a listing of properties listed in the National Register of Historic places, Land and Water Conservation Fund grant sites, and protected NPS affiliated sites.

[Comment 3] Our specific comments below provide additional considerations to improve the PEA and minimize the potential for adverse impacts from future projects. The NPS recommends that the Final PEA and Finding of No Significant Impact include some best management practices or other mitigative commitments to address these concerns on a programmatic level that would be incorporated into future project applications and designs.

Specific Comments

[Comment 4] The most significant potential impacts on natural and cultural resources associated with PV facilities are related to the size of the facility (land conversion), habitat fragmentation, and the potential to utilize water (water use). Solar facility sites are typically cleared prior to construction, including the removal of vegetation and grading, both of which can compact soil, alter site drainage, and increase runoff and erosion. In addition, solar equipment requires direct sunlight to maximize efficiency, such that adjacent vegetation that may reduce light penetration is often removed. Finally, for wildlife and security reasons, the project site may be fenced. For many types of plants and wildlife, the area covered by a solar installation is effectively converted and removed from use as habitat for many species.

Many solar project impacts on wildlife and plants are commensurate with the project footprint, technology selected, local land characteristics (e.g., how much grading is conducted) and the duration of construction. The sensitivity of affected habitats and species will also affect the level of impacts. While most impacts to wildlife and plants occurs during initial land clearing at the project site, indirect effects can result from the introduction or increase of invasive species, erosion, sedimentation, alteration of drainage patterns, habitat fragmentation, noise, artificial light, fugitive dust, spills, soil compaction, topsoil removal, vegetation maintenance, air emissions, or increased human access. Solar panels may also contain hazardous materials that can contaminate the environment if care is not taken during construction, operation, and decommissioning.

[Comment 5] In all habitat types, the use of water for solar energy development or ongoing maintenance (e.g., cleaning) may affect hydrologic patterns in the vicinity of the project. In these cases water use may have impacts (e.g., depletion of surface or ground water, changes in flow, prolonged drying) on aquatic habitats near the project site. These impacts can reduce species diversity and cause habitat loss. A reduction in water depth can also increase fish predation. In intermittent streams, water withdrawal can cause fragmentation by leading certain reaches to become dry during times of year when they would otherwise be flowing. In addition the temperature of remaining water could

increase, leading to decreases in dissolved oxygen. These are only a few of the numerous and long-term direct and indirect impacts of water withdrawal. Water depletions should be carefully considered, particularly in areas where listed or other rare organisms rely on streams, lakes or wetlands. The use or accidental spill of chemicals such as dust suppressants, dielectric fluids, or herbicides, can also lead to the contamination of surface or groundwater.

[Comment 6] Recently, the potential for solar panels to emit polarized light and subsequently confuse aquatic insects has been investigated. Both water bodies and solar panels have the ability to polarize light. Certain aquatic insects use horizontal polarization of light to locate sites for egg laying and therefore this polarized light from solar facilities may cause aquatic insects to be inadvertently attracted to solar panels as a site for egg deposition. Thus, these sources of polarized light can become traps associated with reproductive failure and death. The significance of this effect on insect populations or on insect predators is not well understood and requires further study. A recent and preliminary U.S. Fish and Wildlife Service report found that bird mortality may be occurring at solar energy facilities in Southern California due to the following causes: impact trauma, solar flux (exposure to high temperatures), predation trauma, and electrocution (over half of the carcasses recovered had undetermined or no evident cause of death).

[Comment 7] All solar technologies have the potential to degrade visual resources of park units based on their proximity to the unit and the surrounding physical landscape. Solar facilities can diminish the scenic value of an area by introducing features with strong contrasts of form, line, and color into the natural landscape setting. They also have the potential to generate noise and increase ambient sound levels. Fixed-mount systems can be expected to produce less noise than "trackers" that rotate the solar panels to track the sun. The rotary attenuators that work as "trackers" each make noise and cumulatively can increase sound levels above natural ambient levels.

[Comment 8] Some solar facilities have nighttime lighting intended for security, maintenance and convenience. Lights can be installed on roadways, perimeter fencing, parking areas, and buildings. In naturally dark areas, the use of this light should be used only when and where necessary. Alternatives to installing permanent lighting include using portable systems for temporary maintenance, using motion sensors and timers to control length of time lights are on, shielding and directing light fixtures and avoiding blue and blue-white light.

We appreciate your efforts to address our concerns and look forward to collaborating with you in the future. If you have any questions about our comments, please contact Bryan Faehner at (202) 513-7256 or bryan_faehner@nps.gov.

Sincerely,

Ben West
Chief, Planning and Compliance Division
Southeast Region, National Park Service

Response to Comment 1:
As part of the screening process described in Section 2.1.2 of the PEA, TVA would determine potential effects to a variety of resources, including potential visual effects. In the event a proposed solar facility has the potential to affect National Park Service properties, including views from National Park Service properties, TVA would consult with the Service.

Response to Comment 2:
As stated in Section 3.9.1 of the PEA, "protected areas" are included and considered under the resource heading of Managed Areas and Ecologically Significant Sites. In determining potential effects to such managed areas and ecologically significant sites, TVA routinely considers potential visual effects and will continue to do so.

Response to Comment 3:
Nine mitigative measures were listed in Section 2.3 of the draft PEA. Additionally, as stated in Section 3.1.2, TVA would require suppliers to implement BMPs to reduce the potential for adverse effects to water quality.

Response to Comment 4:
In its screening process, TVA would determine potential adverse effects to wildlife and plant communities. The effects considered would include various direct and indirect effects.

Response to Comment 5:
Based on experience to date, solar facilities of the size considered in the EA typically do not require a source of water either from an onsite well or from nearby surface waters. However, some future facilities could possibly include a well. As stated in the "Local Infrastructure" section in Chapter 3 of the final PEA, an estimated 1,000 to 1,500 gallons per acre per year could be required to wash the panels, as needed. Nevertheless, water use, including extraction of groundwater and use of local surface waters, associated with the proposed action is not expected be of a magnitude that would affect groundwater supplies or nearby aquatic habitats.

Response to Comment 6:
Reflection of polarized light from solar facilities was also mentioned by another commenter. TVA is not aware of any unusual occurrences of solar facilities attracting insects or causing bird fatalities.

Response to Comment 7:
Operation of solar facilities described in the PEA typically generates no noise. To date, the vast majority of the solar facilities that have supplied power to TVA have not used tracking systems to orient the panels toward the sun. However, at least eight solar farms that provide power to TVA do use tracking systems. Three use a single-axis system, and five use a dual-axis tracking system. In the future, additional facilities could possibly use tracking systems. Provided they are maintained properly, these tracking systems generate minimal noise. As stated in Chapter 3 of the final PEA, inverters and transformers produce a hum that is typically indistinguishable from background noise. Noise is typically absent during nighttime hours when power is not being generated and when nearby receptors are most sensitive.

Response to Comment 8:
The solar facilities that provide power to TVA are typically fenced. However, to date, very few facilities have required or utilized nighttime security lighting. This trend is expected to continue. As stated in the programmatic EA, TVA would screen all proposed solar facilities to determine potential environmental effects. During that process, TVA would determine the potential for light pollution. Appropriate measures to reduce levels of unwanted light, such as those suggested, would be developed and implemented as appropriate.

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Appendix B – Critically Imperiled Globally Ranked Communities (G1) Found Within Rare or Uncommon Ecosystems and Associated Ecoregions

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G1 Rank Plant Community and Physiognomic Vegetation Classification	Rare or Uncommon Ecosystem	Ecoregion
Evergreen Forests, Woodland, and Shrublands		
Fraser Fir Forest (Deciduous Shrub Type)	Spruce-Fir (NC, TN)	BR
Fraser Fir / (Catawba Rosebay, Carolina Azalea) Forest	Spruce-Fir (NC, TN)	BR
Fraser Fir / Hobblebush / Mt Woodfern - Mt Woodsorrel / Stairstep Moss Forest	Spruce-Fir (NC, TN, VA)	BR
Red Spruce - (Fraser Fir) / (Catawba Rosebay, Great Laurel) Forest	Spruce-Fir (NC, TN)	BR
Red Spruce / Skunk Currant Forest	Spruce-Fir (NC, TN? VA?)	BR
Carolina Hemlock Forest (Mesic Type)	(NC, TN)	BR
Southern App Pitch Pine Bog Forest	App Bog, Fen, Seep (GA, NC)	BR
Southern App Northern White-cedar Slope Woodland	(KY? TN, VA)	RV, IP, BR
Southern App Heath Bald	(NC, TN)	BR
Heath Bald (Southern Mixed Type)	(NC, TN)	BR
Southern App Sand-myrtle Heath Bald	(GA?, NC, TN)	BR
Deciduous Forests, Woodlands, Shrublands		
Water Tupelo Sinkhole Pond Swamp	Bottomland Hardwood (TN)	IP
Swamp Tupelo / Common Buttonbush - Shining Fetterbush Sagpond Forest	Bottomland Hardwood (AL, GA, TN)	RV, SA
Sinking Pond Overcup Oak Swamp	Bottomland Hardwood (TN)	IP
Highland Rim Upland Depression Flatwoods	Bottomland Hardwood (TN)	IP
Upper East Gulf Calcareous Bluff Forest	(AL. MS)	MVLP
Montane Floodplain Slough Forest	(NC, TN?)	BR
Southern App Beech Gap (South Slope Sedge Type)	(NC, TN, VA?)	BR
Southern App Beech Gap (North Slope Tall Herb Type)	(GA?, NC, TN, VA?)	BR
Southern Crowley's Ridge Dry-mesic Oak Forest	(MS, TN?)	MAP
Southern Crowley's Ridge Dry Post Oak Forest	(MS, TN?)	MAP
App Calcareous Oak - Walnut Forest	(NC, VA?)	BR
Southern BR Ultramafic Outcrop Barrens (Deciduous Forest Type)	Prairies, Grasslands, Barrens (NC)	BR
Southern BR Mafic Woodland Seep	App Bog, Fen, Seep (NC, VA)	BR
Alabama Ketona Dolomite Woodland	(AL)	SA
Chinkapin Oak / Prairie Willow / Rattlesnake-master Woodland	(VA)	RV
Ridge-and-Valley Calcareous Shrubby Fen / Seep	App Bog, Fen, Seep (VA)	RV
Bushy St. John's-wort - Hazel Alder / AL Warbonnet - TN Yellow-eyed-grass Shrubland	Bottomland Hardwood (AL)	IP
Bushy St. John's-wort - Hazel Alder / Eastern Gammagrass Shrubland	Bottomland Hardwood (AL)	IP
Southern App Alder Bald	(NC, TN)	BR
Montane Buttonbush Pond	App Bog, Fen, Seep (VA)	BR

G1 Rank Plant Community and Physiognomic Vegetation Classification	Rare or Uncommon Ecosystem	Ecoregion
Moulton Valley Buttonbush Pond	Bottomland Hardwood (AL, TN)	SA
Mixed Evergreen-Deciduous Forests, Woodlands, Shrublands		
Southern Loess Hills Hardwood - Pine Forest	(MS)	MVLP
Red Spruce - Northern Hardwood Forest (Shrub Type	Spruce-Fir (NC?, TN, VA?)	BR
Southern App Pitch Pine Bog Forest	App Bog, Fen, Seep (GA, TN)	BR
East Gulf Coastal Plain Shortleaf Pine - Post Oak	(Al, GA?, MS, TN?)	SP
Eastern Hemlock / Catawba Rhododendron Forest	(VA)	BR
Cumberland Plateau Mesic Hemlock - Hardwood Forest	(AL)	SA
Southern BR Ultramafic Outcrop Barrens (Pitch Pine Woodland Type)	(NC, TN)	BR
Southern BR Ultramafic Woodland (Prairie Type)	(TN,VA0	BR
Low-Elevation BR Serpentine Woodland	(GA, NC)	BR
Southern BR Mafic Woodland Seep	App Bog, Fen, Seep (NC?, VA)	BR
Southern App Shrub Bog (Typic Type)	App Bog, Fen, Seep (NC, TN?, VA?)	BR
Southern App Low Mountain Seepage Bog	App Bog, Fen, Seep (AL, GA. NC, TN?)	BR, SA
Southern App Bog (Low-Elevation Type)	App Bog, Fen, Seep (GA, NC, TN, VA)	BR
Southern App Ultramafic Fen (Tall Herb Type)	App Bog, Fen, Seep (VA)	BR
Southern App Fen (Muck Type)	App Bog, Fen, Seep (NC, VA)	BR
Southern App Bog (French Broad Valley Type)	App Bog, Fen, Seep (NC, TN?)	BR
Southern App Shrub Bog (Long Hope Valley Type)	App Bog, Fen, Seep (NC, VA)	BR
Herbaceous Grassland (Perennial Graminoid) Vegetation		
Highland Rim Wet-Mesic Prairie	Prairie, Grasslands, Barrens (TN, MS)	IP; SP
Kentucky Mesic Tallgrass Prairie	Prairie, Grasslands, Barrens (KY, TN,)	IP
Grassy Bald (Sedge Type)	Prairie, Grasslands, Barrens (NC, TN)	BR
Grassy Bald (Southern Grass Type)	Prairie, Grasslands, Barrens (NC, TN, VA)	BR
Southern BR Mafic Barrens	Prairie, Grasslands, Barrens (VA)	BR
Highland Rim Dry-Mesic Prairie	Prairie, Grasslands, Barrens (TN)	IP
Southern App Ultramafic Barrens	Prairie, Grasslands, Barrens (VA)	RV
Black Belt Prairie	Prairie, Grasslands, Barrens (AL, MS, TN)	SP
Mississippi Jackson Calcareous Clay Prairie	Prairie, Grasslands, Barrens (AL, MS)	SP

G1 Rank Plant Community and Physiognomic Vegetation Classification	Rare or Uncommon Ecosystem	Ecoregion
Kentucky Prairie Cordgrass Marsh	Prairie, Grasslands, Barrens (KY, TN,)	IP
High-Elevation Greenstone Barrens	Prairie, Grasslands, Barrens (TN, VA)	BR
Southern App Herb Bog (Long Hope Valley Type)	App Bog, Fen, Seep (NC)	BR
Southern App Herb Bog (Typic Type)	App Bog, Fen, Seep (NC, TN? VA?)	BR
Southern App Herb Bog (Low-Elevation Type)	App Bog, Fen, Seep (GA, TN, VA)	BR
Cumberland Plateau Wet Sandstone Cliff	App Bog, Fen, Seep (AL, TN? KY?)	SA
Southern App Ultramafic Fen (Short Graminoid Type)	App Bog, Fen, Seep (NC?, VA)	BR
Highland Rim Parnassia Seepage Fen	App Bog, Fen, Seep (KY, TN)	IP
App Calcareous Artesian Seepage Fen	App Bog, Fen, Seep (TN)	BR
BR High-Elevation Seep (Mt. Le Conte Type)	App Bog, Fen, Seep (TN)	BR
Southern App Ultramafic Fen	App Bog, Fen, Seep (NC)	BR
Interior Highland Maidencane Pond	App Bog, Fen, Seep (TN)	IP
Southern App Montane Upland Pool	App Bog, Fen, Seep (GA, NC, TN, VA)	BR
Southern App High-Elevation Mafic Glade	Cedar Glades (NC, TN?, VA)	BR
Alabama Ketona Dolomite Glade	Cedar Glade (AL)	SA
Herbaceous (Perennial Forb) Vegetation		
Doe River Gorge Seepage Cliff	App Bog, Fen, Seep (TN)	BR
Broadleaf Cattail - Yellow Marsh-marigold Herbaceous Vegetation	App Bog, Fen, Seep (VA)	BR
Highland Rim Pond (Pickerelweed - Arrowhead Type)	App Bog, Fen, Seep (TN)	IP
Southern App High-Elevation Rocky Summit (Anakeesta Type)	(TN)	BR
Southern App High-Elevation Rocky Summit (High Peak Type)	(NC, TN)	BR
Southern App High-Elevation Rocky Summit (Little Bluestem Type)	(NC, TN)	BR
Low-Elevation Rocky Summit (Basic Type)	(GA?, NC)	BR
Low-Elevation Basic Glade (Montane Type)	(NC, VA?)	BR
Consolidated Rock Sparse Vegetation		
Southern App Limestone Sinkhole	(AL, TN)	SA
App Montane Mafic Cliff (Mid- to High-Elevation Type)	(NC, TN)	BR

Ecoregion abbreviations: BR=Blue Ridge, CA=Central Appalachian, IP=Interior Plateau, IRVH=Interior River Valley and Hills, MAP=Mississippi Alluvial Plain, MVLP=Mississippi Valley Loess Plain, RV=Ridge and Valley, SA=Southwestern Appalachian, SP=Southeastern Plains
Location abbreviations: AL=Alabama, GA=Georgia, KY=Kentucky, MS=Mississippi, NC=North Carolina, TN=Tennessee, VA=Virginia

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Appendix C – Federally Listed Endangered, Threatened, Candidate, and Proposed Endangered/Threatened Animal and Plant Species Known from Counties in the TVA Power Service Area

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Scientific Name	Common Name	Federal Status[1]	Ecoregions of Occurrence[2]
Amphibians			
Gyrinophillus gulolineatus	Berry Cave salamander	C	RV
Necturus alabamensis	Black Warrior waterdog	C	SA
Arthropods (Arachnids)			
**Microhexura montivaga*	Spruce-fir moss spider	LE	BR
Arthropods (Terrestrial Insects)			
Neonympha mitchellii	Mitchell's satyr	LE	SP
Nicrophorus americanus	American burying beetle	LE	IP
Pseudanophthalmus colemanensis	Coleman Cave beetle	C	IP
Pseudanophthalmus fowlerae	Fowler's Cave beetle	C	IP
Pseudanophthalmus inquisitor	Inquirer Cave beetle	C	IP
Pseudanophthalmus inexpectatus	A Cave beetle	C	IP
Pseudanophthalmus insularis	Baker Station Cave beetle	C	IP
Pseudanophthalmus paulus	Noblett's cave beetle	C	RV
Pseudanophthalmus tiresias	Indian Cave Point Cave beetle	C	IP
Somatochlora hineana	Hine's (Ohio) emerald dragonfly	LE	SA
Birds			
Charadrius melodus	Piping plover	LT	BR, IP, RV
Grus americana	Whooping crane[3]	LE	SA, IP
Haliaeetus leucocephalus	Bald eagle	PROT	BR, CA, IP, IRVH, MAP, RV, SA, SP
Picoides borealis	Red-cockaded woodpecker	LE	IP, RV, SA, SP
Vermivora bachmanii	Bachman's warbler	LE	IP, RV
Myceteria americana	Wood wtork	LE	IP
Sterna antillarum	Interior least tern	LE	IRVH, MAP
Mussels			
**Alasmidonta atropurpurea*	Cumberland elktoe	LE	SA
**Alasmidonta raveneliana*	Appalachian elktoe	LE	BR
Cumberlandia monodonta	Spectaclecase	LE	IP, RV, SA, SP
Cryprogenia stegaria	Fanshell	LE/XN	IP, IRVH, RV, SA, SP
Dromus dromas	Dromedary pearlymussel	LE/XN	IP, RV, SP
**Epioblasma brevidens*	Cumberlandian combshell	LE/XN	IP, RV, SA, SP
**Epioblasma capsaeformis*	Oyster mussel	LE/XN	IP, RV, SP
Epioblasma florentina florentina	Yellow-blossom pearlymussel	LE/XN	IP, SP
Epioblasma florentina walkeri	Tan riffleshell	LE	BR, IP, RV
**Epioblasma metastriata*	Upland combshell	LE	RV, SA
Epioblasma obliquata obliquata	Purple catspaw	LE/XN	IP, IRVH
**Epioblasma othcaloogensis*	Southern acornshell	LE	RV
Epioblasma penita	Southern combshell	LE	RV, SP
Epioblasma torulosa gubernaculum	Green blossom pearlymussel	LE	RV
Epioblasma torulosa rangiana	Northern riffleshell	LE	IP
Epioblasma torulosa torulosa	Tuberculed blossom pearlymussel	LE/XN	IP, RV, SP
Epioblasma triquetra	Snuffbox	LE	IP, RV
Epioblasma turgidula	Turgid blossom pearlymussel	LE/XN	IP, RV,SP
Fusconaia cor	Shiny pigtoe pearlymussel	LE/XN	IP,RV,SA, SP
Fusconaia cuneolus	Fine-rayed pigtoe	LE/XN	IP, RV, SA
Hemistena lata	Cracking pearlymussel	LE/XN	IP, RV, SP
Lampsilis abrupta	Pink mucket	LE	IP, IRVH, RV, SP

Scientific Name	Common Name	Federal Status[1]	Ecoregions of Occurrence[2]
**Lampsilis altilis*	Fine-lined pocketbook	LT	BR, RV, SA
**Lampsilis perovalis*	Orange-nacre mucket	LT	SA, SP
Lampsilis virescens	Alabama lampmussel	LE/XN	IP, RV, SA, SP
Lemiox rimosus	Birdwing pearlymussel	LE/XN	IP, RV, SP
Leptodea leptodon	Scaleshell	LE	IP
**Lexingtonia dolabelloides*	Slabside pearlymussel	LE	IP, SA, SP
**Medionidus acutissimus*	Alabama moccasinshell	LT	RV, SP
**Medionidus parvulus*	Coosa moccasinshell	LE	RV, SA, SP
Obovaria retusa	Ring pink	LE/XN	IP, IRVH, SP
Pegias fabula	Little-wing pearlymussel	LE	BR, IP, RV
Plethobasus cicatricosus	White wartyback	LE/XN	IP, RV, SP
Plethobasus cooperianus	Orange-foot pimpleback	LE/XN	IP, IRVH, SP
Plethobasus cyphyus	Sheepnose	LE	IP, IRVH, RV,SP
Pleurobema clava	Clubshell	LE/XN	IP,IRVH,SP
Pleurobema curtum	Black clubshell	LE	SP
**Pleurobema decisum*	Southern clubshell	LE	RV, SP
**Pleurobema furvum*	Dark pigtoe	LE	SA
**Pleurobema georgianum*	Southern pigtoe	LE	RV
Pleurobema gibberum	Cumberland pigtoe	LE	IP
**Pleurobema hanleyianum*	Georgia pigtoe	LE	BR, RV
Pleurobema marshalli	Flat Pigtoe	LE	SP
Pleurobema perovatum	Ovate clubshell	LE	RV, SA, SP
Pleurobema plenum	Rough pigtoe	LE/XN	IP, RV,SP
Pleurobema taitianum	Heavy pigtoe	LE	SP
Potamilus capax	Fat pocketbook	LE	IRVH, MAP
Potamilus inflatus	Inflated heelsplitter	LT	SP
**Ptychobranchus greenii*	Trianglular kidneyshell	LE	RV, SA
**Ptychobranchus subtentum*	Fluted kidneyshell	LE	IP, RV, SP
Quadrula cylindrica cylindrica	Rabbitsfoot	LT	IP, IRVH, RV, SA, SP
Quadrula cylindrica strigillata	Rough rabbitsfoot	LE	RV
Quadrula fragosa	Winged mapleleaf	LE/XN	SA
Quadrula intermedia	Cumberland monkeyface	LE/XN	IP, RV, SP
Quadrula sparsa	Appalachian monkeyface	LE/XN	IP, RV
Quadrula stapes	Stirrupshell	LE	SP
Toxoxlasma cylindrellus	Pale lilliput	LE	IP,SA,SP
Villosa fabalis	Rayed bean	LE	IP, RV
**Villosa perpurpurea*	Purple bean	LE	RV, SA
Villosa trabalis	Cumberland bean	LE/XN	IP,RV, SA
Crustaceans			
Lirceus usdagalun	Lee County Cave isopod	LE	RV
Orconectes shoupi	Nashville crayfish	LE	IP
Palaemonias alabamae	Alabama blind cave shrimp	LE	SA
**Palaemonias ganteri*	Mammoth cave shrimp	LE	IP
Snails			
Anguispira picta	Painted snake coiled forest snail (Painted tigersnail)	LT	SA
Elimia crenatella	Lacy elimia	LT	RV
Leptoxis melanoides	Black mudalia	C	SA
Leptoxis plicata	Plicate rocksnail	LE	SA
Leptoxis taeniata	Painted rocksnail	LT	RV

Scientific Name	Common Name	Federal Status[1]	Ecoregions of Occurrence[2]
Lioplax cylostomaformis	Cylindrical lioplax	LE	RV
Marstonia pachyta	Armored marstonia	LE	IP
Patera clarki nantahala	Noonday Globe	LT	BR
**Pleurocera foremani*	Rough hornsnail	LE	SP
Pyrgulopsis ogmorhaphe	Royal marstonia	LE	SA
Tulotoma magnifica	Tulatoma	LT	RV, SP
Mammals			
Corynorhinus townsendii virginianus	Virginia big-eared bat	LE	BR, RV
Glaucomys sabrinus coloratus	Carolina northern flying squirrel	LE	BR
Glaucomys sabrinus fuscus	Virginia northern flying squirrel	LE	BR
Myotis grisescens	Gray bat	LE	BR, CA, IP, IRVH, RV, SA, SP
Myotis septentrionalis	Northern long-eared bat	PE	BR, CA, IP, IRVH, MAP, MVLP, RV, SA, SP
Myotis sodalis	Indiana bat	LE	BR, CA, IP, IRVH, MAP, RV, SA, SP
Puma concolor couguar	Eastern cougar	LE	BR
Ursus americanus luteolus	Louisiana black bear	LE	SP
Fishes			
**Acipenser oxyrinchus desotoi*	Gulf sturgeon	LT	IP, IRVH, RV
**Crystallaria cincotta*	Diamond darter	LE	IP, IRVH, SA
Cyprinella caerulea	Blue shiner	LT	BR, RV, SA
**Elassoma alabamae*	Spring pygmy sunfish	LT	IP
**Erimonax monachus*	Spotfin chub	LT/XN	BR, IP, RV, SA
**Erimystax cahni*	Slender chub	LT/XN	RV
Etheostoma akatulo	Bluemask darter	LE	IP
Etheostoma boschungi	Slackwater darter	LT	IP, SP
**Etheostoma chermocki*	Vermilion darter	LE	SA
Etheostoma chienense	Relict darter	LE	MVLP
Etheostoma etowahae	Etowah darter	LE	PD
Etheostoma nuchale	Watercress darter	LE	RV
Etheostoma percnurum	Duskytail darter	LE/XN	RV
**Etheostoma phytophilum*	Rush darter	LE	SA
Etheostoma scotti	Cherokee darter	LE	PD
Etheostoma susanae	Cumberland darter	LE	CA
Etheostoma wapiti	Boulder darter	LE/XN	IP
Moxostoma sp.2	Sicklefin redhorse	C	BR
Notropis albizonatus	Palezone shiner	LE	IP, RV, SA
Notropis cahabae	Cahaba shiner	LE	SA
**Noturus baileyi*	Smoky madtom	LE/XN	BR
**Norurus crypticus*	Chucky madtom	LE	RV
Noturus flavipinnis	Yellowfin madtom	LT/XN	RV
Noturus stanauli	Pygmy madtom	LE/XN	IP, RV
**Percina antesella*	Amber darter	LE	RV
Percina aurolineata	Goldline darter	LT	BR, RV
Percina aurora	Pearl darter	C	SP
**Percina jenkinsi*	Conasauga logperch	LE	BR, RV
Percina tanasi	Snail darter	LT	RV, SA
Phoxinus cumberlandensis	Blackside dace	LT	CA
Phoxinus saylori	Laurel dace	LE	SA

Scientific Name	Common Name	Federal Status[1]	Ecoregions of Occurrence[2]
Scaphirhynchus albus	Pallid sturgeon	LE	MAP
**Scaphirhynchus suttkusi*	Alabama sturgeon	LE	SP
**Speoplatyrhinus poulsoni*	Alabama cavefish	LE	IP
Reptiles			
Glyptemys muhlenbergii	Bog turtle	LT(SA)	BR
Graptemys flavimaculata	Yellow-blotched Map Turtle	LT	SP
Graptemys oculifera	Ringed Map Turtle	LT	MAP, SP
Sternotherus depressus	Flattened Musk Turtle	LT	RV, SA
Plants			
Apios priceana	Price's potato-bean	LT	IP,IRVH, SA, SP
**Arabis georgiana*	Georgia rock-cress	PT	IP, RV
**Arabis perstellata*	Braun's rock-cress	LE	IP
Asplenium scolopendrium var. americanum	American hart's-tongue fern	LT	RV,SA
Astragalus bibullatus	Pyne's ground plum	LE	IP
Betula uber	Virginia round-leaf birch	LT	RV
Clematis morefieldii	Morefield's leather-flower	LE	IP, SA
Clematis socialis	Alabama leather flower	LE	RV
Conradina verticillata	Cumberland rosemary	LT	SA
Dalea foliosa	Leafy prairie-clover	LE	IP,SA
Echinacea laevigata	Smooth coneflower	LE	RV
Echinacea tennesseensis	Tennessee coneflower	DM	IP
Geum radiatum	Spreading avens	LE	BR
Gymnoderma lineare	Rock gnome lichen	LE	BR
**Helianthus verticillatus*	Whorled sunflower	PE	RV, SP
Helonias bullata	Swamp-pink	LT	BR
Isotria medeoloides	Small whorled pogonia	LT	BR, CA. SA
**Leavenworthia crassa*	Fleshy-fruit gladecress	PE	IP,SA
**Lesquerella globosa*	Shorts bladderpod	PE	IP
Lesquerella lyrata	Lyre-leaf bladderpod	LT	IP
Lesquerella perforata	Spring Creek bladderpod	LE	IP
Liatris helleri	Heller's blazing star	LT	BR
Lindera melissifolia	Pondberry	LE	MAP
Marshallia mohrii	Mohr's Barbara's buttons	LT	RV, SA
Minuartia cumberlandensis	Cumberland sandwort	LE	SA
Narthecium americanum	Bog asphodel	C	BR
Pityopsis ruthii	Ruth's golden aster	LE	BR
Platanthera integrilabia	Monkey-face orchid	C	BR, SA, SP
Ptilimnium nodosum	Harperella	LE	RV, SA
Sagittaria fasciculata	Bunched arrowhead	LE	BR
Sagittaria secundifolia	Arrowhead	LT	RV, SA
Sarracenia jonesii	Mountain sweet pitcher-plant	LE	BR
Sarracenia oreophila	Green pitcher plant	LE	BR, RV, SA
Scutellaria montana	Large-flowered skullcap	LT	RV, SA
Sisyrinchium dichotomum	Reflexed blue-eyed grass	LE	BR
Solidago spithamaea	Blue Ridge goldenrod	LT	BR
Spiraea virginiana	Virginia spiraea	LT	BR, CA, SA
Symphyotrichum georgianum	Georgia aster	C	RV, SA
Thelypteris pilosa var. alabamensis	Alabama streak-sorus fern	LT	SA
Trillium persistens	Persistent trillium	LE	BR
Xyris tennesseensis	Yellow-eyed-grass	LE	IP, RV, SP

Source: TVA Natural Heritage Database
[1] Status Codes: **C** = Candidate; **LE** = Listed Endangered; **LT** = Listed Threatened, **PE** = Proposed Endangered; **PROT** = Protected by the Bald and Golden Eagle Protection Act; **PT**=Proposed Threatened; **SA** = Listed Based on Similarity of Appearance; **XN** = Experimental Population
[2] Ecoregion Abbreviations**: BR** = Blue Ridge, **CA** = Central Appalachians, **IP** = Interior Plateau, **IRVH** = Interior River Valley and Hills, **MAP** = Mississippi Alluvial Plain, **MVLP** = Mississippi Valley Loess Plains, **PD** = Piedmont, **RV** = Ridge and Valley, **SA** = Southwestern Appalachians, **SP** = Southeastern Plains
[3] Based on winter/migrant occurrence only; no record of breeding within the TVA PSA
***** Species with Critical Habitat designated by USFWS