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CLINCH RIVER NUCLEAR SITE ADVANCED NUCLEAR REACTOR TECHNOLOGY PARK
DRAFT PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT

Roane County, Tennessee

Prepared by:
TENNESSEE VALLEY AUTHORITY
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February 2022

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COVER SHEET

Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Proposed action:	The Tennessee Valley Authority has prepared this Programmatic Environmental Impact Statement to address the environmental impacts associated with site preparation, construction, operation, and decommissioning of facilities at an advanced nuclear reactor technology park at TVA's Clinch River Nuclear Site.
Type of document:	Draft Programmatic Environmental Impact Statement
Lead agency:	Tennessee Valley Authority
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Comments due date:	Comments may be submitted online www.tva.com/nepa or sent to Ms. Johnson at the above address. Comments must be submitted by April 4, 2022.
Abstract:	TVA is considering alternatives for the construction and operation of an advanced nuclear technology park at TVA's Clinch River Nuclear (CRN) Site. In addition to the No Action Alternative (Alternative A), TVA considered alternatives for advanced nuclear reactors at two different locations on the CRN Site – Area 1 and Area 2. Alternative B includes a Nuclear Technology Park at Area 1 with small modular reactors (SMRs) and/or advanced non-light water reactors (LWRs). Alternative C includes a Nuclear Technology Park at Area 2 with advanced non-LWRs; Alternative D includes a Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or advanced non-LWRs. The PEIS uses a bounding approach to the evaluation of impacts from the proposed action using a Plant Parameter Envelope established in TVA's Early Site Permit Application to the Nuclear Regulatory Commission in 2019.

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SUMMARY

Introduction

The Tennessee Valley Authority (TVA) prepared this Draft Programmatic Environmental Impact Statement (PEIS) to assess the environmental impacts associated with the proposed action including site preparation, construction, operation, and decommissioning of various facilities at an advanced nuclear reactor technology park (Nuclear Technology Park) at TVA's Clinch River Nuclear (CRN) Site. The proposed action provides an opportunity to evaluate and demonstrate the feasibility of deploying advanced nuclear reactors at the CRN Site, and to evaluate emerging nuclear technologies as part of TVA's technology innovation efforts aimed at developing future generation capabilities.

The CRN Site is located on the northern bank of the Clinch River arm of the Watts Bar Reservoir (the Reservoir) in the City of Oak Ridge, Roane County, Tennessee, approximately 7 miles east of the City of Kingston, Tennessee, and approximately 25 miles west-southwest of the City of Knoxville, Tennessee. The CRN Site comprises 935 acres of TVA-managed land adjacent to the U.S. Department of Energy's (DOE) approximately 33,000-acre Oak Ridge Reservation (ORR). The site is situated on the historical Clinch River Breeder Reactor Project (CRBRP) Site.

In May 2016, TVA submitted an application to the Nuclear Regulatory Commission (NRC) for an Early Site Permit (ESP) at the CRN Site for two or more new nuclear power units demonstrating small modular reactor (SMR) technology, with a total combined nuclear generating capacity not to exceed 800 megawatts electric. The NRC prepared and released a Final Environmental Impact Statement (NRC ESP FEIS) to assess the environmental impacts of the action proposed in the TVA ESP application (ESPA). The NRC ESP FEIS identified issuance of an ESP for the CRN Site as the preferred alternative.

Following the NRC ESP FEIS publication in April 2019, the NRC issued an ESP to TVA on December 19, 2019. The ESP represents NRC's approval of the CRN Site as suitable for the future demonstration of the construction and operation of two or more SMRs with characteristics presented in the ESPA, but it does not authorize TVA to construct or operate a nuclear facility. The ESP establishes early resolution of numerous site safety, environmental, and emergency preparedness issues, providing enhanced predictability and stability in future TVA licensing actions related to the CRN Site. The ESP is valid until December 2039. Prior to initiating construction or operation of advanced nuclear reactors at the CRN Site, TVA must apply for and receive additional licenses from the NRC.

In June 2019, TVA released the Final 2019 Integrated Resource Plan (IRP) and the associated IRP Final EIS. The IRP identified the various generating resources that TVA intends to pursue to meet the energy needs of the Tennessee River Valley (the Valley) over a 20-year planning period. The 2019 IRP recommended that TVA continue to evaluate emerging nuclear technologies, including SMRs, as part of technology innovation efforts aimed at developing future electricity generation capabilities. This Draft PEIS is TVA's next step in exploring the potential for new nuclear generation on the TVA system, to advance the recommendations of the IRP.

In December 2021, the TVA Board of Directors (Board) authorized the implementation of a New Nuclear Program to advance SMR planning efforts at the CRN site, and to explore plans for potential additional reactors to support TVA's 2050 decarbonization aspirations.

TVA's New Nuclear Program does not prejudice or foreclose any of the alternatives under consideration in this PEIS. Rather, it facilitates the possibility that a reliable, affordable, and flexible advanced nuclear reactor option could be potentially available by 2032, and it advances necessary planning for future required TVA decision making for the potential deployment of innovative new nuclear technology, in line with TVA's 2019 IRP and 2021 Strategic Intent and Guiding Principles (TVA 2021i). The implementation of the New Nuclear Program authorizes the expenditure of resources not to exceed $200 Million for the period Fiscal Year 2022 through Fiscal Year 2024.

Purpose and Need for Action

The purpose of the proposed action is to support TVA's goal of demonstrating the feasibility of deploying advanced nuclear reactor technologies at the CRN Site capable of incrementally supplying clean, secure, and reliable power that is less vulnerable to disruption. The proposed action is needed to support the recommendations outlined in TVA's 2019 IRP of continuing to evaluate emerging nuclear technologies, including SMRs, as part of technology innovation efforts. Further, a Nuclear Technology Park at the CRN Site would expand future generation optionality and support TVA's mission of innovation towards a low carbon future for the Valley. In addition to providing a place to demonstrate advanced nuclear technologies, a Nuclear Technology Park at the CRN site could potentially include microgrid power generation demonstration; grid resiliency analysis and support; and use of nuclear generation for hydrogen production, water desalination, waste heat energy storage for grid support, and the intentional production of valuable isotopes, all in support of TVA's statutory missions.

Programmatic Approach

As defined by the Council on Environmental Quality (CEQ), a programmatic review "…describes any broad or high-level National Environmental Policy Act (NEPA) review" in which subsequent actions would be implemented that would "tier" to the programmatic NEPA review (CEQ 2020). This Draft PEIS programmatically considers the site preparation, construction, operation, and decommissioning of various types of advanced nuclear reactors bounded by the plant parameter envelope (PPE) and the supplemental bounding site development attributes and parameters. Supplemental NEPA analyses would tier from this Draft PEIS for any potential project- or site-specific TVA actions at the CRN Site that are not evaluated in this Draft PEIS.

The programmatic analysis included in this Draft PEIS is consistent with the PPE that was evaluated in TVA's ESPA. The PPE developed for this proposed action consists of a set of reactor-vendor and owner-engineered parameters or values that TVA used to bound the characteristics of a reactor (or reactors) that could later be deployed at the CRN Site. The PPE represents an "envelope" that encompasses a range of reactor types having varying levels of design maturity. Analysis of environmental impacts based on a PPE allows TVA to defer the selection of a reactor design until a future licensing stage, when more detailed site-specific and technology-specific information would be available to make a technology selection decision. For the present analysis, TVA has supplemented the ESPA PPE with information about advanced nuclear reactor technologies not discussed in the ESPA and additional areas of potential disturbance for transmission line and site access. This Draft PEIS provides a bounding analysis of maximum potential impacts of implementing each of the alternatives considered, based on a PPE approach.

Alternatives

This PEIS evaluates the environmental impacts associated with the deployment of one or more advanced nuclear reactors at the CRN Site shown on Figure ES-1. TVA is currently considering negotiating and entering into one or more contracts with one or more SMR vendors to: (1) perform design, engineering, scoping, estimating, and planning associated with potential future deployment of a SMR at the CRN Site, and (2) develop content for a potential future licensing application submittal to the NRC. TVA also plans to continue to study potential future deployment of advanced nuclear reactors, light water reactors (LWR) and non-light water reactors (non-LWR) at the CRN Site. These contemplated actions would not prejudice any of the alternatives under consideration in this PEIS, as the contemplated actions would not: (a) authorize or commit TVA to submit a licensing application to the NRC, (b) allow any construction activities at the CRN Site, or (c) result in any potential environmental impacts to the CRN Site.

TVA is considering a range of alternatives for site preparation, construction, operation, and decommissioning of a Nuclear Technology Park at the CRN Site, including two different Areas on the site and roughly 14 different reactor designs.

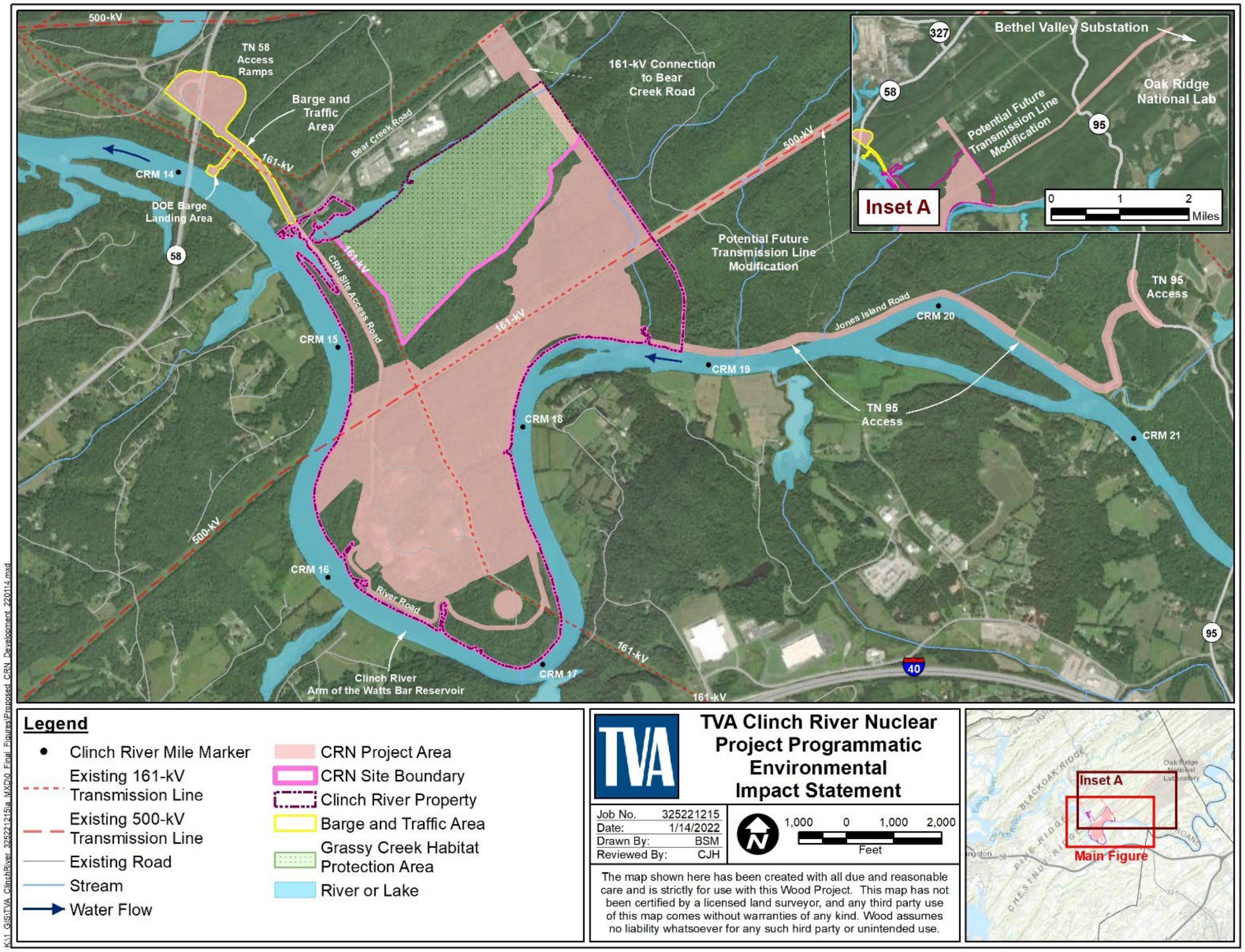

Figure ES-1. CRN Project Area

TVA identified two areas – Area 1 and Area 2 –within the 935-acre CRN Site that are best suited for the Nuclear Technology Park development. Area 1 includes the area previously disturbed by the CRBRP evaluated in the ESPA ER. A portion of Area 2 was also evaluated in the ESPA ER for a proposed temporary laydown area.

TVA plans to evaluate four discrete alternatives (A-D) for the Nuclear Technology Park:

- Alternative A: No Action Alternative
- Alternative B: Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs
- Alternative C: Nuclear Technology Park at Area 2 with Advanced non-LWRs
- Alternative D: Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs

Under action Alternatives B thru D, activities would be undertaken within each of the following areas that are referred to in the analyses of this PEIS:

1. CRN Site – lands contained within the boundaries of the CRN Site.
2. Associated Offsite Areas – a collective term that includes the following:
    a. Barge and Traffic Area (BTA): Area outside of the CRN Site boundary that encompasses proposed improvements to the intersection of Tennessee Highway 58 (TN 58) with Bear Creek Road. Improvements include those at Bear Creek Road and the existing DOE barge landing facility on the Reservoir.
    b. TN 95 Access: Area containing a proposed roadway access that extends from TN 95 southwesterly, following Jones Island Road to the CRN Site boundary.
    c. 161-kV Offsite Transmission Corridor: Area containing a proposed segment of 161-kV transmission line that extends outside of the CRN Site boundary to an interconnection with the existing 161-kV line along Bear Creek Road.
3. Existing 500-kV Offsite Transmission Corridor: Segment of 500-kV transmission line that extends northeast, outside of the CRN Site boundary to the Bethel Valley substation that includes a potential future transmission upgrade.

TVA considered, but dismissed two alternatives:

- Alternative E: Construction of SMRs at Alternative Sites
- Alternative F: Construction of Alternative Energy Generation Sources

Overview of Environmental Impacts Associated with the Proposed Action

The environmental consequences of the proposed action were assessed in this Draft PEIS in multiple phases, including those associated with site preparation, construction, operation, and decommissioning activities at the CRN Site. For the purposes of this Draft PEIS the project consists of construction phase activities that include pre-construction or site preparation (grading, excavation, infrastructure development, and other actions), actual fabrication and erection of the nuclear reactor and associated facilities, and other site improvements and related interfaces; and operation of the Nuclear Technology Park.

The proposed action was determined to result in primarily minor adverse impacts to resources within the Project Area and a 6-mile vicinity surrounding the CRN Site. Minor adverse impacts during construction of the Nuclear Technology Park include: stormwater discharge into local surface waters and groundwater; alteration of stream habitat; loss of vegetated land cover; impact to wetlands; and increased noise, dust, traffic, and air emissions. Minor to moderate adverse impacts during construction were determined to occur as a result of soil disturbance and erosion; impacts to onsite streams; and shoreline alteration. Moderate impacts would include loss of upland plant and animal communities; loss of habitat for listed bat species; disruption of views from adjacent properties; removal of low quality forest and herbaceous habitat; impacts to three small areas of native cedar glades, and cumulative traffic increases on the local transportation network.

Potential impacts to the state-listed rigid sedge and pale green orchid could occur from the proposed development of the 161-kV offsite transmission line. TVA would ensure that these species are not significantly impacted under all action alternatives by consulting with the TVA botanist during design to avoid the plants and their associated calcareous wetland habitat to the greatest extent possible. Consultation with the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the Endangered Species Act (ESA) would occur when specific designs have been selected and scope of the project has been refined. By implementing minimization measures such as winter tree removal and any additional conservation measures that may result from Section 7 consultation, large impacts to gray bat, Indiana bat, northern long-eared bat, little brown bat, and tricolored bat are not expected.

Additionally, moderate impacts to six archaeological sites eligible for the National Historic Register would occur due to construction disturbance from the project. However, effects to these sites would be mitigated through a Programmatic Agreement between TVA and the Tennessee State Historic Preservation Officer. The proposed action would also result in minor to moderate beneficial impacts associated with increased employment, payroll, and tax revenues.

Minor impacts during operation of the Nuclear Technology Park would include localized alteration of hydrologic patterns, limited scour diversion from the use and discharge of cooling water from and into the Reservoir, noise, and increased traffic. The combined environmental impacts from the uranium fuel cycle, the storage of spent fuel onsite, radioactive waste management, and the transportation of unirradiated fuel and radioactive waste would be minor. Additionally, the impacts associated with design basis accidents (DBAs), severe accidents, and plant security would be minor.

Best Management Practices (BMPs), mitigation measures, and commitments designed to avoid, minimize, or reduce adverse impacts to the environment are identified by TVA in Chapter 3 of this Draft PEIS. Minor and moderate impacts resulting from construction and operation would be minimized through the use of mitigative measures committed to by TVA through regulatory permit processes and final design. Additional project specific BMPs may be applied as appropriate on a site-specific or technology-specific basis to enable efficient maintenance of construction projects and further reduce potential impacts on environmental resources.

The environmental impacts of each of the alternatives under consideration are summarized in Table ES-1. The summaries presented are derived from the information and analyses provided in the Affected Environment and Environmental Consequences sections in Chapter 3 of the PEIS.

TVA’s Preferred Alternative

TVA’s preferred alternative is Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs. Alternative D provides the greatest flexibility to meet the purpose and need of the project to support TVA’s goal of demonstrating the feasibility of deploying advanced nuclear reactor technologies at the CRN Site capable of incrementally supplying clean, secure, and reliable power that is less vulnerable to disruption. Alternative D also supports the recommendations outlined in TVA’s 2019 IRP and TVA’s 2021 Strategic Intent and Guiding Principles.

Table ES-1. Summary and Comparison of Alternatives by Resource Area

Resource Area	Alternative A—No Action	Alternative B1—Nuclear Technology Park at Area 1 with SMRs	Alternative B2—Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs	Alternative C—Nuclear Technology Park at Area 2 with Advanced non-LWRs	Alternative D—Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs
Geology and Soils	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Water Resources	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Floodplains and Flood Risk	No impacts	*Construction:* **Minor** *Operation:* **None**	*Construction:* **Minor** *Operation:* **None**	*Construction:* **Minor** *Operation:* **None**	*Construction:* **Minor** *Operation:* **None**
Wetlands	No impacts	*Construction:* **Minor**	*Construction:* **Minor**	*Construction:* **Minor**	*Construction:* **Minor**
Aquatic Ecology	No impacts	*Construction:* ***Minor to Moderate*** *Operation:* **Minor**	*Construction:* ***Minor to Moderate*** *Operation:* **Minor**	*Construction:* ***Minor to Moderate*** *Operation:* **Minor**	*Construction:* ***Minor to Moderate*** *Operation:* **Minor**
Terrestrial Ecology	No impacts	*Construction:* **Moderate** *Operation:* **Minor**	*Construction:* **Moderate** *Operation:* **Minor**	*Construction:* **Moderate** *Operation:* **Minor**	*Construction:* **Moderate** *Operation:* **Minor**
Threatened and Endangered Species	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Managed and Natural Areas	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Recreation	No impacts	*Construction:* **Minor** *Operation:* **Minor**	*Construction:* **Minor** *Operation:* **Minor**	*Construction:* **Minor** *Operation:* **Minor**	*Construction:* **Minor** *Operation:* **Minor**
Meteorology, Air Quality, and Climate Change	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**

Resource Area	Alternative A—No Action	Alternative B1—Nuclear Technology Park at Area 1 with SMRs	Alternative B2—Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs	Alternative C—Nuclear Technology Park at Area 2 with Advanced non-LWRs	Alternative D—Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs
Transportation	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Visual Resources	No impacts	*Construction and Operation:* **Minor to Moderate**	*Construction and Operation:* **Minor to Moderate**	*Construction and Operation:* **Minor to Moderate**	*Construction and Operation:* **Minor to Moderate**
Noise	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Socioeconomics					
Land Use	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Demographics	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Employment and Income	No impacts	*Construction and Operation:* **Beneficial, Minor to Moderate**	*Construction and Operation:* **Beneficial, Minor to Moderate**	*Construction and Operation:* **Beneficial, Minor to Moderate**	*Construction and Operation:* **Beneficial, Minor to Moderate**
Community Characteristics	No impacts	*Construction:* **Minor** *Operation:* **Minor to Moderate**	*Construction:* **Minor** *Operation:* **Minor to Moderate**	*Construction:* **Minor** *Operation:* **Minor to Moderate**	*Construction:* **Minor** *Operation:* **Minor to Moderate**
Environmental Justice	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Archaeological Resources and Historic Structures	No impacts	*Construction:* **Moderate**	*Construction:* **Moderate**	*Construction:* **Moderate**	*Construction:* **Moderate**
Solid and Hazardous Waste	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**

Resource Area	Alternative A—No Action	Alternative B1—Nuclear Technology Park at Area 1 with SMRs	Alternative B2—Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs	Alternative C—Nuclear Technology Park at Area 2 with Advanced non-LWRs	Alternative D—Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs
Radiological Effects of Normal Operations	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Uranium Fuel Effects	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Nuclear Plant Safety and Security	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Decommissioning	No impacts	**Minor**	**Minor**	**Minor**	**Minor**

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Symbols, Acronyms, Abbreviations, and Glossary of Terms

AADT	Annual Average Daily Traffic
AC	Alternating Current
ACE	Affordable Clean Energy
ACS	American Community Survey
AIA	Aircraft Impact Assessment
ALARA	As Low as Reasonably Achievable
AMSL	Above Mean Sea Level
APE	Area of Potential Effects
ARAP	Aquatic Resource Alteration Permit
B/CTP	Biocide/Corrosion Treatment Plan
bgs	Below Ground Surface
BMP	Best Management Practice
BP	Containment Bypass
BTA	Barge and Traffic Area
Btu	British Thermal Units
BWR	Boiling Water Reactor
CAA	Clean Air Act
CDC	U.S. Centers for Disease Control and Prevention
CDF	Core Damage Frequency
CEC	Categorical Exclusion Checklists
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CEUS SSC	Central and Eastern United States Seismic Source Characterization
CFE	Early Containment Failure
CFI	Intermediate Containment Failure
CFL	Late Containment Failure
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CH_4	Methane
Ci	Curies
CI	Containment Isolation Failure
Ci/yr	Curies per Year
CO	Carbon Monoxide
CO_2	Carbon Dioxide
CPP	Clean Power Plan
CRBRP	Clinch River Breeder Reactor Plant
CRM	Clinch River Mile
CRN	Clinch River Nuclear
CWA	Clean Water Act
CWIS	Cooling Water Intake Structure
CWS	Circulating Water System
dB	decibel
dBA	A-weighted Decibels
DBA	Design Basis Accidents
DC	Direct Current
DO	Dissolved Oxygen
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DRH	TDEC Division of Radiological Health
EAB	Exclusion Area Boundary
EIS	Environmental Impact Statement
EMF	Electromagnetic Field
EMS	Emergency Medical Services

EO	Executive Order
EPA	U.S. Environmental Protection Agency
EPZ	Emergency Planning Zone
ER	Environmental Report
ESA	Endangered Species Act
ESF	Engineered Safety Features
ESP	Early Site Permit
ESPA	Early Site Permit Application
ESPA ER	Early Site Permit Application Environmental Report
ESPA PPE	Early Site Permit Application Plant Parameter Envelope
ETSZ	Eastern Tennessee Seismic Zone
ETTP	East Tennessee Technology Park
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FEIS	Final Environmental Impact Statement
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
FPPA	Farmland Protection Policy Act
FSLG	Flood Storage Loss Guideline
FSZ	Flood Storage Zone
ft^3/yr	Cubic Feet per Year
FTE	Full-Time Equivalent Employee
GEH	General Electric Hitachi
GHG	Greenhouse Gas
gpd	Gallons per Day
gpm	Gallons per Minute
GW	Gigawatt
HALEU	High-Assay Low-Enriched Uranium
HPA	Habitat Protection Area
HUC	Hydrologic Unit Code
HUD	U.S. Department of Housing and Urban Development
HWEL	Headwater Elevation
IAEA	International Atomic Energy Agency
IC	Intact Containment
IPaC	Information for Planning and Consultation
IPPP	Integrated Pollution Prevention Plan
IRP	Integrated Resource Plan
ISFSI	Independent Spent Fuel Storage Installation
ISL	In-situ Leaching
kV	Kilovolt
LERF	Early Release Frequency
LLW	Low-level Waste
LOCA	Loss-of-coolant Accident
LOS	Level of Service
LPZ	Low Population Zone
LWR	Light Water Reactor
MBtu/hr	Million British Thermal Units per Hour
MCFR	Molten Chloride Fast Reactor
MCL	Maximum Contaminant Level
MEI	Maximally Exposed Individual
MGD	Million Gallons per Day
MMI	Modified Mercalli Intensity
mph	Miles per Hour
mrad	Millirad
mrem	Millirem
MT	Metric Ton

MTU	Metric Ton of Uranium
MWd	Megawatt-days
MWe	Megawatts Electric
MWh	Megawatt-hours
MWt	Megawatts Thermal
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NCRP	National Council on Radiation Protection and Measurements
NDC	Nationally Determined Contribution
NEI	Nuclear Energy Institute
NEPA	National Environmental Policy Act
NESC	National Electrical Safety Code
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NO_2	Nitrogen Dioxide
NO_X	Nitrogen Oxides
NOI	Notice of Intent
NOTAM	Notice to Airmen
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NPG	Nuclear Power Group
NRC	Nuclear Regulatory Commission
NRC ESP FEIS	Final Environmental Impact Statement for an Early Site Permit at the Clinch River Nuclear Site, April 2019
NRHP	National Register of Historic Places
NRI	Nationwide Rivers Inventory
NSSS	Nuclear Steam Supply System
NWI	National Wetlands Inventory
NWS	National Weather Service
O_3	Ozone
ORR	Oak Ridge Reservation
OSHA	Occupational Safety and Health Association
PA	Programmatic Agreement
Pb	Lead
PCB	Polychlorinated Biphenyls
PEIS	Programmatic Environmental Impact Statement
PM	Particulate Matter
PMC	Plant Management Corporation
PPE	Plant Parameter Envelope
PRA	Probabilistic Risk Assessment
PSD	Prevention of Significant Deterioration
PSDAR	Post-Shutdown Decommissioning Activities Report
PWR	Pressurized Water Reactor
RBI	Reservoir Benthic Index
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RFAI	Reservoir Fish Assemblage Index
RG	Regulatory Guide
RIMS II	Regional Input-Output Modeling System
RLMP	Watts Bar Reservoir Land Management Plan
RM	River Mile
ROW	Right-of-Way
RPV	Reactor Pressure Vessel
Ryr	Reactor Year
SACTI	Seasonal and Annual Cooling Tower Impact
SHPO	State Historic Preservation Officer

SMR	Small Modular Reactor
SMZ	Streamside Management Zone
SNA	State Natural Area
SO_2	Sulfur Dioxide
SO_X	Sulfur Oxides
SVOC	Semi-Volatile Organic Compounds
SWPPP	Stormwater Pollution Prevention Plan
TDEC	Tennessee Department of Environment and Conservation
TDOT	Tennessee Department of Transportation
TDS	Total Dissolved Solids
TL	Transmission Line
TN 58	Tennessee Highway 58
TN 95	Tennessee Highway 95
TOC	Total Organic Carbon
TRAM	Tennessee Rapid Assessment Method
TRC	TRC Environmental Corporation
TRISO	Tri-structural Isotropic
TRM	Tennessee River Mile
TSS	Total Suspended Solids
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resources Agency
U.S.	United States of America
U-235	Uranium-235
U-238	Uranium-238
UCO	Uranium Oxycarbide
UF_6	Uranium Hexaflouride
UFC	Uranium Fuel Cycle
UHS	Ultimate Heat Sink
UN	Uranium Nitride
UO_2	Uranium Dioxide
U_3O_8	Uranium Oxide
UPF	Uranium Processing Facility
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCB	U.S. Census Bureau
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UT	University of Tennessee
veh/day	Vehicles per Day
VOC	Volatile Organic Compounds
WBN	Watts Bar Nuclear
WOTUS	Waters of the U.S.
WSEL	Water Surface Elevation
WWC	Wet Weather Conveyance

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CHAPTER 1 – PURPOSE AND NEED FOR ACTION

1.1 Introduction

The Tennessee Valley Authority (TVA) prepared this Draft Programmatic Environmental Impact Statement (PEIS) to assess the environmental impacts associated with the proposed action including site preparation, construction, operation, and decommissioning of various facilities at an advanced nuclear reactor technology park (Nuclear Technology Park) at TVA's Clinch River Nuclear (CRN) Site (Figure 1-1). The proposed action provides an opportunity to evaluate and demonstrate the feasibility of deploying advanced nuclear reactors at the CRN Site, and to evaluate emerging nuclear technologies as part of TVA's technology innovation efforts aimed at developing future generation capabilities.

TVA's goal is to demonstrate emerging nuclear technologies are capable of incrementally supplying clean, secure, reliable power that is less vulnerable to disruption, by constructing and operating one or more advanced nuclear reactors at the CRN Site (Figure 1-1). This goal is informed by four objectives, demonstrating:

(1) power generated by advanced nuclear reactors could be used to address critical energy security issues;

(2) advanced nuclear reactors can assist TVA, stakeholders, and federal government facilities with meeting various carbon reduction objectives;

(3) advanced nuclear reactor design features include underground containment and inherent safe-shutdown features, longer station blackout coping time without external intervention, and core and spent fuel pool cooling without the need for active heat removal; and

(4) advanced nuclear reactor power generating facilities are designed to be deployed in an incremental fashion to more precisely meet the power generation needs of a service area.

This Draft PEIS was developed in accordance with the National Environmental Policy Act (NEPA), at 42 United States Code (USC) § 4321 *et seq.*; the 2020 Council on Environmental Quality's (CEQ) regulations for implementing NEPA, at 40 Code of Federal Regulations (CFR) Parts 1500-1508 (85 FR 17434, Mar. 27, 2020); TVA's corollary NEPA regulations at 18 CFR Part 1318 and associated guidance from various federal and state agencies.

1.2 Background

The CRN Site is located on the northern bank of the Clinch River arm of the Watts Bar Reservoir (the Reservoir) in the City of Oak Ridge, Roane County, Tennessee (Figure 1-1), approximately 7 miles east of the City of Kingston, Tennessee, and approximately 25 miles west-southwest of the City of Knoxville, Tennessee. The CRN Site comprises 935 acres of TVA-managed land adjacent to the U.S. Department of Energy's (DOE) approximately 33,000-acre Oak Ridge Reservation (ORR). The site is situated on the historical Clinch River Breeder Reactor Project (CRBRP) Site. At the time of the CRBRP cancellation in 1983, preliminary site work was essentially completed, including all necessary sediment ponds, construction shops, concrete batch plants, the nuclear island excavation, extensive site grading, and a foundation for a ringer crane needed for the Breeder Reactor project. After the U.S. Congress terminated the CRBRP, DOE's Site Redress Plan was approved and implemented to leave the site in a safe and environmentally stable condition. Subsequently, management of the CRN property was transferred back to TVA in 1989.

In May 2016, TVA submitted an application to the Nuclear Regulatory Commission (NRC) for an Early Site Permit (ESP) at the CRN Site for two or more new nuclear power units demonstrating small modular reactor (SMR) technology, with a total combined nuclear generating capacity not to exceed 800 megawatts electric (MWe). The NRC prepared and released a Final Environmental Impact Statement (NRC ESP FEIS) to assess the environmental impacts of the action proposed in the TVA ESP application (ESPA). The Nashville District, Regulatory Division, U.S. Army Corps of Engineers (USACE) was a cooperating agency with the NRC during preparation of the EIS to verify that the information presented was adequate to support a Department of the Army permit application, should TVA submit a permit application at a future date.

The NRC ESP FEIS identified issuance of an ESP for the CRN Site as the preferred alternative. Following the NRC ESP FEIS publication in April 2019, the NRC issued an ESP to TVA on December 19, 2019. The ESP represents NRC’s approval of the CRN Site as suitable for the future demonstration of the construction and operation of two or more SMRs with characteristics presented in the ESPA, it but does not authorize TVA to construct or operate a nuclear facility. The ESP establishes early resolution of numerous site safety, environmental, and emergency preparedness issues, providing enhanced predictability and stability in future TVA licensing actions related to the CRN Site. The ESP is valid until December 2039. Prior to initiating construction or operation of advanced nuclear reactors at the CRN Site, TVA must apply for and receive additional licenses from the NRC.

In June 2019, TVA released the Final 2019 Integrated Resource Plan (IRP) and the associated IRP Final EIS. The IRP identified the various generating resources that TVA intends to pursue to meet the energy needs of the Tennessee River Valley (the Valley) over a 20-year planning period. The 2019 IRP recommended that TVA continue to evaluate emerging nuclear technologies, including SMRs, as part of technology innovation efforts aimed at developing future electricity generation capabilities. This Draft PEIS is TVA’s next step in exploring the potential for new nuclear generation on the TVA system, to advance the recommendations of the IRP.

In December 2021, the TVA Board of Directors (Board) authorized the implementation of a New Nuclear Program to advance SMR planning efforts at the CRN site, and to explore plans for potential, additional reactors to support TVA’s 2050 decarbonization aspirations. Further, TVA’s Chief Executive Officer was delegated the authority to enter into one or more contracts with one or more advanced nuclear reactor vendors and other private entities, as necessary and appropriate, to pursue the initial planning for this Program. The New Nuclear Program includes a multi-stage decision making process with three discrete “decision gates”, referred to as (1) Authorize Planning, (2) Authorize Project, and (3) Authorize Construction. A multi-stage decision gate process is consistent with both industry and TVA enterprise best practices for potential projects on a similar scale to potential new nuclear deployment. The Board approval of the New Nuclear Program at the first Decision Gate does not authorize the subsequent Decision Gate actions, which would require future Board approvals.

TVA’s New Nuclear Program does not prejudice or foreclose any of the alternatives under consideration in this PEIS. Rather, it facilitates the possibility that a reliable, affordable, flexible, and clean advanced nuclear reactor option could be potentially available by 2032, and it advances necessary planning for future required TVA decision making for the potential deployment of innovative new nuclear technology, in line with TVA’s 2019 IRP and 2021 Strategic Intent and Guiding Principles (TVA 2021i). The implementation of the New Nuclear

Program authorizes the expenditure of resources not to exceed $200 Million for the period Fiscal Year 2022 through Fiscal Year 2024.

1.3 Purpose and Need

The purpose of the proposed action is to support TVA's goal of demonstrating the feasibility of deploying advanced nuclear reactor technologies at the CRN Site capable of incrementally supplying clean, secure, and reliable power that is less vulnerable to disruption. The proposed action is needed to support the recommendations outlined in TVA's 2019 IRP and TVA's 2021 Strategic Intent and Guiding Principles, and to support TVA's mission of innovation towards a low carbon future for the Valley. In addition to providing a place to demonstrate advanced nuclear reactor technologies, a Nuclear Technology Park at the CRN Site could potentially include microgrid power generation demonstration; grid resiliency analysis and support; and use of nuclear generation for hydrogen production, water desalination, waste heat energy storage for grid support, and the intentional production of valuable isotopes, all in support of TVA's statutory missions.

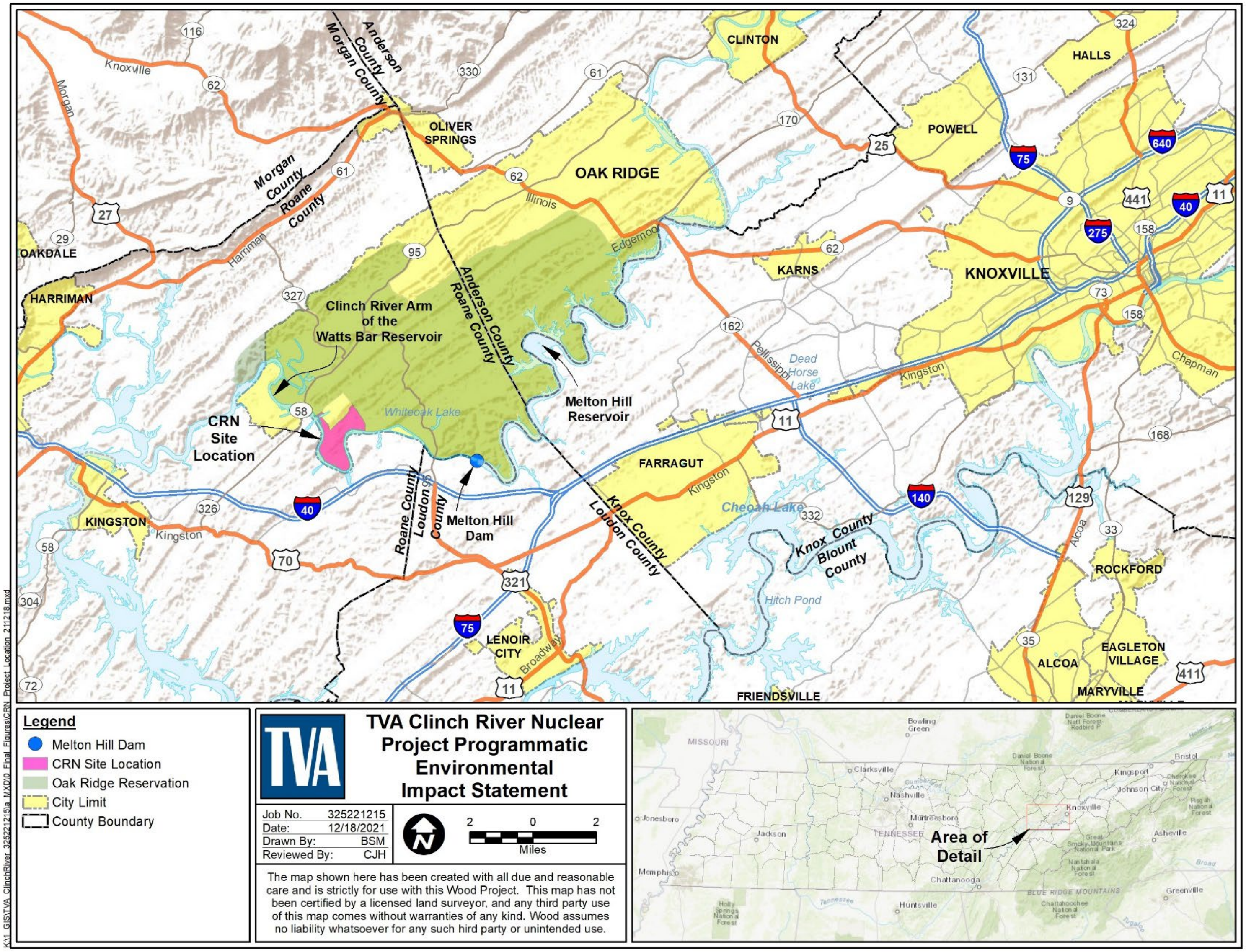


Figure 1-1. CRN Site Location

1.4 Decision to be Made

This Draft PEIS is being prepared to inform TVA decision makers and the public about the potential environmental impacts of the proposed action. Specifically, the decision to be made by TVA is whether to conduct site preparation, construct, operate, and decommission facilities at a Nuclear Technology Park at the CRN Site to evaluate and demonstrate the feasibility of deploying advanced nuclear reactors, and to evaluate emerging nuclear technologies as part of TVA's technology innovation efforts aimed at developing future generation capabilities.

1.5 Programmatic Approach

As defined by CEQ, a programmatic review "…describes any broad or high-level NEPA review" in which subsequent actions would be implemented that would "tier" to the programmatic NEPA review (CEQ 2020). This Draft PEIS programmatically considers the site preparation, construction, operation, and decommissioning of various types of advanced nuclear reactors bounded by the plant parameter envelope (PPE) and the supplemental bounding site development attributes and parameters as discussed in Section 2.4. NEPA analysis for any potential construction and operation of selected, specific nuclear reactors for the CRN Site by TVA would tier from this Draft PEIS as a supplementary NEPA analysis for those project- or site-specific elements not evaluated in this Draft PEIS.

The programmatic analysis included in this Draft PEIS is consistent with the PPE that was evaluated in TVA's ESPA. The PPE developed for this proposed action consists of a set of reactor-vendor and owner-engineered parameters or values that TVA used to bound the characteristics of a reactor (or reactors) that could later be deployed at the CRN Site. The PPE represents an "envelope" that encompasses a range of reactor types of varying levels of design maturity. Analysis of environmental impacts based on a PPE allows TVA to defer the selection of a reactor design until a future licensing stage, when more detailed site-specific and technology-specific information would be available to make a technology selection decision. The PPE used by TVA for the ESP is located in Appendix A of this Draft PEIS. For the present analysis, TVA has supplemented the ESPA PPE with information about advanced nuclear reactor technologies not discussed in the ESPA and additional areas of potential disturbance for transmission line and site access. This Draft PEIS provides a bounding analysis of maximum potential impacts of implementing each of the alternatives described in Chapter 2, based on a PPE.

1.6 Related Environmental Reviews

The following previous environmental reviews were prepared for actions related to the CRN Site:

- *Final Environmental Statement Related to Construction and Operation of Clinch River Breeder Reactor Plant (CRBRP)* NRC, *February 1977*. The Environmental Statement was prepared for the NRC by Project Management Corporation (PMC) for the issuance of a construction permit for construction and operation of the CRBRP at the CRN Site in 1977.
- *Environmental Report Volumes I & II, PMC, 1982*. The CRN Site was selected as the location for construction of a liquid metal fast breeder reactor in 1972. Site preparation for the CRBRP began in 1982 and disturbed approximately 240 acres. CRBRP site preparation activities included leveling a ridge that originally reached 880 feet above mean sea level (AMSL) to 780 AMSL and excavation of an

approximately 24-acre area to a depth of as much as 100 feet, resulting in excavation of approximately three million cubic yards of earth and rock. Structures installed at the CRBRP site included a cement crane pad, quality control test laboratory, construction shops, concrete batch plants, and sediment ponds. An approximately 6,450-foot-long 8-inch water line from the DOE's Bear Creek Filtration Plant was also installed at the CRBRP site. The CRBRP project was terminated in 1983.

- *Clinch River Breeder Reactor Plant DOE/TVA/PMC Site Redress Planning Task Force Report, DOE, TVA, and PMC, January 1984*. The CRBRP site redress plans included measures to stabilize the CRBRP site such as reseeding of grass, planting of trees, mulching cleared areas, installation of straw bales in shallow ditches, installation of small berms of riprap in larger ditches, installation of culverts to direct water from steep slopes, and modification of the holding ponds for long-term stability. Portable buildings and structures were removed from the CRBRP site with the exception of the crane pad, meteorological tower, and two meteorological instrumentation buildings. The approximately 6,450-foot-long 8-inch water line was terminated at a hydrant and left in place. Stormwater runoff/collection ponds and associated piping was left in place. The 80-foot by 80-foot crane pad was left in place. The excavated area was partially backfilled in a manner to sustain site drainage. Rock bolts within the excavated area were left in place. Level areas of the CRBRP site were graded and compacted.
- *Grading of Clinch River Site for Potential Industrial Development Environmental Assessment, May 1998.* The site is the previous location of the canceled CRBRP on TVA property. The Environmental Assessment considered the impacts from grading the site because the existing topographic features that were created from the CRBRP, which included the "hill" and the "hole", had discouraged the use of the site for industrial development. The proposed action of grading the site was evaluated to allow for enhanced marketability for industrial development consistent with TVA's Watts Bar Reservoir Land Management Plan.
- *Clinch River Nuclear Site Early Site Permit Application, Environmental Report, Part 3, May 2016* (ESPA ER). The ESPA ER was prepared and submitted as part of the TVA application for an ESP for the CRN Site in Oak Ridge, Roane County, Tennessee. TVA prepared this ER to analyze the environmental effects of construction, operation, and decommissioning of two or more SMRs at the CRN Site having a maximum electrical output not to exceed 800 MWe. The application used four potential SMR designs to develop a bounding analysis of the potential engineering, safety, and environmental impacts. The NRC used this ER to develop an EIS that evaluated TVA's proposed action and informed NRC's decision on whether to issue TVA an ESP.
- *Final Environmental Impact Statement for an Early Site Permit at the Clinch River Nuclear Site, April 2019* (NRC ESP FEIS). NRC issued the NRC ESP FEIS in response to the TVA application for an ESP for new nuclear power units demonstrating SMR technology in Oak Ridge, Roane County, Tennessee. The NRC EIS evaluated the proposed action and the potential impacts of the proposed action, to make a recommendation to the Commission regarding whether or not to issue an ESP. After considering the environmental aspects of the proposed action before the NRC, NRC staff recommended that an ESP be issued for the CRN Site.

- *Early Site Permit, December 2019*. The NRC issued Early Site Permit No. ESP-006 to TVA for the CRN Site.

Other minor actions at the CRN Site that qualified as Categorical Exclusions include the following Categorical Exclusion Checklists (CECs) completed by TVA:

- Clinch River SMR Project Met Tower Road Culvert Installation – CEC 24366, May 2011
- Clinch River Site Meteorological Tower – CEC 23403, June 2011
- Clinch River Site Characterization – CEC 23595, November 2012
- Clinch River Small Modular Reactor (SMR) Site Meteorological Tower Removal – CEC 28783, August 2013
- Portable Bridge Installation at the Clinch River Nuclear CRN Site – CEC 40907, August 2019

1.7 Scope of the Draft PEIS and Summary of Proposed Action

This Draft PEIS provides a bounding analysis of the potential environmental impacts of the proposed site preparation, construction, operation, and decommissioning of various facilities at the proposed Nuclear Technology Park at the CRN Site. A detailed description of the proposed action and alternatives considered is provided in Chapter 2. The scope of this Draft PEIS includes evaluation of impacts associated with the proposed activities within the CRN Project Area (Figure 1-2), which includes the CRN Site and associated offsite areas: the Barge and Traffic Area (BTA), the offsite 161-kilovolt (kV) transmission line corridor, and the Tennessee Highway 95 (TN 95) Access. Because the design, location, and requirements for other potential future offsite transmission line upgrades are too speculative at this time, the potential environmental impacts from these actions are not evaluated in this Draft PEIS. In addition, the specific need and modification of a potential future transmission line along a segment of the 500-kV transmission line that extends northeast, outside of the CRN Site boundary to the Bethel Valley substation is also unknown at this time; therefore, only a description of the area affected and a general environmental impact analysis within this corridor is included in Chapter 3 of this Draft PEIS for those resources that would be affected. These potential actions would be considered in future supplementary TVA and NRC NEPA analyses, as necessary and appropriate.

TVA prepared this Draft PEIS to comply with the NEPA statute, associated regulations promulgated by CEQ and TVA, and related procedures from various agencies for implementing NEPA. TVA considered the possible environmental effects of the bounding parameters of the proposed action and determined that potential effects to the environmental resources listed below were relevant to the decisions to be made, and therefore, assessed the potential impacts on these resources using the PPE and additional site development parameters in detail in this Draft PEIS.

- Geology and Soils
- Water Resources
- Floodplains and Flood Risk
- Wetlands
- Aquatic Ecology
- Terrestrial Ecology
- Threatened and Endangered Species
- Natural Areas
- Recreation
- Meteorology, Air Quality, and Climate Change
- Transportation
- Visual Resources
- Noise
- Socioeconomics
- Environmental Justice
- Archaeological Resources and Historic Structures
- Solid and Hazardous Waste
- Non-radiological Public Health & Safety
- Radiological Effects of Normal Operation
- Uranium Fuel Use Effects
- Nuclear Plant Safety and Security

The Draft PEIS also addresses specific requirements associated with a number of federal laws and regulations, such as National Historic Preservation Act (NHPA), Endangered Species Act (ESA), Clean Water Act (CWA), and Clean Air Act (CAA), and would satisfy the requirements of pertinent executive actions, including Executive Order (EO) 11988 (Floodplains Management), EO 11990 (Protection of Wetlands), EO 12898 (Environmental Justice), EO 13112 as amended by 13751 (Invasive Species), EO 13990 Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, EO 14008 Tackling the Climate Crisis at Home and Abroad, EO 14057 Catalyzing Clean Energy Industries and Jobs Through Federal Sustainability, and other applicable or relevant EOs.

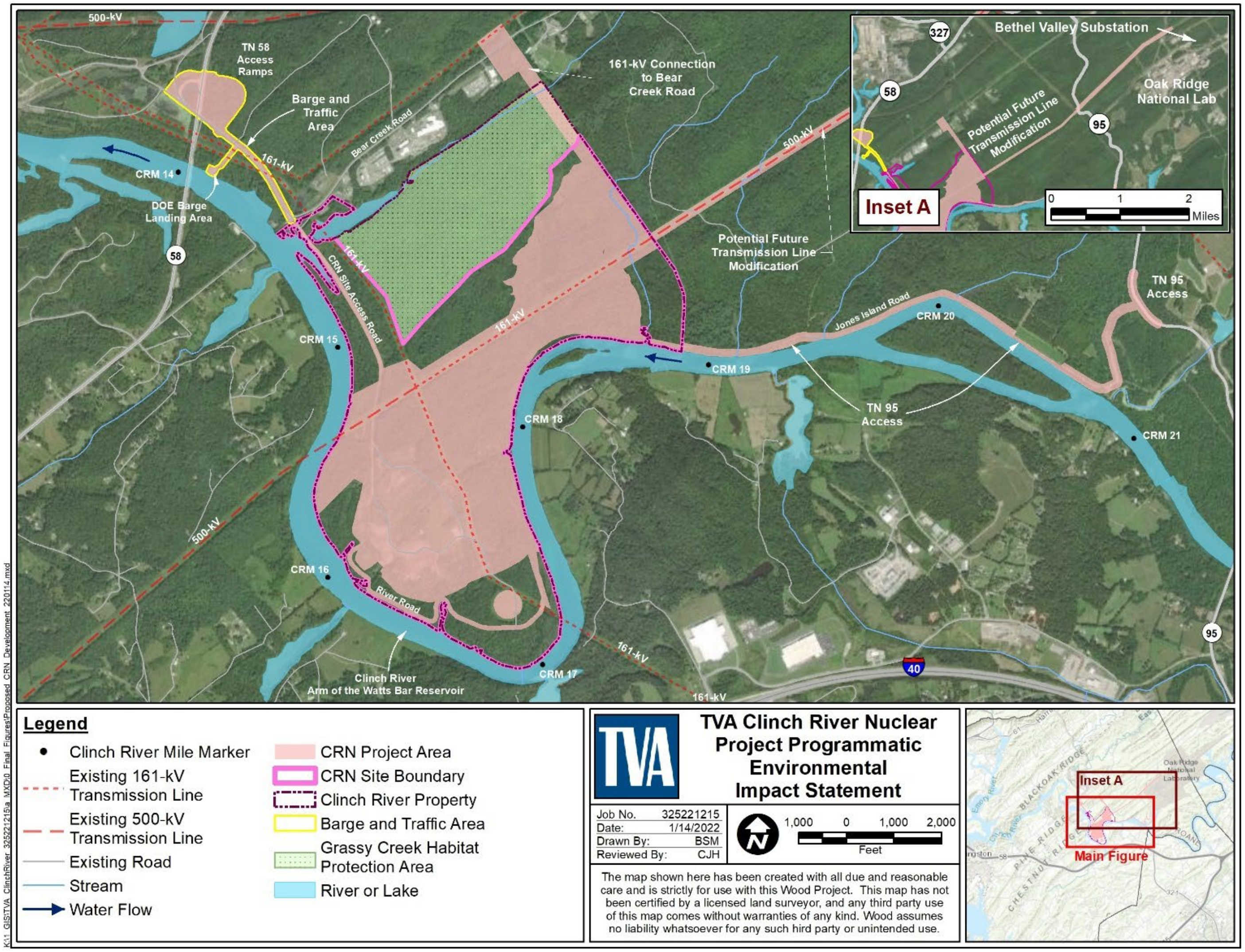


Figure 1-2. CRN Project Area

1.8 Public and Agency Involvement

1.8.1 Scoping

1.8.1.1 Scoping Period Public Outreach

Public scoping was initiated with the publication of the Notice of Intent (NOI) to prepare a Draft PEIS in the Federal Register on February 5, 2021 (Appendix B). Additionally, TVA posted a public notice about the scoping period and information regarding the Draft PEIS on the TVA external website (www.tva.com/nepa). A public scoping period was held from February 2 to March 19, 2021. To facilitate awareness of this opportunity, in addition to posting the NOI in the Federal Register and on the TVA website, TVA contacted local, state, and federal government agencies, local power companies, directly served customers, and sent a media advisory to news outlets across the TVA service area. A public notice advertisement was also placed in the *Roane County News*, *Knoxville News Sentinel*, *News-Herald*, *Oak Ridger*, *Courier News*, and on the TVA website.

TVA encouraged the public to comment on the scope of the Draft PEIS, alternatives under consideration, and the range of environmental issues to be addressed. TVA invited the public to submit formal comments via email (nepa@tva.gov), the TVA website (www.tva.com/nepa), or by postal mail. In addition to the website, TVA established a “virtual meeting room”, accessible through the www.tva.com/nepa website, which offers virtual public engagement throughout the NEPA process. During the scoping period, the virtual meeting room provided information on the scheduled virtual scoping meeting, links for submitting scoping comments, and a scoping meeting registration link. Further, the virtual meeting room provides access to project information in the form of posters and links to additional project documentation, maps, graphics, and project-related webpages. In addition to the NEPA website and virtual meeting room that focuses on plans to develop the CRN Site, there is TVA's Nuclear Technology Innovation webpage that focuses on the types of advanced nuclear reactor technologies under consideration.

As part of scoping, TVA hosted a live virtual scoping webinar on March 1, 2021, to gather input and answer questions from the public and stakeholders. The public was invited to attend this virtual meeting and submit formal comments. During the scoping webinar, TVA gave a presentation outlining the CRN Site history, the proposed project description, project schedule, and NEPA regulatory framework as well as site layouts and a drone video tour of the site. A total of 98 individuals, including members of the general public and representatives of a variety of organizations as well as TVA, registered for the meeting. Among those registered, 69 were not affiliated with TVA and 58 attended the question-and-answer session following the presentation.

1.8.1.2 Summary of Scoping Feedback

TVA received a wide variety of comments and opinions regarding the construction, operation, and decommissioning of a Nuclear Technology Park at the CRN Site and considered this input in developing the Draft PEIS.

TVA received 45 formal comment submissions from members of the public, local government, and state and federal agencies. The submissions consisted of:

- One submission from a federal agency, U.S. Environmental Protection Agency (EPA)
- Three submissions from state agencies, Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources, TDEC Division of Air Pollution Control, and Tennessee Department of Transportation (TDOT)
- One submission from a local government, Roane County Environmental Review Board
- Fourteen submissions from organizations including the Sierra Club, Savannah River Site Watch, Tennessee Environmental Council, Bellefonte Efficiency & Sustainability Team of the Blue Ridge Environmental Defense League, Nuclear Information and Resource Service, Coalition for A Nuclear Free Great Lakes, and Erwin Citizens Awareness Network, Inc.
- Twenty-seven submissions from members of the public that did not state an affiliation with an organization

The 45 comment submissions were reviewed to identify specific issues of concern by each commenter and were grouped in general categories for identification and review. In total, 128 separate comments were identified. Additional detail regarding comments received during the scoping process including information and analyses submitted by State, Tribal, and local governments are included in the Scoping Report, which is available in Appendix C and on TVA's website. TVA considered and addressed these comments during preparation of this Draft PEIS.

1.8.2 Public and Agency Review of the Draft PEIS

TVA's public and agency involvement for the Draft PEIS included publication of a public notice and a 45-day public review of the Draft PEIS. To solicit public input, the availability of the Draft PEIS was announced in regional and local newspapers serving Oak Ridge and the Knoxville area. A news release was issued to the media and posted on TVA's website on February 18, 2022. The Draft PEIS was posted on TVA's NEPA website (www.tva.com/NEPA), and hard copies were made available by request.

TVA's agency involvement included sending notices to local, state, and federal agencies as well as federally recognized tribes to inform them of the availability of the Draft PEIS.

1.9 Necessary Permits and Licenses

TVA would seek and obtain all necessary permits, licenses, and approvals required for the alternative selected. Appendix D provides a complete list of potential permits and authorizations that are expected to be required, depending upon the alternative selected. Representative permits, licenses, and approvals include the following:

- Federal Aviation Administration (FAA) Construction Notice for erection of structures more than 200 feet high that potentially may affect air navigation
- Certificate of Registration from the U.S. Department of Transportation (DOT) for transportation of hazardous materials
- Entrance and right-of-way (ROW) permits from the TDOT for ramps, driveways, and other access points and installation of utilities within highway ROWs along Tennessee Highway 58 (TN 58) and TN 95
- CWA Section 404 Permit through the USACE for disturbance, crossing, or filling of wetland areas or jurisdictional waters
- Rivers and Harbors Act Section 10 permit from the USACE for dredge and fill actions within navigable waters
- U.S. Coast Guard Private Aids to Navigation Permit for construction of discharge pipeline in navigable waters
- EPA and TDEC acknowledgement of notification of hazardous waste activity, facility response plan approval, and spill/discharge prevention plan
- Consultation with the U.S. Fish and Wildlife Service (USFWS) regarding effects on species listed under the ESA
- TDEC permits including CWA Section 401 Aquatic Resource Alteration Permit (ARAP) and Section 402 National Pollutant Discharge Elimination System (NPDES) General Permit for Stormwater Discharges Associated with Construction Activities or an Individual Construction Stormwater Permit, NOI for NPDES General Permit of Discharges from the application of pesticides, water withdrawal registration, and CAA Title V Operating Permit for discharge of air pollutants
- TDEC Division of Radiological Health (DRH) for transportation of radioactive waste within Tennessee to a disposal/processing facility
- Compliance with NHPA Section 106 for protection of archaeological and historical resources
- Municipal site plan approval, sanitary sewer and potable water connections, and construction permits from the City of Oak Ridge

Actual permit requirements would be evaluated based on site-specific conditions and technology selection and details of the permitting requirements would be determined based upon final design.

Future actions at the CRN Site relating to construction and operation of a Nuclear Technology Park would also require the preparation of Environmental Reports (ERs) for NRC licensing such as a Construction Permit, Operating License, Combined License and/or Limited Work Authorization, in addition to any necessary and appropriate supplementary NEPA analyses.

CHAPTER 2 – ALTERNATIVES

TVA is considering a range of alternatives for site preparation, construction, operation, and decommissioning of a Nuclear Technology Park at the CRN Site in the City of Oak Ridge, Roane County, Tennessee (Figure 1-1). This chapter presents an overview of the advanced nuclear reactor technologies under consideration, the specific project alternatives being evaluated by TVA, and a summary and comparison of alternatives by resource area.

2.1 Overview of Nuclear Reactor Technologies

An advanced nuclear reactor is defined as a nuclear fission reactor with significant improvements over the most recent generation of nuclear fission reactors (*see* 42 USC 16271(b)(1)(A)). Such reactors include light water reactor (LWR) designs, both pressurized and boiling water reactors (PWR and BWR), and non-LWR designs, which use various moderators, coolants, and types of fuel. SMRs are a type of advanced LWR with an electrical output of generally no more than 300 MWe, which is considerably less than the electrical output of approximately 1,000 MWe provided by a typical commercial reactor in the United States of America (U.S.) (IAEA 2021). Many SMRs are designed to be manufactured in factories as large, fabricated components and shipped to a project site for assembly. Therefore, less onsite construction would be required for installation of SMRs than for installation of a typical commercial reactor. SMRs may provide the benefits of nuclear-generated power in situations where large nuclear units are not practical because of constraints related to transmission system requirements, limited space or water availability, or limited available capital for construction and operation.

Advanced nuclear reactor designs use combinations of new and existing technologies and materials to improve upon earlier generations of nuclear reactors. SMRs are considered to be among the most mature of the advanced nuclear reactor technologies. Advanced non-LWRs are less mature and therefore further from commercialization.

This section provides an overview of the reactor technologies and other technology park development characteristics being considered for each of the alternatives discussed in the PEIS, including both SMRs and advanced non-LWRs.

2.1.1 Nuclear Reactor Designs Under Consideration by TVA

This PEIS evaluates the environmental impacts associated with the potential future deployment of one or more advanced nuclear reactors at the CRN Site. TVA is currently considering negotiating and entering into one or more contracts with one or more SMR vendors to: (1) perform design, engineering, scoping, estimating, and planning associated with potential, future deployment of a SMR at the CRN Site, and (2) develop content for a potential, future licensing application submittal to the NRC. TVA also plans to continue to study potential, future deployment of advanced nuclear reactors (LWR and non-LWR) at the CRN Site. These contemplated actions would not prejudice any of the alternatives under consideration in this PEIS, as the contemplated actions would not: (a) authorize or commit TVA to submit a licensing application to the NRC, (b) allow any construction activities at the CRN Site, or (c) result in any potential environmental impacts to the CRN Site.

As part of the New Nuclear Program and delegation discussed in Section 1.2, TVA has begun discussions with General Electric Hitachi (GEH) to initially pursue advancing the design work, gather permitting and licensing information, and perform preliminary site-specific analyses for the GEH BWRX-300 SMR. These activities are required preliminary planning steps to license and build any nuclear technology, and these planning actions related specifically to GEH's BWRX-300 will be done while continuing to evaluate other advanced nuclear reactor designs for the CRN Site.

Initial pursuit of the GEH BWRX-300 does not pre-determine any subsequent development; in accord with the approach described in this Draft PEIS, TVA will continue to evaluate various SMR designs for potential deployment at the CRN Site while advancing the design of the GEH BWRX-300. TVA may later decide to pursue similar evaluations of other new nuclear technologies suitable for the CRN Site. Depending upon subsequent decision making and approval processes, and after appropriate environmental reviews, TVA may eventually choose between available detailed designs for potential deployment at the CRN Site.

Initial pursuit of the GEH BWRX-300 does not limit TVA's alternatives, either under consideration in this PEIS or otherwise. As discussed in this PEIS, TVA is considering a range of alternatives for site preparation, construction, operation, and decommissioning of a Nuclear Technology Park at the CRN Site, including two different areas and roughly 14 different reactor designs discussed in the following sections. Advancing the GEH BWRX-300 detailed design work only enables future TVA decision-making amongst the reasonably considered alternatives, and it does not compel TVA to select this or any reactor design over any others in consideration.

Technology alternatives being considered by TVA for the CRN Site include SMRs listed in Table 2-1, and/or advanced non-LWRs, listed in Table 2-2.

Table 2-1. Potential SMR Technologies

SMR Reactor Type	Pressurized Water Reactor – Low or High Power Unit	Boiling Water Reactor
Fuel Type	Fuel assemblies containing Uranium-235	Fuel assemblies containing Uranium-235
Heat Transfer Mechanism	Indirect steam generation from heat transfer between high pressure primary reactor coolant and secondary feedwater.	Direct steam generation from lower pressure reactor coolant
Power Conversion System	Steam Cycle	Steam Cycle
Reactor Coolant	Light Water	Light Water

Table 2-2. Potential Advanced Non-LWR Technologies

Reactor Type	Thermal, Molten Salt, Graphite Moderated	Thermal, Fluoride Salt Coolant, Graphite Moderated	High Temperature Gas, Graphite Moderated, Helium	Molten Chloride Fast Reactor (MCFR)	Micro Reactor
Fuel Type	Homogenous Fuel-Salt	TRISO Pebble High-Assay Low-Enriched Uranium (HALEU)	TRISO Pebble HALEU	Homogenous U-Cl Fuel-Salt	TRISO Pebble HALEU
Heat Transfer Mechanism	Salt Loop(s)	Salt Loop(s)	Primary Helium and Secondary Steam	Salt Loop(s)	Salt Loop(s)
Power Conversion System	Steam Cycle	Steam Cycle	Steam Cycle or Brayton Cycle[1]	Steam Cycle	Steam Cycle
Reactor Coolant	Molten Chloride Salt	Molten Fluoride Salt	Helium	Molten Chloride Salt	Molten Fluoride Salt

[1] The Brayton Cycle is a thermodynamic cycle that uses air, or some other gas, as the working fluid such as that used in combustion turbines

A brief description is provided below for each of the reactor technologies being considered by TVA for the CRN Site.

2.1.1.1 Potential SMR Technologies

The SMRs under consideration and analyzed in this Draft PEIS consist of both PWRs and BWRs and include the NuScale Power Module, GEH BWRX-300, Holtec SMR-160, Last Energy Mini-PWR, and the Rolls-Royce SMR. PWRs are LWRs where the primary reactor coolant is maintained at high pressure during operation such that it does not boil. Heat from the primary reactor coolant is transferred to a lower pressure secondary system, via a steam generator, where steam is generated to drive a steam turbine. BWRs are LWRs where the primary reactor coolant is maintained at a lower pressure during operation such that it boils, turns into steam, and drives a steam turbine directly. The process of generating steam to drive the steam turbine to produce electricity is referred to as the steam cycle. The SMRs use uranium dioxide (UO_2) fuel. The typical refueling cycle for these SMRs is every 12 to 24 months, with a maximum interval of approximately 6 years for certain designs. The expected design life for the overall facility ranges from 40 to 60 years.

The standard SMR designs under consideration include single units (or modules) with a power output of up to 470 MWe (1,358 megawatts thermal [MWt]), or multiple modules, with up to 15 units per site, with a power output as low as 18-22 MWe (83 MWt) per unit. In the electric power industry, MWe refers to the electric power produced by a generator, while MWt refers to thermal power produced by the plant.

The SMRs under consideration use steam turbines for power conversion. The normal heat sink (i.e., the means used for dissipation of waste heat to the ambient environment, such as bodies of water and the atmosphere) design has not been selected for the CRN Site, but the SMR designs included in the PPE allow for different options including wet or dry-type cooling towers, cooling ponds, air-cooled condensers, and/or discharges to a receiving waterbody via diffuser pipes. The quantities of heat that are generated, dissipated to the atmosphere, and released in liquid discharges would depend on the reactor technology selected. The primary source of cooling water makeup for the Nuclear Technology Park at the CRN Site would be the Reservoir.

To address the potential for accidental releases, a range of engineered safety feature (ESF) systems are included in the SMR designs being considered. These include both active and passive types of ESF systems. In general, active safety systems rely on electric-powered components to supply water and provide reactor core and containment cooling. In the event of a loss of the normal alternating current (AC) power supply, the active systems would be powered by onsite auxiliary power sources, such as diesel generators. Alternatively, passive safety systems rely almost exclusively on natural forces, such as density differences, gravity, or stored energy, to supply coolants (e.g., water) and to provide core and containment cooling. All reactor designs being considered allow for passive cooling of the core (i.e., natural circulation of reactor coolant without the need for pumps). Certain reactor designs require direct current (DC) power to ensure cooling after an accident. Some of the designs do not require AC or DC power to provide cooling. The safety-related ultimate heat sink (UHS) (i.e., the heat sink that provides cooling in the event of an accident) would typically be a dedicated reservoir of water within the facility and would not require any safety-related makeup water from external sources.

2.1.1.2 Potential Advanced Non-LWR Technologies

The advanced non-LWRs under consideration and analyzed in this Draft PEIS include a wide range of reactor technologies and consist of the BWXT Advanced Nuclear Reactor, Flibe Energy Liquid Fluoride Thorium Reactor, Kairos Power KP-X, Moltex Energy Stable Salt Reactor-Waste Burner, Oklo Natural Circulation Sodium Fast Reactor, Terrestrial Energy Integral Molten Salt Reactor, Ultra Safe Nuclear Corporation High Temperature Gas Cooled Micro Modular Reactor, and the X-energy XE-100. The non-LWR fuel types under consideration mostly fall into two categories: (1) molten fuel salts (e.g., thorium and uranium fuel salts), and (2) tri-structural isotropic (TRISO) coated fuel particles which contain High-Assay Low-Enriched Uranium (HALEU) (e.g., UO_2, uranium oxycarbide [UCO], or uranium nitride [UN]-based TRISO particles contained in a spherical fuel “pebble” or cylindrical fuel “pellet”). Molten fuel salt reactors use a homogenous mixture of fuel and primary coolant (i.e., the fuel is dissolved directly into the coolant), made from molten metals (e.g., sodium), or salts. The TRISO fuel-based reactors either use molten salt or gas (e.g., helium) as the primary coolant. One of the reactor designs under consideration uses recycled nuclear waste as a fuel with molten salt as a coolant. Some of the advanced non-LWR designs may use a metallic fuel (e.g., uranium- zirconium) where the fuel is not dissolved directly into the coolant. TRISO particles include layers of porous carbon, pyrolytic carbon (which is similar to graphite), and silicon carbide so that the particles act as their own containment and can withstand extreme temperatures without melting. The “pebble” design means that these TRISO particles are then contained inside small spheres of graphite.

The expected design life for advanced non-LWRs ranges from 20 to 60 years. Depending on the design, the reactor could be continuously refueled (e.g., for a pebble bed design) or may need to be refueled every 5 to 20 years, depending on fuel uranium-235 (U-235) enrichment level.

The designs under consideration include single units (or modules) with a power output of up to 300 MWe (750 MWt), or multiple modules with a power output as low as 10 MWe (30 MWt) per unit.

Depending on the design, either natural circulation or forced circulation (i.e., the use of pumps to provide adequate flow) of coolant is used during normal operation. The non-LWR technologies under consideration primarily use steam turbines for power conversion but some may use gas turbines. Some of the non-LWRs may have power conversion systems that reject heat directly to the atmosphere, such as air-cooled gas turbines. Multiple heat sink designs are possible for the advanced non-LWR(s) options. The quantities of heat that are generated, dissipated to the atmosphere, and released in liquid discharges (if any) would depend on the reactor technology selected.

The advanced non-LWR reactor designs all allow for the use of passive systems for safe shutdown and cooling of the reactor. Certain reactor designs may require DC power to ensure cooling whereas some of the designs do not require AC or DC power to provide cooling. Some of the designs allow for passive heat removal directly to the atmosphere.

2.2 Project Alternatives

The proposed CRN Site layout is presented in Figures 2-1 through 2-3. TVA identified two areas within the 935-acre CRN Site that are best suited for the Nuclear Technology Park development. Area 1 includes the area previously disturbed by the CRBRP evaluated in the ESPA ER. A portion of Area 2 was also evaluated in the ESPA ER for a proposed temporary laydown area.

TVA plans to evaluate four discrete alternatives (A-D) for the Nuclear Technology Park:

- Alternative A: No Action Alternative
- Alternative B: Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs
- Alternative C: Nuclear Technology Park at Area 2 with Advanced non-LWRs
- Alternative D: Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs

Under action alternatives B thru D, activities would be undertaken within each of the following areas that are referred to in the analyses of this PEIS:

4. CRN Site – lands contained within the boundaries of the CRN Site.

5. Associated Offsite Areas – a collective term that includes the following:

    a. Barge and Traffic Area (BTA): Area outside of the CRN Site boundary that encompasses proposed improvements to the intersection of TN 58 with Bear Creek Road, improvements to Bear Creek Road, and improvements to the existing DOE barge landing facility on the Reservoir.

   b. TN 95 Access: Proposed roadway access that extends from TN 95 southwesterly, following Jones Island Road to the CRN Site boundary.

   c. 161-kV Offsite Transmission Line: Segment of proposed 161-kV transmission line that extends outside of the CRN Site boundary to an interconnection with the existing 161-kV line along Bear Creek Road.

6. 500-kV Offsite Transmission Line: Segment of 500-kV transmission line that extends northeast, outside of the CRN Site boundary to the Bethel Valley substation.

TVA considered, but dismissed two alternatives:

- Alternative E: Construction of SMRs at Alternative Sites
- Alternative F: Construction of Alternative Energy Generation Sources

The No Action Alternative, the individual action alternatives, and the alternatives considered but dismissed are described in the following sections.

2.2.1 Alternative A – No Action

Under the No Action Alternative, TVA would not seek additional approvals from the NRC for the CRN Site. A Nuclear Technology Park and advanced nuclear reactors would not be further explored, constructed, operated, or potentially decommissioned at the CRN Site. The CRN Site would continue to be managed in accordance with the Watts Bar Reservoir Land Management Plan (RLMP). TVA would continue routine maintenance and clearing associated with the transmission lines that currently traverse the CRN Site.

Under the No Action Alternative, TVA would not evaluate and demonstrate the feasibility of deploying advanced nuclear reactors at the CRN Site as part of TVA's technology innovation efforts aimed at developing future generation capabilities. The No Action Alternative would not meet the project purpose and need. However, it is included in this PEIS review as it provides a baseline for describing the anticipated environmental effects of the proposed action for comparison to the Action Alternatives.

2.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs

To meet the purpose and need, the project considers an array of potential activities, including the potential site preparation, construction, operation, and decommissioning of one or more advanced nuclear reactor(s) at Area 1 of the CRN Site (Figure 2-1).

Options to be considered under this alternative include:

- Alternative B1 – Construction of one or more SMR(s). Under this alternative, one or more of the reactor types shown in Table 2-1 would be constructed and operated on Area 1.
- Alternative B2 – Construction of one or more SMR(s) and/or advanced non-LWR(s). Under this alternative, one or more of the reactor types shown in Table 2-1 and/or one or more of the reactor types shown in Table 2-2 would be constructed and operated on Area 1.

2.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced non-LWRs

To meet the purpose and need, the project considers an array of potential activities, including the site preparation, construction, operation, and potential decommissioning of one or more advanced non-LWR(s) at Area 2 on the CRN Site (Figure 2-2).

2.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs

To meet the purpose and need, the project considers an array of potential activities, including the site preparation, construction, operation, and potential decommissioning of one or more advanced nuclear reactor(s) at Area 1 and Area 2 on the CRN Site (Figure 2-3). Specifically, one or more SMR(s) shown in Table 2-1 and/or advanced non-LWR(s) shown in Table 2-2 could be constructed at Area 1 and one or more advanced non-LWR(s) could be constructed at Area 2.

2.3 Alternatives Eliminated from Consideration

2.3.1 Alternative E – Construction of SMRs at Alternative Sites

As part of the ESPA process, TVA conducted a siting study with the overall objective of identifying a nuclear power plant site that:

1. Meets TVA's business objectives for the project as outlined in Section 1.1,
2. Satisfies applicable NRC site suitability requirements, and
3. Complies with NRC's implementation guidance for NEPA requirements regarding the consideration of alternative sites.

Site selection was conducted in accordance with the process outlined in the *Advanced Nuclear Technology: Site Selection and Evaluation Criteria for New Nuclear Power Generation Facilities* (EPRI Siting Guide), June 2015, Report 3002005435 (EPRI 2015) and defined in NUREG-1555, *Standard Review Plans for Environmental Reviews for Nuclear Power Plants: Environmental Standard Review Plan*, Revision 1, July 2007 (NRC 2007). The results of the study were published in the *Tennessee Valley Authority Site Selection Report* (TVA 2016).

After a rigorous screening process described in the report, three alternative sites were considered in detail for construction of SMRs: the Clinch River Site, a site on the ORR, and a site at the Redstone Arsenal in Alabama. TVA's ESPA ER described (1) the TVA region of interest for identification of alternative plant sites, (2) the methods used by TVA to select the proposed site and alternative sites, and (3) generic issues that are consistent among the alternative sites. The ESPA ER also compared the environmental impacts at the CRN Site to those at the alternative sites. The ESPA ER and NRC ESP FEIS qualitatively determined that none of the alternative sites are obviously superior from an environmental or nuclear safety perspective to the proposed site. The NRC ESP FEIS recommended that an ESP should be issued for the Clinch River Site in Roane County, Tennessee. Following publication of the NRC ESP FEIS in April 2019, the NRC issued an ESP to TVA in December 2019. TVA does not have such an authorization for any other site. For these reasons, TVA finds that Alternative E does not meet the purpose and need of this PEIS to develop a Nuclear Technology Park at the CRN Site, and this Alternative is dismissed from further consideration.

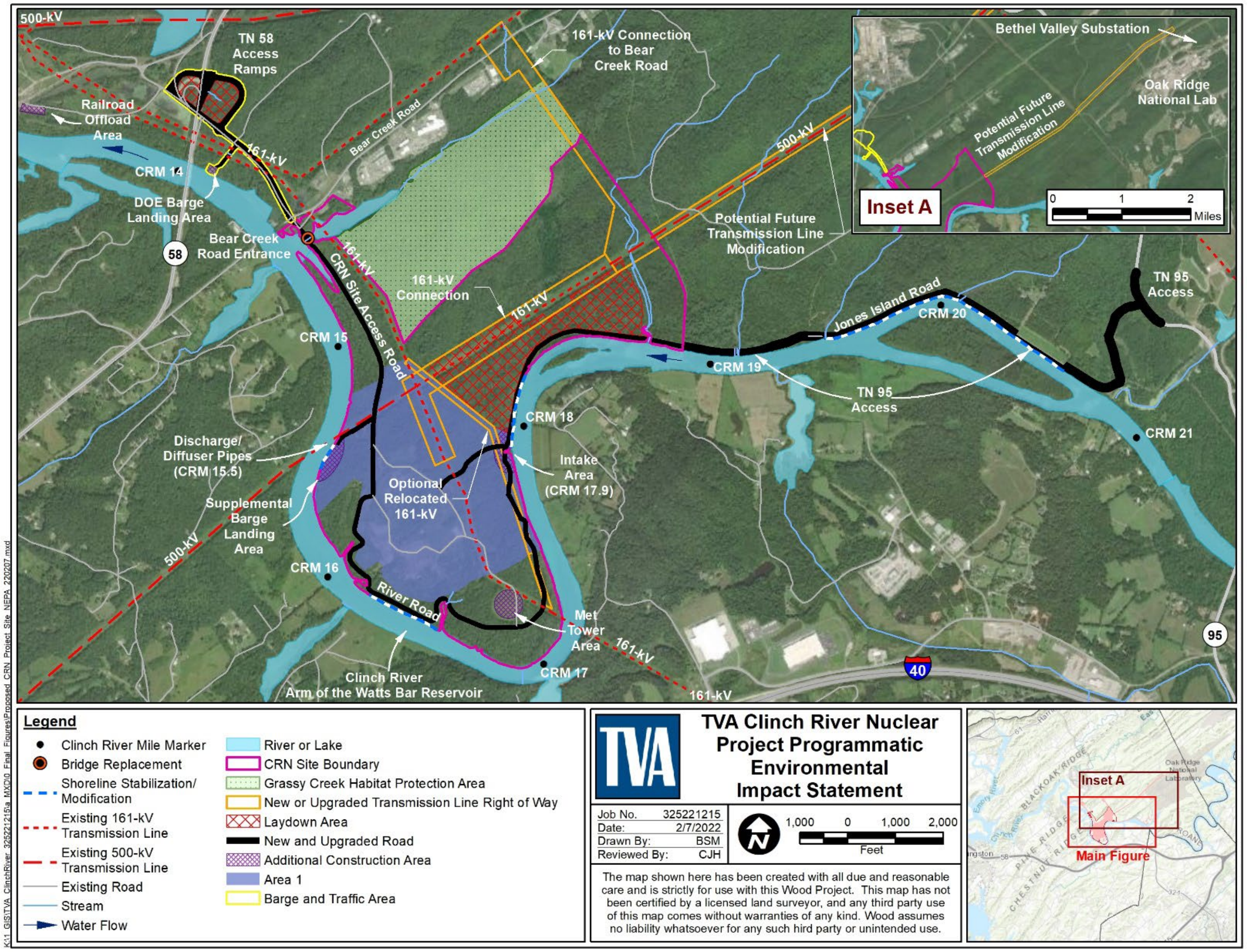


Figure 2-1. Alternative B: Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs

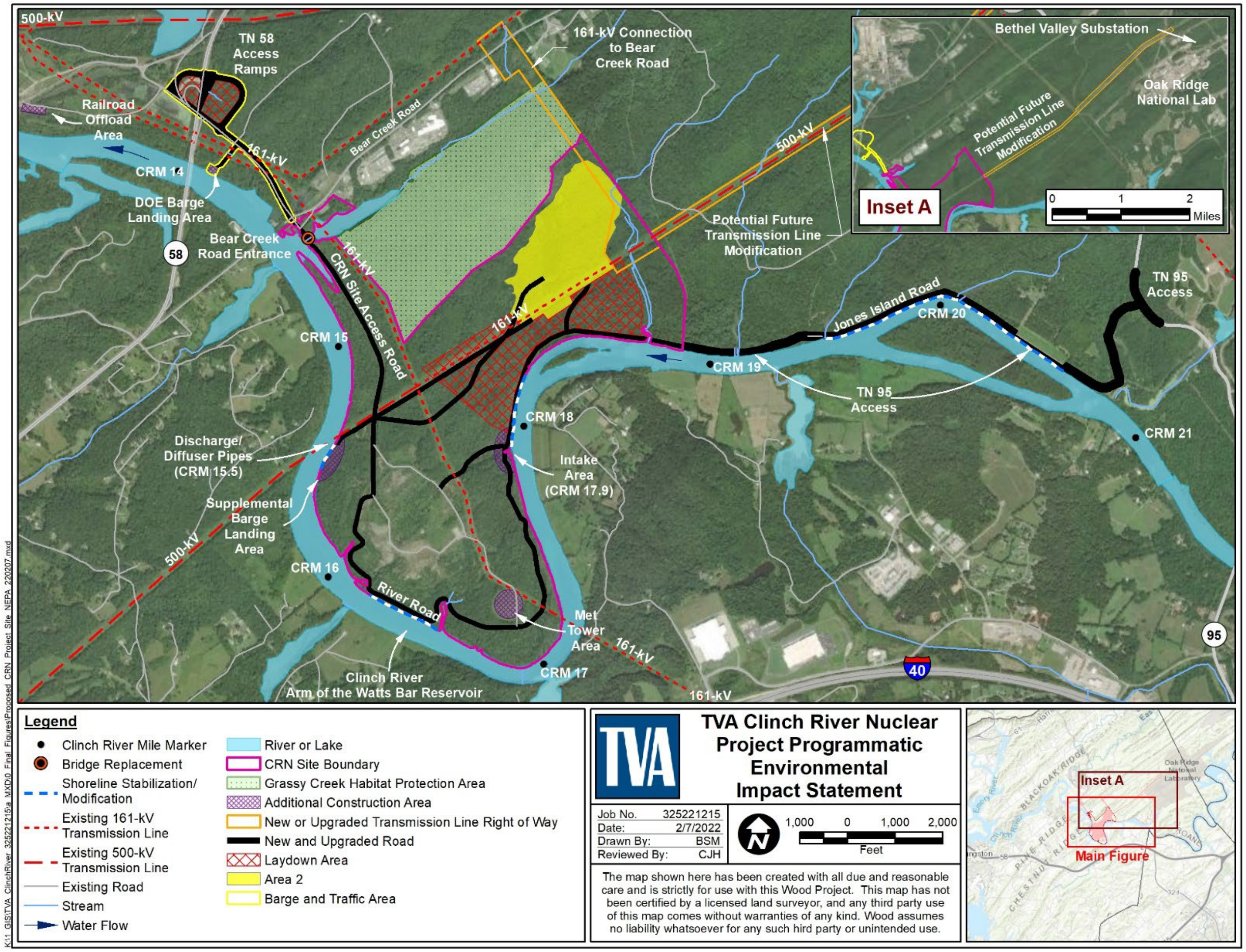


Figure 2-2. Alternative C: Nuclear Technology Park at Area 2 with Advanced non-LWRs

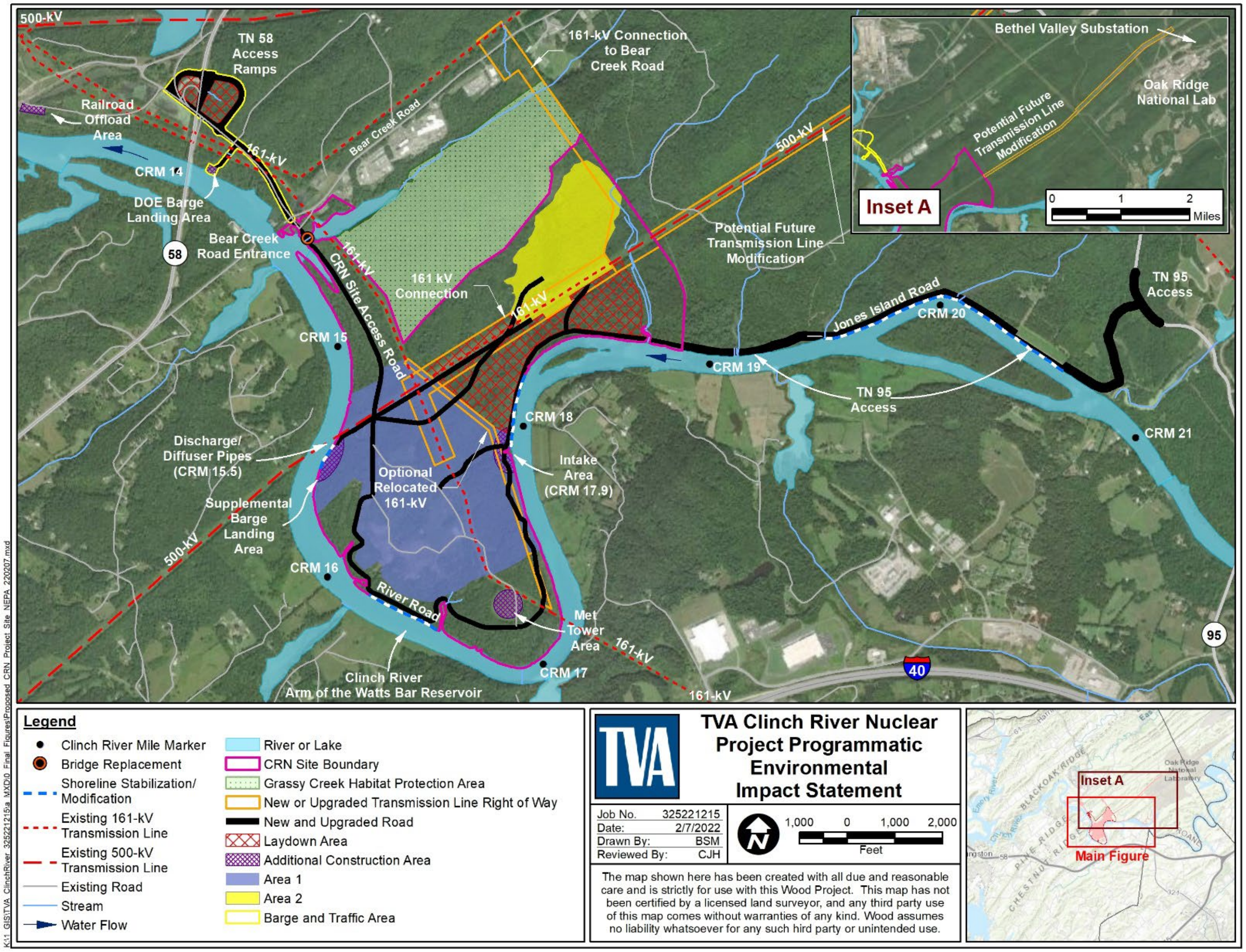


Figure 2-3. Alternative D: Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs

2.4 Alternative F – Construction of Alternative Energy

Construction of other generation systems (e.g., solar, coal, etc.) would not meet the purpose and need of this Project. TVA considered various generating technologies in the 2019 Final IRP that would meet the anticipated future demand for power with low-cost, increasingly clean, reliable electricity supply. This includes up to 14 gigawatts (GW) of solar and up to 5 GW of electricity storage added to the TVA mix of power generation resources. Alternative energy generating sources are being considered for other locations in the TVA system, and they are being evaluated and pursued under separate analyses, as appropriate. For these reasons, TVA finds that Alternative F does not meet the purpose and need of this PEIS to develop a Nuclear Technology Park at the CRN Site and is dismissed from further analysis

2.5 Nuclear Technology Park Development Characteristics

The following sections provide descriptions of the activities required for site preparation, construction, operation, and decommissioning of any of the nuclear technologies that might become part of a Nuclear Technology Park at the CRN Site. The descriptions encompass the activities that could occur under all alternatives being considered. Specific considerations relating to permitting or authorizations for those certain actions that are currently contemplated, including decommissioning, are addressed in Chapter 3. Any additional specific considerations relating to permitting or authorizations not currently contemplated would be analyzed in supplemental NEPA analyses at the appropriate time.

2.5.1 General Site Development

2.5.1.1 Primary Use Areas on the CRN Site

Land clearing, grading, and excavation would be required in conjunction with any development of the CRN Site. Areas proposed for use include Area 1, Area 2, laydown areas, transmission line ROWs and the roadway network. Major site infrastructure that could be constructed or installed within Areas 1 and/or 2 include the reactor and turbine buildings, cooling towers, transmission lines, transformers, switchyard, administration/control building, and associated parking.

Major cut and fill activities are expected with the grading of Area 1 and/or Area 2 in preparation for any nuclear foundation construction. As such, for the purposes of impact analysis, all lands within the footprint of Area 1, Area 2, and the laydown area are assumed to be disturbed in conjunction with site development for each alternative, as appropriate. TVA intends to use onsite cut/fill material to balance and minimize the need for offsite borrow material. If borrow material is needed, the associated actions would be addressed in a supplemental NEPA analysis. Topsoil typically contains organic material, such as vegetation, leaves, roots, etc., and as such it is not expected to be suitable for reuse as fill material. The excess topsoil would be spread outside the reactor Power Block (the area containing the reactor, turbine, cooling tower, transmission lines, transformers, switchyard, admin/control building, and associated parking) perimeter fences and reseeded instead of being hauled off the CRN Site. It is assumed that other in-situ soils would be suitable for general and structural fill. Importing sand, rock, or other similar materials may still be required for pipe bedding, surfacing, riprap use, etc. Blasting may be required in certain areas due to the known presence of bedrock on the site. Details regarding the need for blasting and its associated impacts would be evaluated in a subsequent NEPA review when more design and construction information is available. The existing stormwater management system in Area 1 consisting of stormwater runoff/collection ponds and associated piping remaining from the CRBRP would be re-used as practicable.

Area 1 and Area 2

Area 1 is located on a relatively flat plateau within the southwest part of the CRN Site (Figures 2-1 and 2-3). The existing grade in Area 1 varies from 800 AMSL to 770 AMSL. Approximately 240 acres within Area 1 were disturbed in 1982-1983 during CRBRP site preparation activities which included leveling a ridge from 880 feet AMSL to 780 AMSL, excavation of the reactor area, and the installation of various structures. The excavation totaled approximately 24 acres with a depth of up to 100 feet. After the CRBRP termination in 1983, site redress plans were implemented by DOE. The excavated area was partially backfilled in a manner to sustain site drainage. Level areas of the CRBRP site were graded and compacted. The hilly terrain northeast of Area 1 directs the flow of stormwater runoff toward Area 1.

Area 2 is located on the northeast part of the CRN Site (Figures 2-2 and 2-3) and consists of forested rolling hills with the exception of the cleared, 500-kV ROW. Elevation ranges between approximately 780 ASML to 950 AMSL. Some cut work or grading would be required to level Area 2 for construction.

The final determination of the reactor locations and elevations would require detailed geotechnical analysis for slope stabilization, erosion protection, and stormwater discharge. Some fill may be required for both Area 1 and Area 2 to raise the existing grade; as stated earlier, the plan is to use a balanced cut/fill process to minimize the need for offsite borrow material.

Laydown Areas

Approximately 129 acres of onsite and offsite laydown areas would be required for material staging and storage in support of construction on the CRN Site (see Figures 2-1 through 2-3). Much of the onsite laydown area is currently heavily vegetated and wooded. Clearing, grubbing, and grading for construction of the gravel or paved laydown area and potential crane pad would be necessary. Haul roads would be constructed within the onsite laydown area to both Areas 1 and 2. A 50-foot buffer would be maintained to protect the large wetland complex near the east boundary of the onsite laydown area. An additional offsite laydown area would be required for improvements of the TN 58 ramps and Bear Creek Road. Improvements for the TN 95 access would utilize onsite laydown areas as appropriate. Following CRN Site construction activities, some or all the laydown area would be revegetated with non-invasive plant species. A portion of it may be retained for use as laydown for future plant outage and maintenance work.

Landscape and Stormwater Drainage

Large portions of the CRN Site would be cleared and graded during site preparation. Therefore, drainage runoff controls would be established early in the process. Activities related to installing site drainage would include grading, creation of berms around temporary spoils disposal areas, and shallow trenching for ditches, drainpipes, and culverts.

Slopes, swales, ditches, and pipes would direct runoff to aboveground stormwater management ponds. Existing retention ponds in Area 1 would be redesigned and rebuilt as needed to accommodate excavation dewatering effluent and runoff from the future plant design. Establishing the redesigned stormwater management ponds would involve shallow excavation and emplacement of geotextile fabric, drainpipe, rock, cover material, and grading as needed. The surface would be re-vegetated, graveled or paved, depending on the use, to stabilize the surface.

Drainage crossings have been identified along the site access road in addition to the existing bridge/culvert at the Grassy Creek crossing. The existing bridge/culvert crossing at Grassy Creek is in poor condition and would need to be removed and replaced to accommodate heavy construction vehicles. Similarly, additional drainage crossings have been identified along the new access road to Area 2. An entirely new site drainage system would be required at Area 2.

The stormwater system design is assumed to be sheet runoff to swales and inlets, which would discharge to the Reservoir at permitted discharge point(s). Site stormwater discharge would be controlled through detention in accordance with NPDES requirements. New culverts and improvements to existing culverts would be required in support of site development.

2.5.1.2 Road Development

Development of the CRN Site would require the construction and/or improvements of roadways within both the CRN Site and associated offsite areas to provide access (see Figures 2-1 through 2-3). Roadways within the CRN Project Area include the following existing and proposed new roads: site access road from the Bear Creek Road entrance, River Road; site access road from TN 95; access road to Area 2 from the Bear Creek Road access; additional access roads to Area 2; roads to the intake and discharge areas; and temporary haul roads. All roads would be 2-lane roadways of sufficient width (up to 50-foot width) to accommodate heavy civil construction equipment and industrial traffic. The limits of disturbance for any road construction on the CRN Site is assumed to be 100 feet in width. Clearing and grading would be required to construct the new roads with the applicable maximum grade requirements.

Proposed roadways would be either asphalt or gravel and designed to support heavy haul traffic required for construction and plant maintenance using the following criteria:

1. An approximate 24-foot-wide asphalt pavement with 3-foot-wide gravel shoulder on each side, a total width of up to 50 feet. This road width would need to be verified in Phase 2 Site Development studies.

2. Minimum radius of horizontal curvature: 500 feet.

3. Maximum vertical slope: 4 percent.

4. Design speed for plant access road: 30 mph.

New culverts or culvert replacements would be required in several locations along the TN 95 Access, River Road and the road connecting to Area 2. Blasting of rock to widen the road and tie backs or rock anchors to stabilize rock faces may be required in localized areas. This work would result in periodic high levels of noise and vibration that may be heard offsite. Details to quantify any amount of blasting and associated impacts would be described in a subsequent NEPA review when more design and construction information is available.

Roads within the BTA

TN 58 represents the primary access point for the CRN Site as it is expected that approximately 80 percent of traffic entering and exiting the site would use this route. The

ESPA ER and NRC EIS evaluated 100 percent of the traffic entering the site from TN 58 through the Bear Creek Road Entrance and identified specific mitigation measures to prevent deterioration of traffic levels below Tennessee acceptable standards at the TN 58 and Bear Creek Road intersection due to the substantial increase in traffic associated with the Nuclear Technology Park. These measures have been incorporated into the overall project and include the following:

- Adding a northbound access ramp between TN 58 and Bear Creek Road
- Widening of Bear Creek Road to three lanes, including a reversible traffic lane between TN 58 and the CRN Site entrance
- Signalizing the intersection of Bear Creek Road and the CRN Site entrance
- Adding a two-lane roundabout at the intersection of the proposed northbound ramp and Bear Creek Road
- Adding a northbound exit and entry lanes on TN 58 for accessing and exiting the proposed ramp to Bear Creek Road.

In addition, Bear Creek Road could be realigned to a “T” intersection, eliminating the existing curve at the CRN Site entrance, and widened and upgraded to create a heavy haul road between the rail delivery area and the CRN Site entrance.

TN 95 Access

The TN 95 Access is expected to carry up to 20 percent of traffic entering and exiting the CRN Site. This access starts at the gated entrance to the DOE property on TN 95 and extends southwesterly, intersecting with Jones Island Road near Clinch River Mile (CRM) 20.75. The route then follows Jones Island Road west to the CRN Site boundary where it becomes River Road on the CRN Site. River Road and Jones Island Road are currently gated and not used by the public. Use of Jones Island Road for CRN Site access would require a change in DOE’s current use of the road. Both River Road and Jones Island Road would require significant improvements to roadway geometry, shoulders, and clear zones for use as heavy haul and construction roadways. Where these roads are located close to the Reservoir, shoreline stabilization and other measures would also be required in certain areas. Benching back of slopes, riprap work, retaining walls, concrete or asphalt paving would be required for this upgrade, as appropriate. Limits of roadway construction for primary site access roads are assumed to be up to 100 feet wide to accommodate construction traffic, grading requirements, and utility location, but would be minimized as appropriate during final design.

There are some radiologically contaminated areas along the TN 95 Access on the ORR that have been previously remediated by DOE’s Environmental Management program. These remediated areas would be avoided to the extent practicable. In the event the remediated areas cannot be avoided, plans to use these remediated areas would be made in accordance with DOE, EPA and TDEC guidance and approvals, including existing land use and institutional controls, and the appropriate TVA guidelines.

2.5.1.3 Shoreline Stabilization and Restoration

Improvements to the TN 95 access road and barge landing, both on DOE land, and River Road on TVA land may require stabilization measures on up to 9,050 feet of shoreline between CRM 20.75 and CRM 16.2. Riprap would be required in certain areas to rebuild, stabilize, and protect shoreline and would protrude into the river at a maximum of +/- 10 feet. Based on design, rock riprap of sufficient size would be installed from the toe (2 feet below normal pool) to the top of the eroding bank. Delivery and placement of the riprap would be conducted by barge, and filter fabric would be applied where practical. The banks are covered with limited grasses, forbs, shrubs, and trees. Disturbed ground outside of the shoreline stabilization area that is not covered by existing shoreline buffer plantings would be revegetated utilizing non-invasive woody and herbaceous plants. Clearing of trees along the riverbank would also be required. Sheet piles or other similar type retaining wall pylons may be required in areas where the riverbed is too deep for practical use of riprap.

2.5.2 Transmission System

2.5.2.1 Existing Transmission System

Two transmission corridors cross the CRN Site as shown on Figures 2-1 through 2-3. The Kingston FP–Ft Loudoun HP 161-kV No.1 transmission line crosses the site from the southeastern tip of the peninsula (Figure 2-1) to the northwestern corner of the CRN Site near the entrance gate off Bear Creek Road. The Bull Run FP-Watts Bar NP 500-kV transmission line transverses the CRN Site from the northeast to the southwest. Both of these lines are owned and operated by TVA.

2.5.2.2 Transmission System Upgrades

Every alternative other than the No Action Alternative would require transmission upgrades to complete the connection between the CRN Site and existing power transmission systems. As summarized in Table 2-3, the need for these upgrades is dependent upon the project alternative and specific reactor technologies selected for the Park. The following list describes the potential types of transmission upgrades required to support the construction of one or more advanced nuclear reactors generating up to 800 MWe and to connect the CRN Site to the grid, considering the use of both Area 1 and/or Area 2.

- Construction of a new 500-kV switchyard on the CRN Site.
- Construction of a new 161-kV switchyard on the CRN Site.
- Construction of a small substation, likely near the 161-kV line on the CRN Site.
- Potential future transmission line modification along segment of 500-kV transmission line that extends northeast, outside of the CRN Site boundary to the Bethel Valley substation.
- A new 161-kV above ground transmission line extending from the existing 500-kV transmission line, across the CRN Site, and then offsite perpendicular to Bear Creek Road. This proposed transmission line would require a 120-foot-wide ROW but would be located within a corridor that is up to 280 feet wide (see Figures 2-1 through 2-3).
- For alternatives proposing development of Area 1, relocation of the 161-kV transmission line that bisects Area 1 of the CRN Site. Based on reactor siting needs, the transmission line could be shifted eastward as shown on Figure 2-1 and 2-3.
- For alternatives proposing development of Area 2, construction a new 120-foot-wide transmission line ROW that would extend from the proposed Area 1 switchyard across the entire length of the site to provide power to Area 2.

Development of the corridor connecting the Area 1 switchyard to Area 2 would consist of clearing and grubbing approximately 1-2 miles of new transmission ROW. Some grading may be required depending on terrain along the new ROWs. Construction of transmission towers and lines would be consistent with standard TVA Transmission and Power Supply construction methods. Table 2-3 lists the transmission elements and potential ROW areas expected to be needed to support the proposed Nuclear Technology Park.

Table 2-3. Transmission System Upgrades Parameters

CRN Site Feature/Attribute	Design Description	Alternative
New Switchyards (500-kV, 161-kV)	Location and size within Area 1 or 2 subject to design	B, C, D
New Substation (161-kV)	Small substation near the existing 161-kV line and existing tap from the CRBRP.	B, C, D
161-kV connection from the existing 161-kV line along Bear Creek Road southeast to 500kV-line near northern CRN Site boundary and Area 2	120-foot ROW to be developed within a 280-foot corridor	B, C, D
Potential future 500-kV transmission line modifications; extends northeast, outside of the CRN Site boundary to the Bethel Valley substation.	Extent of upgrades would be determined based on final design.	B, C, D
161-kV transmission line (TL) relocated along edge of Area 1	120-foot ROW	B, D
Connection from Area 1 switchyard to Area 2	Additional 120 feet of the existing 161-kV ROW and the 500-kV ROW	B, D

Other Potential Offsite Transmission System Upgrades

In addition to the upgrades listed in Table 2-3, TVA expects that upgrades may be required for multiple offsite transmission lines in conjunction with the development of the Nuclear Technology Park at the CRN Site including potential modifications to the 500-kV transmission line which extends northeast, outside of the CRN Site boundary to the Bethel Valley substation (Figures 2-1 through 2-3). Potential modifications within this transmission line corridor would occur under Alternatives B, C, and D, however the extent of upgrades would be determined during final design. Because details regarding these upgrades are not yet available, specific environmental impacts from these actions cannot be fully evaluated in this PEIS. However, the area within this segment of the 500-kV transmission line is described and general environmental impacts from potential upgrades in this corridor are determined by affected resource in Chapter 3.

TVA also identified a number of other potential offsite transmission upgrades during the development of the ESPA based on the PPE. Because such upgrades are highly dependent upon the type of reactor technology selected, as well as regional grid stability issues at the time of project development, specific needs for offsite transmission upgrades cannot be determined at this time. Needs for all offsite transmission development would be determined following the selection of a particular reactor technology and would be the subject of additional NEPA review as necessary and appropriate.

2.5.2.3 Transmission Development Activities
Installation of new transmission lines and relocation of the existing 161-kV transmission line on the CRN Site would involve the removal of vegetation, including trees and shrubs, along portions of the transmission line corridors and access roads, movement of construction equipment along the ROW, and excavation for the foundations of the transmission line towers. Temporary dewatering may be needed to build footings for transmission towers.

These activities would involve access by standard transmission line equipment (e.g., bulldozers, bucket trucks, boom trucks, forklifts) in the expanded ROWs described above. Transmission structure replacement or new structure installation would involve limited clearing and shallow excavation, usually within 100 feet of the structure location. Conductor modification would involve using a bucket truck to access existing lines.

2.5.3 Cooling Water System

2.5.3.1 Cooling Water Intake System
Preparing the cooling water intake structure location would require clearing, grubbing, and grading the structure location; placement of a temporary cofferdam in the Reservoir; and shallow excavation along the shoreline to form the forebay for the cooling water intake structure (CWIS). The intake system is expected to be approximately 50 feet wide and 50 feet in length with four intake channels. Each channel likely would include a debris raking system and trash racks, and they may require fish returns.

The design of the intake structure would comply with the CWA 316(b) regulations by providing aquatic life protection. The maximum through-screen velocity at the water screens would be less than 0.5 feet per second. A common CWIS is expected for all reactors to be located within the Nuclear Technology Park.

The flow velocities for operational modes other than full power operation have not yet been defined, pending selection of specific reactor technologies. The quantities of chemicals used for treatments of intake or process waters to prevent biological fouling would be in accordance with a site and technology-specific Biocide/Corrosion Treatment Plan (B/CTP) that would be permitted and approved by TDEC and submitted as required with the NPDES permit application for the facility. Underwater excavation would be used to install the intake structure. Additionally, localized dredging would be used to support installation.

2.5.3.2 Cooling Water Discharge System
The discharge structure for the CRN Site is proposed to be located at approximately CRM 15.5. This structure is expected to consist of a concrete or riprap headwall, two 3-foot-diameter outfall diffuser conduits each, approximately12 feet long, extending from the discharge structure on the shoreline into the Reservoir. The system would be designed to minimize erosion instream and on land. Underwater excavation would likely be used to install the discharge system, with localized dredging to support installation.

Installing the cooling water discharge system would require clearing, shallow excavation, and backfilling. Any excavated material would be disposed of appropriately depending on the characterization of the material and in accordance with CWA Section 404 permit conditions.

2.5.3.3 Cooling Towers
The conceptual design for the plant(s) developed in support of the PPE includes mechanical draft cooling towers to dissipate heat. The mechanical draft cooling towers would be no more than 65 feet in height and disturb no more than approximately 6 acres in the CRN Project Area.

2.5.3.4 Melton Hill Dam Flow Augmentation
In the ESPA, TVA proposed to add a bypass flow system (conduit) through an existing part of the Melton Hill Dam structure to maintain a minimum flow of 400 cubic feet per second (cfs) independent of the hydroelectric generating system. This supplemental flow was proposed in conjunction with TVA's management of thermal conditions of the river. Depending on the technology selected for deployment at the CRN Site, it is possible that instead of modifying the Melton Hill Dam structure, TVA could manage releases from the Melton Hill Dam to augment flow and maintain water quality. Such flow augmentation would be accomplished using the existing dam and would not substantially disturb the Clinch River sediments. Details regarding the need for augmentation of Melton Hill Dam Flow and its associated impacts would be evaluated further in a subsequent NEPA review when more technology-specific design and construction information is available.

2.5.4 Other Infrastructure

2.5.4.1 Barge Facilities
With DOE's permission, TVA expects to use the previously developed offsite barge unloading area in the BTA as the primary barge facility. This facility (Figures 2-1 through 2-3) includes a gravel pad, an access road, and a sheet pile retaining wall on the edge of the Reservoir. The depth of the Reservoir in this area is sufficient to allow barge access. Only minimal improvements would be needed to use this facility in support of CRN Site development. The landside area would be cleared of vegetation, re-graveled, and refurbished as needed to support barge offloading activities. The access road would be widened according to the roadway specifications stated in Section 2.4.1.2. No instream work or disturbance is expected to be required to make this facility usable for TVA's purposes. Should instream work be required for the existing offsite barge facility in the future, additional NEPA evaluation would be conducted.

As a back-up to using the DOE barge facility, a supplemental onsite barge landing is being evaluated for the Nuclear Technology Park. The supplemental onsite barge landing would be located within the CRN Site a short distance upstream of the discharge location (Figures 2-1 through 2-3). This onsite barge landing would be constructed out of riprap and engineered fill. Sheet piles may be required during construction. Dredging is not expected but may be required as a part of this activity. A concrete crane pad may be constructed. Permanent upland disturbance area for the proposed barge landing is estimated to be up to 1 acre. Additionally, the barge landing area is expected to entail the disturbance of approximately 200 feet of shoreline and up to 0.23 acres of instream habitat. Localized dredging would also be used to support installation.

The supplemental onsite barge landing would require a new 0.5-mile access road from the main CRN Site entrance road. This road would be consistent with the other access roads described in Section 2.4.1.2.

2.5.4.2 Rail
The Energy Solutions Heritage Railroad is an existing, privately owned, 11.5-mile rail line between the Norfolk Southern Railway line and the East Tennessee Technology Park

(ETTP), north-northwest of the CRN Site. A spur of the Energy Solutions Heritage Railroad ends at an offload area just west of the TN 58 and Bear Creek Road intersection (Figures 2-1 through 2-3). TVA is considering using this rail spur for building material, equipment, and component deliveries to the CRN Site. Use of the railroad would primarily occur during the construction and preconstruction period, but it could also be used for delivery of large parts or components during operation. To meet this anticipated purpose, the railroad would require refurbishment of the lines in the offload area and possibly elsewhere on the line.

2.5.4.3 Other Supporting Infrastructure and Site Development

Development of a Nuclear Technology Park at the CRN Site would require the installation of temporary utilities to support construction activities including power, lighting, communications, potable water and waste treatment, fire protection, construction gases, air systems, and pre-operational monitoring equipment. Temporary facilities would also be required including parking lots, laydown, storage, and fabrication areas. Temporary construction facilities, including offices, warehouses, workshops, sanitary facilities, locker rooms, training facilities, storage facilities, and access facilities would also be installed. In addition to temporary construction facilities, TVA may choose to construct and operate an onsite landfill for construction, site clearing, and grading debris. The landfill would be constructed in accordance with relevant permits and licenses. All construction activities, facilities, and supporting infrastructure would occur within the CRN Project Area shown on

Development of the CRN Site would also entail the construction and refurbishment of permanent infrastructure to support plant operation that includes onsite utilities, potable water (from the City of Oak Ridge) and sewage pipelines, fire water lines, stormwater runoff ponds, security systems, administration and warehouse buildings, training, and other miscellaneous support facilities.

2.5.5 Traffic

Over the course of the initial estimated 6-year construction period, approximately 100,000 transport construction vehicles would be expected to enter and exit the CRN Site from either the main entrance within the BTA or via the TN 95 Access. Per the traffic assessment performed for the ESPA ER, up to 5,700 vehicles could enter the site per day at the peak construction period. TVA projects that 80 percent of the construction traffic would use the Bear Creek Road entrance and 20 percent would use the TN 95 Access. It is anticipated that the intersection of Bethel Valley Road and TN 95 would require modification to facilitate safe traffic flow.

Existing transportation routes would be affected by an increase in commuter traffic to and from the CRN Site associated with the construction and operation workforces. The workforce for the new plant would use the same access routes identified for plant construction. Approximately 80 percent of the operation traffic for Areas 1 and 2 is anticipated to access the CRN Site via Bear Creek Road with the other 20 percent accessing the site via the TN 95 Access. In addition to serving as a secondary entrance to the site, the TN 95 entrance could serve as an alternate site emergency egress.

2.5.6 Staffing

Staffing would be dependent on selected reactor type(s); see Table 2-1 and Table 2-2. The total peak construction workforce (including some operational staff) evaluated in the ESPA was up to 3,300 workers. It is anticipated the construction, operational, and support workforces for Area 1 and Area 2 would be less than, and bounded by, the analysis in the ESPA ER.

The total facility operation workforce for a Nuclear Technology Park built out to 800 MWe capacity is estimated to be not more than 500, as presented in Table 2-4 and the PPE in Appendix A, item 16.3.1. It is assumed that operation staffing would begin at the same time as site preparation to allow time for simulator training and startup testing support, and it would increase to full staffing at the time of the initial unit(s) operation. Staffing would continue to ensure a full complement of operation personnel at the time of the additional unit(s) operation. Up to an additional 1,000 workers (Appendix A, item 16.3.2) are expected to temporarily work at the CRN Site during periodic refueling and major maintenance activities. Detailed staffing analyses related to refueling activities would be analyzed in a future, supplementary NEPA analysis.

2.5.7 Operational Water Use

Water is required to support the facility during construction and operation. Typical water uses for facility operation include the circulating water system (CWS), potable and sanitary water system, fire protection systems, and other auxiliary systems such as demineralized water and a liquid radioactive waste treatment system. All reactor technologies evaluated in this PEIS would require some quantity of makeup water. The primary water makeup source for plant operation would be water withdrawn from the Reservoir via a new intake structure. During construction activities, water for concrete batch plant operation would be provided by the City of Oak Ridge. Surface water from the Reservoir may be used during construction for purposes such as dust control. Water for potable and sanitary uses during both construction and operation would be obtained from the City of Oak Ridge.

The ESPA assumes a closed loop CWS with the use of mechanical draft cooling towers, but this is not expected for all reactor types considered in this PEIS as discussed in Section 2.1.1. For reactor technologies that would utilize mechanical draft cooling towers, per the ESPA ER and PPE (Appendix A), the intake is expected to withdraw an average of approximately 18,500 gallons per minute (gpm) and a maximum of approximately 31,000 gpm. Of this total, approximately 17,000 gpm average (approximately 26,000 gpm maximum) is to serve as makeup water for the CWS. These values are intended to serve as bounding values to evaluate maximum environmental impacts The proposed CWS would likely use mechanical draft cooling towers for heat dissipation from the plant systems.

The mechanical draft cooling towers would consume some water through evaporation and drift. The average and maximum drift rate is estimated to be 8 gpm, and the average and maximum evaporation rate is estimated to be 12,800 gpm (Appendix A, item 3.3.9). For discharge mixing, blowdown from the cooling towers could be distributed to a holding pond on the western edge of the site. The blowdown rate is estimated to be an average of 4,270 gpm, and a maximum of 12,800 gpm (Appendix A, item 3.3.4). The holding pond would discharge water back to the Reservoir through the proposed discharge located at CRM 15.5. Note that the operational modes for the CWS would be defined as specific reactor designs are selected.

For reactor technologies that would not utilize mechanical draft cooling towers, the assumptions of operational water usage and actual operational water usage captured in the ESPA ER and PPE would conservatively bound any operational water use impacts.

Of the total intake withdrawal volume, an average of 1,345 gpm (and a maximum of 5,100 gpm) would be directed to the plant and facilities, from which it would be distributed for use to various auxiliary systems (Appendix A, item 3.2.3). The consumptive uses of water within these systems are estimated to be negligible. The specific water volumes distributed to each of these individual uses have not been defined but are to be developed once the reactor design has been selected. Estimated effluent from the miscellaneous raw water users, miscellaneous demineralized water users, and fire protection system are distributed to the holding pond at an average flow rate of 445 gpm and maximum flow rate of 4,200 gpm (Appendix A, item 3.2.4). The effluent from the liquid radioactive waste treatment system could be discharged directly to the Reservoir through the proposed discharge at CRM 15.5, at a maximum flow rate of 900 gpm (Appendix A, item 10.2.1).

Water for potable and sanitary purposes during operation is estimated to have a normal demand of 50 gpm and a maximum demand of 100 gpm (Appendix A, items 5.1.1, 5.1.2). Potable water would be provided from the City of Oak Ridge for restrooms, emergency safety showers, and as required for drinking water in both Areas 1 and 2. Because the use of City of Oak Ridge water during operation is less than during construction, impacts of that use would be bounding for operation. No onsite or offsite groundwater would be used during operation and no permanent dewatering system is planned.

2.5.8 Waste Management

2.5.8.1 Radioactive Waste Management

Radioisotopes are produced during the normal operation of nuclear reactors through the processes of fission and activation. Fission products may enter the reactor coolant by diffusing from the fuel and then passing through the fuel cladding via leaks or by diffusion. The primary coolant may contain dissolved or suspended corrosion products and nonradioactive materials leached from plant components. These products and materials can be activated by the neutrons in the reactor core as the water passes through the core. These radioisotopes leave the reactor coolant via plant systems designed to remove impurities, via small leaks that occur in the reactor coolant system and auxiliary systems, or via breaching of systems for maintenance. Therefore, each plant generates some quantity of radioactive waste that can be liquid, solid, or gaseous. This PEIS uses a PPE (see Table 24 and Appendix A) to provide an upper bound on liquid effluents, gaseous radioactive effluents, and solid radioactive waste releases. Because a preferred reactor design has not been selected for the project, bounding values (Appendix A) have been developed for the projected quantities of radioactive wastes to be generated, processed, and then stored or shipped as waste, whether in solid, liquid, or gas form. Following selection of the reactor technology, if radioactive waste parameters that are not bounded by the PPE are identified, future NEPA analysis would be required. Radioactive waste management systems would be designed and maintained to meet the requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I and associated NRC guidance. However, TVA has not identified specific radioactive waste-management systems for the various reactor technologies that may be deployed on the CRN Site. As more details become available on forecasted radioactive waste generation, TVA would supplement this PEIS appropriately with additional analysis of any potential environmental effects.

For context purposes, note that SMRs are currently anticipated to generate comparable amounts, and the same types, of spent fuel and wastes on a per megawatt basis as the currently operating 1,000 MWe TVA nuclear fleet. Alternatively, advanced non-LWRs consist of many technologies with different existing and proposed nuclear fuel types that in many cases are yet untested and unproven in commercial settings; most proposed technologies have not been through the full testing and licensing processes for approval by the NRC or other regulators to allow for a complete understanding of their operational impacts.

At this time, TVA cannot provide an analysis of the anticipated environmental effects from these potential radioactive waste streams. As TVA better refines its proposal for this location, and as additional analysis and understanding is developed for these potential radioactive waste streams, TVA would supplement this NEPA analysis as appropriate.

2.5.8.1.1 Liquid Radioactive Waste

All liquid radioactive waste systems would be designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including anticipated operational occurrences. Sources of liquid radioactive waste include leakage from systems, wastes generated by processing systems, and maintenance activities.

NRC's regulations require proper accounting of all discharges of radioactive materials from commercial nuclear power plants. Liquid radioactive wastes present the potential of groundwater contamination. In all the cases of groundwater contamination evaluated by the NRC to date in the US, none have exceeded any of the NRC's dose limits or any of the licensee's Technical Specification Limits. Although no limits have been exceeded, some of the events evaluated by the NRC have exceeded the reporting thresholds, which require licensees to notify local, state, and/or federal authorities through an approved reporting system. Licensees report radioactive discharges and the results of all groundwater monitoring efforts in annual reports to the NRC.

The NRC licensing process for nuclear power plants includes a thorough review of all the plant's radioactive, gaseous, liquid, and solid waste systems, components, and programs to ensure that radioactive material is safely controlled in accordance with NRC regulations. The licensing process evaluates the plant's ability to safely handle, store, monitor, and discharge radioactive effluents in accordance with NRC requirements.

As with TVA’s current operating fleet of nuclear plants, any discharges of liquid waste from a point source would be to the Reservoir, after appropriate measurements and subject to monitoring and controls, to ensure any discharges would meet authorized requirements. Liquid waste processing systems would be designed to maintain the radiation exposures of plant personnel as low as reasonably achievable (ALARA). Appendix A, item 10.3.1 in the ESPA PPE provides the total projected bounding annual release activity in liquid effluents from the CRN Site as 887 curies per year (Ci/yr). Table 3.5-2 from the ESPA ER provides the total projected bounding annual release activity in liquid effluents from a single unit as 221 Ci/yr.

2.5.8.1.2 Gaseous Radioactive Waste

Typical gaseous radioactive waste release pathways include vents from collection tanks and processing equipment and non-condensable gases in steam systems. Regulated gaseous wastes would be collected and processed to decrease the radioactivity content to the point that they can be released to the environment through a controlled and monitored release point (plant vent or plant stack). Gaseous radioactive waste discharges would be controlled consistent with the requirements of 10 CFR 20 and the ALARA principles of 10 CFR Part 50, Appendix I, as well as applicable National Emission Standards for radioactive Hazardous Air Pollutants and all applicable Federal and state permit requirements. Gaseous radioactive waste system equipment would be designed to ensure occupational exposures to plant personnel are ALARA. Appendix A, item 9.5.1 in the ESPA PPE provides the total projected bounding release activity in gaseous waste from the CRN Site as 7,130 Ci/yr. Table 3.5-4 from the ESPA ER provides the total projected bounding annual release activity in gaseous waste from a single SMR unit as 1,550 Ci/yr.

2.5.8.1.3 Solid Radioactive Waste

The solid radioactive waste management system would be designed to collect, monitor, segregate, process, and prepare solid radioactive wastes prior to and for their shipment or onsite storage. The system design would ensure that any radioactive wastes are handled, processed, and stored in a manner that minimizes exposure to plant personnel and the public in accordance with 10 CFR 20 and 10 CFR Part 50, Appendix I.

Wastes would be packaged to meet DOT (49 CFR 173 and 178) and NRC (10 CFR 71) regulations for transportation of radioactive material. Radioactive waste would be transported to either a licensed waste processing facility or a licensed low-level radioactive waste disposal facility. As noted in the ESPA PPE (Appendix A, item 11.2.1), the projected bounding total annual activity of solid radioactive waste from the CRN Site was projected to be 57,200 Ci/yr, and, as noted in Appendix A item 11.2.3, the projected bounding generated volume of solid radioactive waste from the CRN Site would be no more than 5,000 cubic feet per year.

2.5.8.2 Non-Radioactive Waste Management

Typical non-radioactive waste streams include cooling water that may contain water treatment chemicals or biocides, water-treatment wastes, waste from floor and equipment drains, stormwater runoff, water pumped from excavations during construction, laboratory waste, trash, hazardous waste, effluents from the sanitary sewer system, and miscellaneous gaseous, liquid, and solid effluents. All waste streams would be managed in accordance with applicable permit and regulatory requirements.

2.5.8.2.1 Effluents Containing Chemicals or Biocides

Water used in various reactor operational systems requires treatment using chemicals and/or biocides to avoid scaling or fouling. The rates of inflow into and blowdown out of the water systems are to be managed, and effluents from the systems would be processed to minimize the concentrations of the chemicals and biocides contained in facility discharges. However, facility discharges may contain low-level concentrations of chemicals and/or biocides. The chemical concentrations in effluent streams would be controlled through engineering and operational/administrative controls to meet the requirements of a TDEC-approved Biocide/Corrosion Treatment Plan, which would be part of the site’s NPDES permit, as well as requirements and limitations set by relevant federal, regional, or local regulatory agencies at the time of construction and operation. The specific chemicals and biocides to be used depend upon the characteristics of the water to be treated and the design requirements of the reactor systems. The anticipated constituents and their concentrations in the facility’s non-radioactive liquid waste discharges are provided in Appendix A, item 3.3.3.

2.5.8.2.2 Sanitary System Effluents

The projected effluent flow from the facility’s potable/sanitary water system to the City of Oak Ridge sanitary treatment system is included in Appendix A, item 5.1.1, and is estimated to average 50 gpm. This equates to an average daily flow of 72,000 gallons per day (gpd). The estimated maximum flow rate, included in Appendix A, item 5.1.2, is 100 gpm, or a maximum daily flow of 144,000 gpd.

2.5.8.2.3 Gaseous Effluents

Nuclear reactors emit gaseous and particulate emissions to the air. For reactor technologies using cooling towers, the cooling towers are expected to be the primary source of particulate emissions. The primary sources of emissions from auxiliary systems are expected to be auxiliary boilers, standby diesel generators, and emergency standby gas turbine generators. These effluents commonly include particulates, sulfur oxides, carbon monoxide, hydrocarbons, and nitrogen oxides. Estimated emissions are provided in Appendix A, items 13.1, 13.2, 14.1, 14.2, and 14.3. TVA would consult with TDEC on air permit requirements following technology selection and would obtain operational air permits as required.

2.5.8.2.4 Liquid Effluents

Nonradioactive wastewater discharges to surface water from construction include water pumped from excavations and stormwater. Nonradioactive wastewater discharges to surface water from reactor units during operation include cooling tower blowdown; wastewater from the demineralized water system; and wastewater from floor drains, sinks, laboratories, and stormwater runoff. Additional aqueous waste streams may include raw cooling water, air conditioning condensate, steam generator blowdown, and high-pressure fire protection water. Non-radioactive liquid effluents would be discharged to the Reservoir, consistent with applicable regulatory and permit requirements.

2.5.8.2.5 Solid Waste

Operation of nuclear reactors result in the generation of hazardous and nonhazardous nonradioactive solid waste. Nonradioactive solid wastes include typical industrial wastes such as metal, wood, and paper, as well as process wastes including hazardous and universal wastes. Solid waste management practices and procedures would comply with applicable federal, state, and local requirements and standards for handling, transporting, and disposing of solid waste, as well as multiple internal TVA practices and procedures.

2.6 Programmatic Bounding Analysis

In order to programmatically assess potential effects associated with the development of a Nuclear Technology Park at the CRN Site, attributes of reactor technologies, facility siting requirements, construction characteristics, and operational features were compiled and summarized as bounding attributes and characteristics to support the analysis of potential environmental impacts. The PPE values described in the ESPA ER and contained in Appendix A of this PEIS summarize the bounding attributes of the SMR technologies included in the ESPA.

In conjunction with this PEIS, TVA requested further input from vendors to provide information that describes their technology (both SMR and advanced non-LWR) and associated parameter values for comparison against the ESPA PPE. Requested information included reactor type, coolant, moderator, cooling system, flow conditions, power output, electric conversion system, heat sink, and fuel type. TVA also requested physical plant structure parameters including structure heights, required excavation/foundation embedment, disturbance acreage, and water use requirements. TVA performed a confirmatory analysis utilizing the values provided by the vendors (SMR and advanced non-LWRs) to confirm that the contemplated reactor designs fit within the bounds of the ESPA PPE, as appropriate.

Selected values of the PPE in Appendix A are summarized in Table 2-4. The PPE defines a set of plant design parameter values that TVA expects would bound the characteristics of potential reactors that could be constructed at the CRN Site. The values in the PPE are based on a composite of advanced nuclear reactor owner-engineered data for all the technologies listed in Table 2-1 and Table 2-2. Similarly, the values in Table 2-5 represent site development attributes and bounding values associated with the development of the CRN Site. The values in the PPE bound the analysis in the PEIS for both SMR and advanced non-LWR technologies. TVA would supplement the PEIS if and where any reactor technology is selected; the use of the PPE approach should limit the quantity of topics required to be addressed in future reviews, and the level of detail of review necessary for each topic. Table 2-4 is a summarized version of the PPE table within Appendix A intended to provide a general representation of these contemplated design parameters.

Table 2-4. Representative PPE Bounding Parameters for SMRs and Advanced Non-LWRs

PPE Parameters	Value
Megawatts electrical (MWe) generated by the CRN Site	800 MWe
Megawatts thermal (MWt) generated by the CRN Site	2,420 MWt
Normal plant heat sink	Clinch River arm of the Watts Bar Reservoir / Atmosphere
Waste heat rejected to the CRN Site	5,593 MBtu/hr
Cooling tower blowdown flow to the reservoir in gallons per minute (gpm)	12,800 gpm
Cooling tower evaporation rate for CRN Site in gpm	12,800 gpm
Raw water consumption for the CRN Site in gpm	12,800 gpm
Discharge flow rate of potentially radioactive effluent streams in gpm	900 gpm
Volume of solid radioactive waste generated in cubic feet per year (ft^3/yr)	5,000 ft^3/year
Acreage to support plant operation	153 acres
Height of power block structure from plant grade	160 feet
Depth of power block structure from plant grade	138 feet
Expected sound produced by cooling towers in A-weighted decibels (dBA)	< 70 dbA measured at 1,000 feet from noise source
Expected sound level due to construction activities in dBA	101 dBA measured at 50 feet
Estimated number of permanent plant workers to support operation	500 workers
Estimated number of onsite workers during construction	2,200 workers[1]
Estimated number of workers to support refueling or major maintenance activities	1,000 workers

[1]However, the maximum number of construction personnel onsite during a 24-hour period is estimated to be 3,300, due to the potential use of multiple shifts.

Table 2-5. CRN Site Characteristics and Bounding Values of Site Development Attributes

CRN Site Feature/Attribute	Quantitative Value (area, length, etc.) and Assumptions
CRN SITE CHARACTERISTICS	
Clinch River Property (including the Grassy Creek Habitat Protection Area [HPA])	• 1,200.8 acres • Includes land adjacent to the Clinch River arm of the Watts Bar Reservoir, located west of the Oak Ridge Reservation, within the City of Oak Ridge, Tennessee. The land is owned by the U.S. and managed by TVA as the agent of the federal government. The Clinch River Property includes all or part of the Watts Bar Reservoir Land Management Plan parcels 137a, 142, 143, 144, 145, 146, 147, and 148 (Figure 1-2).
CRN Site	• 935 acres • Includes that portion of the Clinch River Property that is proposed to be used as the location of the Nuclear Technology Park. The CRN Site is 935 acres, and includes the Watts Bar Reservoir Land Management Plan parcels 137a, 142, 143, 144, 145, and 148. Parcel 146, the Grassy Creek HPA is excluded from the CRN Site (Figure 1-2).
CRN Project Area	• 868 Acres • Includes that portion of the CRN Site where impacts are evaluated and associated offsite areas: the Barge and Traffic Area (BTA), the offsite 161-kilovolt (kV) transmission line corridor, and the Tennessee Highway 95 (TN 95) Access (Figure 1-2).
Clinch River Mile (CRM) Markers	• Intake: approximately CRM 17.9 • Outfall: approximately CRM 15.45 • Melton Hill Dam: CRM 23.1
Low Population Zone (LPZ)	• The LPZ is defined as a circular area with a radius of 1 mile (1,609 meters) from the site centerpoint.
Exclusion Area Boundary (EAB)	• The EAB is defined as the total 1,200 acres that makes up the Clinch River Property. This encompasses the analytical EAB of an 1,100-foot distance from the effluent release boundary.
Emergency Planning Zone (EPZ)	• TVA developed two “major features” Emergency Plans as part of the ESPA: one with a two-mile plume exposure pathway EPZ (with an onsite and offsite component), and one with a site boundary plume exposure pathway EPZ (with an onsite plan and reference to an offsite “all-hazards” approach to emergency planning).
Water Depth at Site	• At approximately between CRM 16 and CRM 18 the mean thalweg depth is 22±0.5 feet.
Land Elevation of the Site	• The site elevations range from approximately 750 feet above mean sea level (AMSL) to approximately 940 feet AMSL.

CRN Site Feature/Attribute	Quantitative Value (area, length, etc.) and Assumptions
SITE DEVELOPMENT ATTRIBUTES	
Primary Use Areas	
Area 1	• Size: approximately 341 acres • Use: Permanent use area, assume total site disturbance (including grading), all vegetation removed
Area 2	• Size: approximately 88 acres • Use: Permanent use area, assume total site disturbance, all vegetation removed
Laydown Areas	• Size: approximately 129 acres (15 acres offsite, 114 acres onsite) • Use: Temporary use area, assume full disturbance, restoration with non-invasive vegetation following construction
Site Roadways	
CRN Site Access Road from Bear Creek Road – Primary Access	• Length: 1.2 miles (based on existing alignment) • Width of disturbance (includes grading/utilities, etc.): 100 feet • Roadway surface: asphalt • Width: 50 feet

TN 95 Access (via Jones Island Road) – Secondary Access	• Length outside CRN Site: 2.3 miles (based on existing configuration)
	• Length of intersection improvement at TN 95: approximately 0.3 mile (based on existing configuration)
	• Maximum width of disturbance (includes grading/utilities, etc.): 100 feet
	• Road surface: asphalt
	• Maximum width: 50 feet
	• Reservoir Shoreline Disturbance:
	  o Location of reach for bank stabilization: CRM 20.75 to CRM 19.5
	  o Length of disturbance along shoreline: up to 5,700 feet
	  o Width of instream disturbance area: up to 10 feet

River Road – Extending from CRN Site Entrance Road along Clinch River to the TN 95 Access at Jones Island Road	• Length: 3.0 miles (based on existing configuration) • Width of disturbance (includes grading/utilities, etc.): 100 feet • Road surface: asphalt • Width: 50 feet • Reservoir Shoreline Disturbance: o Location of reach for bank stabilization: CRM 18.9 to CRM 16.2

CRN Site Feature/Attribute	Quantitative Value (area, length, etc.) and Assumptions
	o Length of disturbance along shoreline: up to 3,350 feet o Width of instream disturbance area: up to 10 feet
Roads to intake and discharge locations	• Approximate length: intake road – up to 2,000 feet, discharge road up to 1,000 feet • Width of disturbance – 100 feet • Road surface – asphalt • Roadway width – 50 feet
Interior Haul Roads	• Various lengths located within disturbed areas (onsite laydown area, Area 1, and Area 2) • Width of disturbance – up to 100 feet
Support Facilities	
Intake Structure	• Located at approximately CRM 17.9 • Localized dredging would be used to support installation (200 by 50 feet) • Area of instream work from bank: up to 0.23 acres
Discharge Structure	• Located at approximately CRM 15.45 • Localized dredging would be used to support installation (200 by 50 feet) • Length of disturbance along shoreline of Watts Bar Reservoir: up to 600 feet
Offsite Barge Unloading Facility (DOE property)	• Size: landside – 1.0 acre • Use: Permanent use area, assume vegetation clearing, no grading needed • Length of disturbance along bank/shoreline in reservoir: none • Access road to landing area: o Length: 0.12 mile o Width of disturbance: 100 feet o Roadway width: 50 feet o Road surface: gravel
Supplemental Onsite Barge Landing Area	• Located at approximately CRM 15.45 • Size: landside – 1.0 acre • Use: Permanent use area, assume total site disturbance • Length of disturbance along bank/shoreline in reservoir – up to 200 feet • Localized dredging to support installation (200 by 50 feet) • Area of instream work from bank – up to 0.23 acres • Access road to landing area:

CRN Site Feature/Attribute	Quantitative Value (area, length, etc.) and Assumptions
	○ Length – 0.5 miles ○ Width of disturbance – 100 feet ○ Roadway width – 50 feet ○ Road surface – gravel
Transmission	
Connection from Area 1 switchyard to Area 2 (*Alternatives B and D*)	• Additional 120 feet
161-kV connection from the existing 161-kV line along Bear Creek Road southeast to 500-kV line near northern CRN Site boundary and Area 2 (*Alternatives B, C, and D*)	• 120-foot ROW to be developed within a 280-foot corridor
Optional 161-kV relocated transmission line along edge of Area 1 (*Alternatives B and D*)	• 120-foot ROW
Specialized Activities	
Blasting	• Expected to be localized. More detailed design and geotechnical investigation needed to determine extent and location.

2.7 Comparison of Alternatives

The environmental impacts of each of the alternatives under consideration are summarized in Table 2-6. These summaries are derived from the information and analyses provided in the Affected Environment and Environmental Consequences sections in Chapter 3. Tables that present summary impacts for each alternative are also included in the resource analyses contained in Chapter 3.

Table 2-6. Summary and Comparison of Alternatives by Resource Area

Resource Area	Alternative A—No Action	Alternative B1—Nuclear Technology Park at Area 1 with SMRs	Alternative B2—Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs	Alternative C—Nuclear Technology Park at Area 2 with Advanced non-LWRs	Alternative D—Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs
Geology and Soils	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Water Resources	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Floodplains and Flood Risk	No impacts	*Construction:* **Minor** *Operation:* **None**	*Construction:* **Minor** *Operation:* **None**	*Construction:* **Minor** *Operation:* **None**	*Construction:* **Minor** *Operation:* **None**
Wetlands	No impacts	*Construction:* **Minor**	*Construction:* **Minor**	*Construction:* **Minor**	*Construction:* **Minor**
Aquatic Ecology	No impacts	*Construction:* **Minor to Moderate** *Operation***: Minor**	*Construction:* **Minor to Moderate** *Operation***: Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation***: Minor**
Terrestrial Ecology	No impacts	*Construction:* **Moderate** *Operation:* **Minor**	*Construction:* **Moderate** *Operation:* **Minor**	*Construction:* **Moderate** *Operation:* **Minor**	*Construction:* **Moderate** *Operation:* **Minor**
Threatened and Endangered Species	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Managed and Natural Areas	No impacts	*Construction:* **Minor to Moderate** *Operation***: Minor**	*Construction:* **Minor to Moderate** *Operation***: Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Recreation	No impacts	*Construction:* **Minor** *Operation***: Minor**	*Construction:* **Minor** *Operation***: Minor**	*Construction:* **Minor** *Operation***: Minor**	*Construction:* **Minor** *Operation***: Minor**

Resource Area	Alternative A—No Action	Alternative B1—Nuclear Technology Park at Area 1 with SMRs	Alternative B2—Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs	Alternative C—Nuclear Technology Park at Area 2 with Advanced non-LWRs	Alternative D—Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs
Meteorology, Air Quality, and Climate Change	No impacts	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**
Transportation	No impacts	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**	*Construction:* **Minor to Moderate** *Operation:* **Minor**
Visual Resources	No impacts	*Construction and Operation:* **Minor to Moderate**	*Construction and Operation:* **Minor to Moderate**	*Construction and Operation:* **Minor to Moderate**	*Construction and Operation:* **Minor to Moderate**
Noise	No impacts	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**
Socioeconomics					
Land Use	No impacts	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**
Demographics	No impacts	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**
Employment and Income	No impacts	*Construction and Operation*: **Beneficial, Minor to Moderate**	*Construction and Operation*: **Beneficial, Minor to Moderate**	*Construction and Operation*: **Beneficial, Minor to Moderate**	*Construction and Operation*: **Beneficial, Minor to Moderate**
Community Characteristics	No impacts	*Construction:* **Minor** *Operation*: **Minor to Moderate**	*Construction:* **Minor** *Operation*: **Minor to Moderate**	*Construction:* **Minor** *Operation*: **Minor to Moderate**	*Construction:* **Minor** *Operation*: **Minor to Moderate**
Environmental Justice	No impacts	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**	*Construction and Operation*: **Minor**
Archaeological Resources and Historic Structures	No impacts	*Construction:* **Moderate**	*Construction:* **Moderate**	*Construction:* **Moderate**	*Construction:* **Moderate**

Resource Area	Alternative A—No Action	Alternative B1—Nuclear Technology Park at Area 1 with SMRs	Alternative B2—Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs	Alternative C—Nuclear Technology Park at Area 2 with Advanced non-LWRs	Alternative D—Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs
Solid and Hazardous Waste	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Radiological Effects of Normal Operations	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Uranium Fuel Effects	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Nuclear Plant Safety and Security	No impacts	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**	*Construction and Operation:* **Minor**
Decommissioning	No impacts	**Minor**	**Minor**	**Minor**	**Minor**

2.8 TVA's Preferred Alternative

TVA's preferred alternative is Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs. Alternative D provides the greatest flexibility to meet the purpose and need of the project to support TVA's goal of demonstrating the feasibility of deploying advanced nuclear reactor technologies at the CRN Site capable of incrementally supplying clean, secure, and reliable power that is less vulnerable to disruption. Alternative D also supports the recommendations outlined in TVA's 2019 IRP and TVA's 2021 Strategic Intent and Guiding Principles.

Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs would also meet the purpose and need of the project and would have less impacts than Alternatives C and D as Area 2 would not be disturbed. However, as the project would be limited to only the use of Area 1, there would be less flexibility for project activities and less opportunity for exploring a variety of technologies which could assist in meeting the project goals.

Alternative C – Nuclear Technology Park at Area 2 with advanced non-LWRs would also meet the purpose and need of the project and would have somewhat less impacts than Alternative D, as the majority of Area 1 would not be disturbed. However, as the project would be limited to only the use of Area 2, and the advanced non-LWR technologies are less mature and further from commercialization than SMRs, there is limited flexibility to meet the purpose and need of the project.

2.9 Summary of Mitigation Measures and Best Management Practices

Best Management Practices (BMPs), mitigation measures, and commitments identified in Chapter 3 to avoid, minimize, or reduce adverse impacts to the environment are summarized below. Additional project specific BMPs may be applied as appropriate on a site-specific or technology-specific basis to enable efficient maintenance of construction projects and further reduce potential impacts on environmental resources.

2.9.1 Best Management Practices

- TVA would ensure that all safety related structures are properly designed to meet hazards and risks associated with seismic conditions for the CRN Site.
- BMPs would be implemented including those described in *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority* (TVA 2017), the Tennessee Erosion and Sediment Control Handbook (TDEC 2012), the project-specific stormwater pollution prevention plan (SWPPP), and site-specific Integrated Pollution Prevention Plan (IPPP).
- Discharge of chemicals to surface water would be specifically regulated by the conditions of the applicable NPDES permit issued and administered by TDEC.
- Permanent structures and facilities that are not water-use or water-dependent facilities would be located outside of the 100-year floodplain. If they cannot be located outside the 100-year floodplain, additional floodplain review would be required.
- Intake and outfall structures would be constructed using the least amount of fill practicable.
- Flood-damageable material and equipment would be stored outside the floodplain and/or above the 100-year flood elevation as a standard practice.

- Land clearing operations would be conducted in accordance with TVA BMPs (TVA 2017) and in a manner that would prevent any unnecessary damage to the remaining natural vegetation, would protect wetlands and streams, and would prevent soil erosion.
- Nonhazardous and hazardous solid waste would be managed by TVA-approved solid waste disposal vendors and disposed of at state-approved, licensed facilities in accordance with Tennessee solid waste regulations. The disposal vendor applicant would be required to confirm that they would comply with all applicable federal, state, and local requirements and standards for handling, transporting, and disposing of nonhazardous or hazardous solid waste, as applicable. Additionally, should TVA choose to construct and operate an onsite landfill for disposal of construction, site clearing, and grading debris, it would be designed in accordance with all applicable state, local, and federal regulations.
- Waste-minimization procedures would be implemented, and standard processes related to the handling of nonradioactive solid waste utilized at other TVA plants would be employed.
- Industry standard and regulatory compliant hazardous chemical control and radiological control measures would be applied during testing, handling, and storage (accumulation area) of hazardous and mixed wastes. Further, TVA Nuclear sites have instituted procedures that establish the requirements to control chemicals, expendable products, and hazardous materials used at TVA Nuclear Power Group (NPG) power plants. These procedures assign responsibilities for control of chemicals purchased, brought into, used, and disposed of from NPG Licensed Facilities.
- Industry BMPs included in TVA's Waste Minimization Plan for nuclear power facilities include inventory identification and control that utilizes a tracking system to manage waste generation data and waste minimization opportunities; work planning to reduce mixed waste generation; mixed waste reduction, recycling, and reuse methods that maximize opportunities for reclamation and reuse of waste materials are used whenever feasible; and training and education of employees on the principles and benefits of the waste minimization.
- Stormwater detention would be incorporated into detailed site design to ensure that runoff rates and discharge requirements are in compliance with all appropriate state and local requirements, including NPDES permit limits.
- TVA would implement detailed and robust security measures at the CRN Site in accordance with NRC regulations, similar to those implemented at TVA's other nuclear facilities, to help prevent physical intrusion by hostile forces seeking to gain access to nuclear reactors or materials. Furthermore, TVA would ensure that each of the designs for the reactor technologies being considered would follow the applicable requirements of 10 CFR 50.150 for Aircraft Impact Assessment.
- TVA would conduct surveys and additional NEPA reviews as necessary and appropriate based on future planning needs.
- TVA Nuclear sites have instituted procedures that establish the requirements to control chemicals, expendable products and hazardous materials used at TVA NPG power plants. These procedures assign responsibilities for control of chemicals purchased, brought into, used and disposed of from NPG Licensed Facilities. The

control of chemicals, expendable products, and hazardous materials is essential to: protect the health and welfare of employees; protect nuclear fuel reliability; protect plant systems from the intrusion of harmful chemicals or hazardous materials; and protect the environment.

2.9.2 Proposed Mitigation Measures

- Conduct additional site-specific investigations to evaluate the presence of karst features in areas proposed for structure development. Detailed designs for safety related features and other structures would include all appropriate karst related mitigative measures and a grouting plan would be implemented as applicable.
- Unavoidable alterations and impacts to jurisdictional waters would be minimized in conjunction with design and mitigated as appropriate in accordance with the CWA Section 10/404 permit issued by USACE and in accordance with the CWA Section 401 and the ARAP issued by TDEC.
- Disturbance of contaminated sediments within the Clinch River arm of the Watts Bar Reservoir would be subject to the terms of the Watts Bar Interagency Agreement that includes the USACE, DOE, TDEC, and the EPA, to coordinate review of permitting and authorization.
- To minimize the noise effects of blasting, TVA would require the construction contractor to develop a blasting plan to include notifications to local officials, emergency departments, and neighboring businesses and residents.
- To minimize the effect of construction dewatering on groundwater levels in the areas surrounding any potential excavation, and to reduce the need for dewatering, fractures and cavities transmitting large amounts of water would be appropriately blocked or grouted. As appropriate, TVA would assess the effects of dewatering by monitoring groundwater levels surrounding the excavation and water levels in potentially affected surface waterbodies.
- A groundwater monitoring program would be defined that would include water level, radiological, and chemical monitoring as well as groundwater modelling to assess future changes from baseline conditions.
- New construction to refurbish the existing rail line would be limited to the north side of the rail spur, and thereby avoid the 100- and 500-year floodplains.
- TVA would minimize permanent and temporary impact to wetlands and other sensitive resources during the design phase. If impacts to wetlands are not avoidable, CWA permitting with the USACE and TDEC would be required, as appropriate. TVA would ensure applicable permitting and required mitigation is obtained such that wetland impacts would be compensated through the wetland mitigation process.
- TVA would establish a buffer around forested wetland W019, which is rated with exceptional value, such that it would not be impacted by project activities.
- The cooling water intake structure would be fully compliant with Section 316(b) of the CWA, including applicable provisions related to entrainment and impingement mortality.

- The diffuser ports that are part of the discharge system would direct effluent upwards into the water column so that no physical alteration or scouring occurs, thereby minimizing impacts to benthic habitats.
- TVA would work to minimize and avoid impacts in native cedar glade areas during design, construction, and operation.
- If the timing of proposed actions within 660 feet of active osprey nests cannot be modified to avoid nesting seasons, then coordination with the U.S. Department of Agriculture (USDA) Wildlife Services would be required for guidance to ensure compliance under the EO 13186.
- When feasible, tree removal across the Project Area would occur in winter (October 15 - March 31) when most species of migratory birds would not be nesting and/or would be away from the region.
- Any proposed tree removal identified, once site-specific designs are completed, would be reviewed to determine if impacts to potentially suitable Indiana bat and northern long-eared bat habitat may occur. Consultation under Section 7 of the ESA would occur, if appropriate, when specific designs have been selected, scope of each project has been refined, and impacts to federally bats can be properly assessed. Where feasible, TVA would minimize impacts by removing trees in winter (October 15 – March 31) and add protective buffers around caves.
- TVA would ensure that state-listed rigid sedge and pale green orchid are not significantly impacted by designing the proposed offsite transmission line to avoid the species and their habitat to the greatest extent possible. TVA transmission engineers would consult with the TVA botanist during design to ensure the location of the habitat is considered early in the process. In conjunction with avoiding impacts to state-listed rigid sedge and pale green orchid, TVA would develop a plan to mitigate impacts associated with the loss of habitat in the Grassy Creek Habitat Protection Area (HPA).
- TVA will pursue expansion of the Grassy Creek HPA by about 14 acres to provide additional protection to the state-listed rigid sedge and pale green orchid.
- Site design would minimize and avoid impacts to streams and wetlands where feasible to minimize impacts to suitable habitat for the southeastern shrew and other riparian dependent rare species.
- Mitigation measures that may be considered for localized traffic congestion include staggering work shifts to avoid localized delays at key intersections, installation of traffic lights and stop signs, and addition of turning lanes.
- Air emission sources associated with new reactors would be managed in accordance with federal, state, and local air quality control laws and regulations. New reactors at the CRN Site would comply with all regulatory requirements of the CAA, as well as the TDEC requirements to minimize impacts on state and regional air quality. When the reactor design is selected, detailed air quality modelling would be conducted as required to demonstrate that project-related emissions would not result in exceedances of the National Ambient Air Quality Standards (NAAQS). Measures to reduce air quality impacts during onsite construction may include stabilizing construction roads and spoils piles, covering haul trucks, watering unpaved construction roads to control dust, and conducting routine inspections and maintenance on construction vehicles and equipment.

- Mechanical draft cooling towers would be equipped with efficient drift eliminators and/or other design attributes to reduce PM emissions.
- TVA would maintain the grounds of the Hensley Cemetery and would avoid the cemetery during operation and maintenance activities. The cemetery would remain accessible to those individuals that have family members buried at Hensley Cemetery
- To avoid and minimize impacts to archaeological resources, TVA has executed a Programmatic Agreement (PA) with the Tennessee State Historic Preservation Officer (SHPO) Invited concurring parties are the Eastern Band of the Cherokee Indians and the United Keetoowah Band of the Cherokee Indians in Oklahoma The PA records the terms and conditions agreed upon to resolve potential adverse effects of the undertaking and remains in effect until construction of the project is complete or the project is otherwise terminated. Per the stipulations of the PA, TVA would seek ways to avoid or minimize adverse project impacts on National Register of Historic Places (NRHP)-eligible archaeological sites, and if avoidance or sufficient minimization are not possible, TVA would mitigate the adverse effects in accordance with the stipulations of the PA. TVA would consult with the Tennessee SHPO and federally recognized tribes throughout the process.
- When designs for specific reactor and cooling technologies are developed, TVA would conduct further analysis and/or modelling to determine offsite noise impacts. If needed, TVA would implement noise abatement measures in order to comply with Oak Ridge’s residential noise level limits.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

3.1 Scope of Analysis

This chapter describes the baseline environmental conditions (affected environment) of environmental resources in the CRN Project Area and the anticipated environmental consequences (or impacts) that would occur from implementation of the alternatives identified for further study as described in Chapter 2.

3.1.1 Impact Assessment

Environmental consequences are and will continue to be assessed in multiple phases, including those associated with site preparation, construction, operation, and decommissioning activities at the CRN Site. For the purposes of this Draft PEIS the project consists of construction phase activities that include pre-construction or site preparation (grading, excavation, infrastructure development, and other actions), actual fabrication and erection of the nuclear reactor and associated facilities, other site improvements and related interfaces, and operations. Notably, the NRC differentiates between “preconstruction” and “construction” based on their particular licensing jurisdiction (10 CFR 51.4) and has clarified that construction with regard to a nuclear power plant refers to those activities having a nexus to radiological health and safety and/or common defense and security. Further, NRC has also clarified that preconstruction includes clearing and grading, excavating, erection of support buildings and transmission lines, and other associated activities. These preconstruction activities may take place before the application for an ESP, CP, or COL is submitted, but are subject to the authority of local, State, or other Federal agencies as appropriate. Because TVA is a federal agency subject to NEPA and other federal laws and regulations, both preconstruction (including site preparation) and construction activities are subject to TVA’s decision-making. The impacts from these activities are evaluated in this chapter together as part of the “construction” phase.

Impacts may be beneficial or adverse and may apply to the full range of natural, aesthetic, historic, cultural, and socioeconomic resources within the CRN Project Area and within the surrounding area. Impact severity is dependent upon their relative magnitude and intensity and resource sensitivity. In this document, four descriptors are used to characterize the level of impacts in a manner that is similar to that described by the NRC (2021) and consistent with TVA’s current practice. In order of degree of impact, the descriptors are as follows:

- No Impact (or “absent”) – Resource not present or affected by project alternatives under consideration.
- Minor (similar to NRC’s “SMALL”) – Environmental effects are not detectable or are so minor that they would not noticeably alter any important attribute of the resource.
- Moderate – Environmental effects are sufficient to alter noticeably, but not to destabilize, important attributes of the resource.
- Large – Environmental effects are clearly noticeable and are sufficient to destabilize important attributes of the resource.

This Draft PEIS provides a bounding analysis of maximum potential impacts of implementing each of the alternatives, based upon the application of the PPE values within the ESP and the attributes and bounding values associated with site development. Alternative B1 and Alternative B2 differ with respect to potential for deployment of advanced non-LWR technology in addition to SMRs, but both alternatives are still bounded by the PPE and site development attributes. As such, impacts associated with the two optional alternatives under Alternative B (B1 and B2) would not differ. Therefore, the impact analysis in this chapter describes these impacts in a singular approach as impacts associated with Alternative B.

3.1.2 Content Incorporated by Reference

The information and impact analyses presented in this chapter have largely been drawn from prior assessments in TVA's 2019 ESPA ER that have been previously validated, reviewed, and accepted. The ESPA ER and other supporting information were provided to NRC for its use in preparing the EIS for the ESP at the Clinch River Nuclear Site (NRC 2019).

As detailed in Chapter 2, the proposed action under evaluation in this PEIS is similar to the action evaluated in the 2019 CRN ESPA ER and the 2019 NRC EIS that considers the development of nuclear technologies within a Nuclear Technology Park at the CRN Site using a bounding PPE approach. As such, each of these documents shares the same general project setting, the same PPE, and many of the key environmental interfaces. However, in addition to the range in project alternatives, notable features evaluated in the analyses within this PEIS that differ from those in the ESPA ER and NRC EIS include the following:

- Adjustments to and/or expansion of the primary onsite use area to include Area 2, and an expanded laydown area
- New supplemental TN 95 access road that would carry approximately 20 percent of CRN Site traffic
- A new 161-kV transmission line extending from the CRN Site to Bear Creek Road
- Supplemental onsite barge access
- On- and offsite reservoir shoreline stabilization measures
- Additional improvements to River Road

Both TVA's 2019 CRN ESPA ER and NRC's 2019 EIS are, therefore, incorporated in this document by reference. However, where needed, new or updated information is presented and referenced to support resources analyses, as appropriate.

3.1.3 Reasonably Foreseeable Future Actions

CEQ's revised 2020 NEPA regulations (40 CFR 1508.1(g)) include the requirement that agencies simplify the definition of "effects" to focus on analysis of changes to the human environment from the proposed action or alternatives defining these effects as follows:

> "Effects or impacts means changes to the human environment from the proposed action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the proposed action or alternatives, including those effects that occur at the same time and place as the proposed action or alternatives and may include effects that are later in time or farther removed in distance from the proposed action or alternatives."

The human environment includes the natural and physical environment and the relationship of present and future generations of Americans with that environment.

In accordance with the revised 2020 CEQ regulations, the affected environment for each resource describes the environment of the area(s) to be affected by the alternatives under consideration, including the reasonably foreseeable environmental trends and planned actions in the area(s). Table 3-1 identifies reasonably foreseeable future trends and planned actions that were identified during internal and external scoping to be in proximity to the proposed action. The projects listed are clearly presented in approved planning documents, have been funded to adequately support full construction and operation, or have applied for appropriate permits for construction or operation. Past and present actions inherently have environmental impacts that are integrated into the base condition for each of the resources analyzed in this chapter.

Accordingly, the affected environment described in this Draft PEIS considers changes to the human environment from reasonably foreseeable future actions that have a close causal relationship to the alternatives. Potential effects are generally considered in this Draft PEIS if they are projected to occur at the same time and place as the proposed action and may include those that overlap in time and geography.

Table 3-1. Summary of Reasonably Foreseeable Future Trends and Planned Actions in Proximity to the CRN Site

Project Name	Description	Approximate Distance from CRN Site	Status
Roane Regional Business and Technology Park	Business and Industrial Park (655 acres) with 10 sites for development	0.5 mile east	Operational since 2001, sites available for development
West End Corridor Intersection Improvements	Intersection improvements along Oak Ridge Turnpike (TN 95/TN 58) at Renovare Boulevard, Novus Drive, Heritage Center Boulevard, and Broadberry Avenue at Gallaher Road (Lead Agency: City of Oak Ridge)	2 miles north	Estimated completion by 2030
ETTP Property Transfer / Development of Heritage Center Industrial Park	Transfer of DOE property to private companies/Community Reuse Organization of East Tennessee and development of the 1,200-acre Heritage Center. Both new and renovated industrial buildings are available for sale or lease, as well as approximately 555 acres served by a robust, redundant utility system.	2 miles north	Ongoing, sites available for development. Completion of CERCLA and other cleanup activities ongoing.
Kairos Nuclear Reactor Demonstration at ETTP	Demonstration of Kairos' Hermes low-power test reactor at the ETTP	2 miles north	Subject to ongoing due diligence evaluations
Oak Ridge General Aviation Airport	Development of a general aviation airport. The airport, with a 5,000-foot runway, would support general aviation in the Oak Ridge Corridor region, as current capacity is limited in this market and is not expected to support projected growth and future demand.	3 miles north	City Council approved a resolution that authorizes actions related to the Oak Ridge General Aviation Airport in 2020, including seeking transfer of sponsorship of the airport from Metropolitan Knoxville Airport Authority to the City of Oak Ridge and initiating transfers of grants related to the airport to the City. Estimated completion by 2025.

Project Name	Description	Approximate Distance from CRN Site	Status
Horizon Center Industrial Park	Industrial park with sites containing approximately 320 acres remaining for development and approximately 500 acres set aside for environmental preservation.	3 miles north-northeast	Operational; sites available for development
Sludge Build-Out Project at the TRU Waste Processing Center	Changes to the method of sludge processing and changes to waste shipping routes	3 miles east	Site preparation began for the Sludge Processing Mock Test Facility in January 2020, and construction is slated for completion in 2022. Oak Ridge Environmental Management anticipates approximately two years of testing to gather the data needed to determine the best designs and approaches for the Sludge Processing Facility's final design.
Uranium Processing Facility (UPF) at Y-12	Construction of a multiple facility complex for a modern UPF; would have processing capabilities for enriched uranium casting, oxide production, and salvage and accountability operations to support the Nation's nuclear weapons stockpile, defense nuclear nonproliferation, and naval reactors.	10 miles northeast	Currently under construction, estimated to complete in 2025
Mercury Cleanup Activities at Y-12	Mercury environmental remediation	10 miles northeast	Ongoing and expected to continue into at least the 2030s.
DOE Environmental Management Disposal Facility on ORR	New onsite landfill potentially to the east of existing Environmental Management Waste Management Facility	10 miles northeast	DOE working with TDEC and EPA to resolve issues prior to landfill approval. TDEC and EPA have issued comments on DOE's draft ROD, dated July 2021, which must be addressed before a revised document is submitted.

Project Name	Description	Approximate Distance from CRN Site	Status
TDOT Roadway Improvement Projects	Widen TN 1 (US 70), from TN 382 to near Raritan Road, from 2-lane to 5-lane with center turn lane.	10 miles west	Funding for ROW phase approved 2020
City of Oak Ridge Water Treatment System Upgrades	The City of Oak Ridge will design and construct a new ultrafiltration membrane drinking water treatment plant to replace the existing 80-year-old conventional treatment plant at Y-12, which is currently at capacity and beyond its useful life. New plant will be located at the existing raw water intake off Pump House Road.	10 miles northeast	Plant is estimated to be completed by mid-to-late 2022.
Cardiff Valley Road Site	Roane Specialized Services, LLC (made up of Roane Transportation and Roane Metals) approved to purchase 45-acre Cardiff Valley Road Site in Rockwood's Roane County Industrial Park. Plans include the addition of a new corporate office and warehouse facility, truck fleet parking, and storage space for their existing customers. Roane Specialized Services employs 224 individuals, growing from 205 in 2019, and is expected to grow by an additional 25 jobs over the next two years.	13 miles west	Roane County Industrial Development Board accepted formal offer in February 2021.
Simulated Nuclear and Radiological Activities Center	Oak Ridge Enhanced Technology Training Center will construct the Simulated Nuclear and Radiological Activities Facility to train personnel in the safeguarding of nuclear and radioactive material with the latest nuclear operations, safeguards, cyber and emergency response.	10 miles northeast	Construction began in 2021; expected completion in 2023.

3.2 Geology and Seismology

3.2.1 Affected Environment

3.2.1.1 Geology

3.2.1.1.1 Geographic and Project Setting

The CRN Site is located within the southwestern part of the city limits of Oak Ridge, Roane County, Tennessee. The site is bordered to the south, east, and west by the Clinch River arm of the Watts Bar Reservoir (the Reservoir) and to the north by the ORR. Topography at the CRN Site is characterized by alternating northeast to southwest trending valleys and ridges. The terrain is gently and moderately rolling to steep, with elevations ranging from approximately 745 feet AMSL along the shoreline to 940 feet AMSL at the ridge tops. The Reservoir traces a meandering south and west course around the CRN Site with incised water gaps through the major ridges of the central and southern portion of the site. Smaller ephemeral and perennial tributary streams generally flow perpendicular to and drain down from the ridges and flow parallel to the valleys. Previous construction and site grading activities in the central portion of the CRN Site excavated portions of the ridges, and some of the valleys were filled creating a generally flat to gently sloping ground surface surrounding the partially filled abandoned CRBRP excavation.

3.2.1.1.2 Geology and Physiography

The CRN Site is located within the southwestern portion of the Valley and Ridge physiographic province. The Valley and Ridge province is approximately 50 to 100 miles wide (east-west) in eastern Tennessee and is bounded to the west by the Appalachian Plateaus physiographic province and to the east by the Blue Ridge physiographic province. The Valley and Ridge physiographic province is characterized by parallel valleys and ridges, typically aligned northeast to southwest, consisting of interbedded sequences of sedimentary rock composed of weak and strong formations exposed at the surface by erosion and exhumation of strongly folded and thrust-faulted terrain. The geomorphology of the province is a direct result of differential weathering and erosion of different folded and faulted Paleozoic strata. In the Valley and Ridge province, the ridges are typically composed of more erosion resistant strata such as sandstone, siltstone, and carbonate units with higher silica content, and valleys are typically composed of more soluble carbonate units and less erosion resistant shale formations. In the area of the CRN Site, thrust faulting of the Cambrian to Ordovician aged strata has resulted in an imbricate stack of south-east dipping thrust sheets and repetitive sequences of geologic units across the landscape as shown in Figure 3-1.

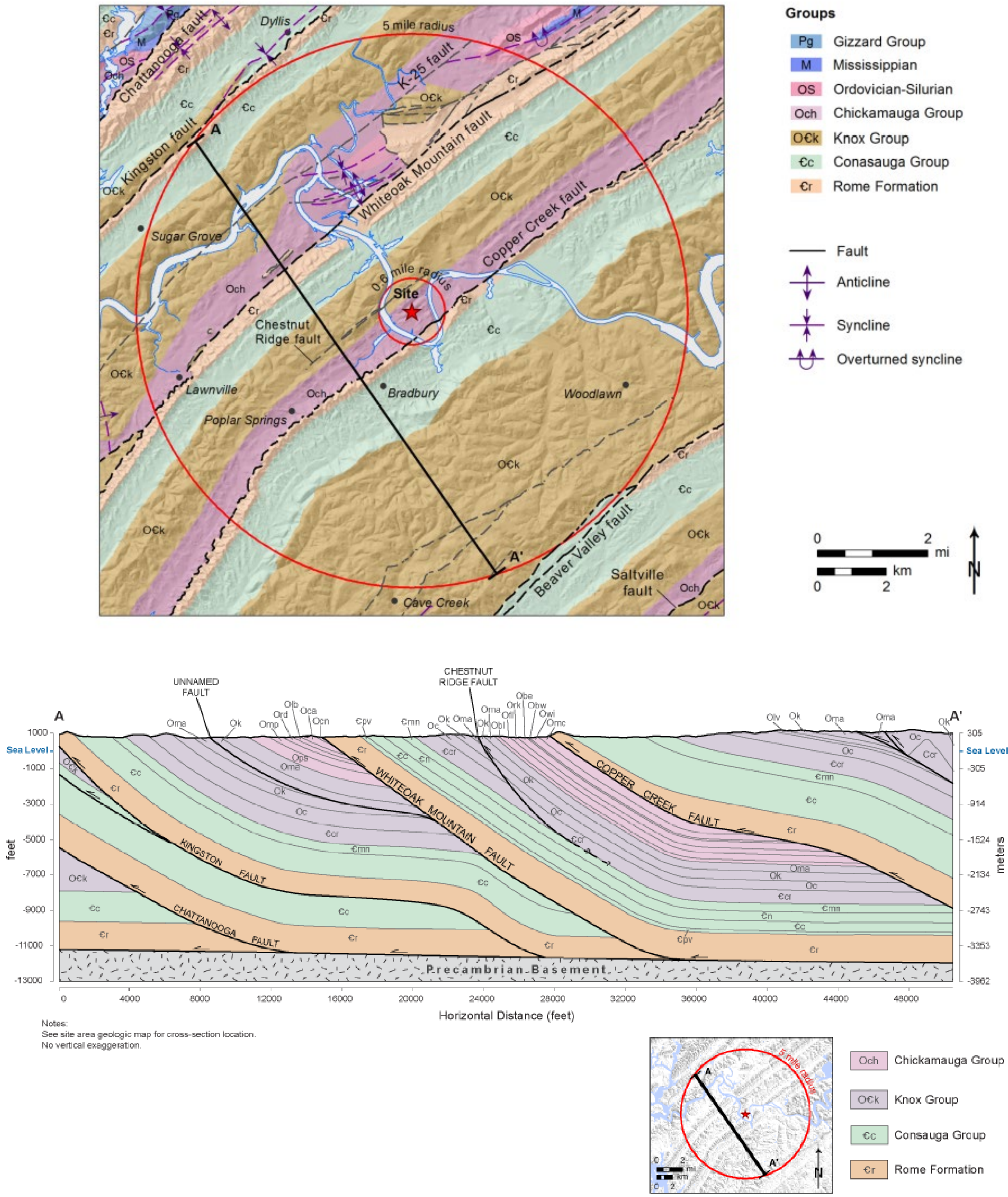


Figure 3-1. CRN Site Area Geology

The general stratigraphic sequence consists of the Rome Formation, Conasauga Group, Knox group, and Chickamauga Group geologic units (from oldest to youngest). The White Oak Mountain thrust fault, located approximately 2 miles northwest of the CRN Site, is a regional structure that displaces older Cambrian Rome Formation over younger Cambrian Knox Group and Ordovician Chickamauga Group strata. The CRN Site is on the White Oak Mountain thrust sheet. The Chestnut Ridge thrust fault, located in the northern portion of the CRN Site, is shown to be displacing geologic units within the Knox Group. The areal extent of the Chestnut Ridge fault is discontinuous but is thought to exist further northeast than its currently mapped extent and does not displace geologic units with significant stratigraphic or temporal differences. The Copper Creek thrust fault, a major structure of the Valley and Ridge province, is located along Haw/Hood ridge and crosses the southern portion of the CRN Site, displacing Cambrian aged Rome Formation (hanging wall) over the Ordovician aged Chickamauga Group units (footwall). The Clinch River has created a water gap through the erosion resistant Rome Formation that forms Haw/Hood Ridge.

Surface materials at the CRN Site consist of Quaternary aged alluvial and colluvial soils, artificial fill soils, and residual soils. The colluvial soils consist of weathered residuum transported by hillslope processes including slopewash and creep and deposited at the bottom of slopes and in hollows on the hillsides. The thickness and extent of colluvial soils varies widely, dependent on the subsurface bedrock, slope, and primary method of erosion. Bedrock units most susceptible to mechanical weathering such as the Rome Formation produce extensive colluvial deposits, while carbonate units, most susceptible to chemical weathering processes, only produce extensive colluvial deposits if the bedrock units contain significant amounts of erosion resistant chert such as some Knox Group units. Alluvial soils are deposited in hillside drainages and in the principal tributary valleys at the CRN site and along the banks of the Reservoir. Artificial fill soils are present at the CRN Site in construction and redress areas associated with the former CRBRP (Area 1). In contrast, the alluvial and colluvial deposits are most extensive in the north-eastern portion (Area 2), along Bear Creek valley and to a lesser extent in the southern portion of the CRN Site (Figure 3-2). Holocene era terraces are generally located along the Reservoir. The residual soils at the site are the result of in-situ weathering of the underlying bedrock material. The residual soils consist mostly of moderately to highly plastic clay. These surface materials vary in thickness and mantle the underlying weathered rock and bedrock, which outcrop in some portions of the site.

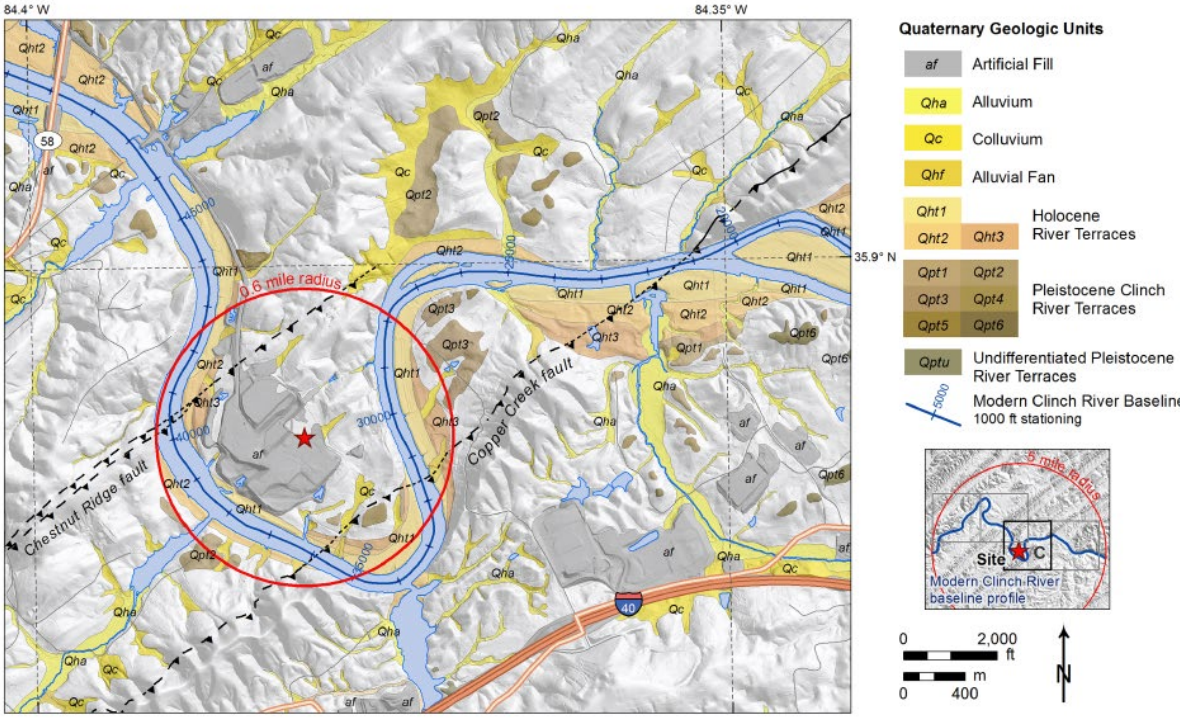


Figure 3-2. Quaternary Terrace Map Adjacent to the Clinch River Arm of the Watts Bar Reservoir Within the Clinch River Nuclear Site

The bedrock at the CRN Site consists of over 12,000 feet of bedded sedimentary rock units. These units strike approximately N 52°E, and dip consistently 32 to 35° southeast. Previous site investigations have identified stratigraphic layers (from oldest to youngest) corresponding to the Lower Cambrian Rome Formation, the Upper Cambrian through Lower Ordovician Knox Group, and the Middle Ordovician Chickamauga Group exposed at the surface or shallow subsurface within the boundaries of the CRN Site. Strata belonging to the Middle to Upper Cambrian Conasauga Group are not present at the surface within the CRN Site, occurring at estimated depths greater than 5,000 feet within the subsurface. Rocks of the Rome Formation do not outcrop at the CRN Site but were identified in two boreholes performed during previous subsurface investigations to locate and characterize the Copper Creek thrust fault in the southern portion of the site. In these boreholes the Rome Formation was encountered above and displacing the upper most Chickamauga Group unit. The contact between these units, represented by the weathered fault gouge between the calcareous siltstone of the Rome Formation and underlying limestones of the Chickamauga Group marks the location of the Copper Creek fault at the CRN Site. The geologic map and cross section shown on Figure 3-3 and Figure 3-4 illustrate the succession of stratigraphic units and bedrock structure encountered at the CRN Site.

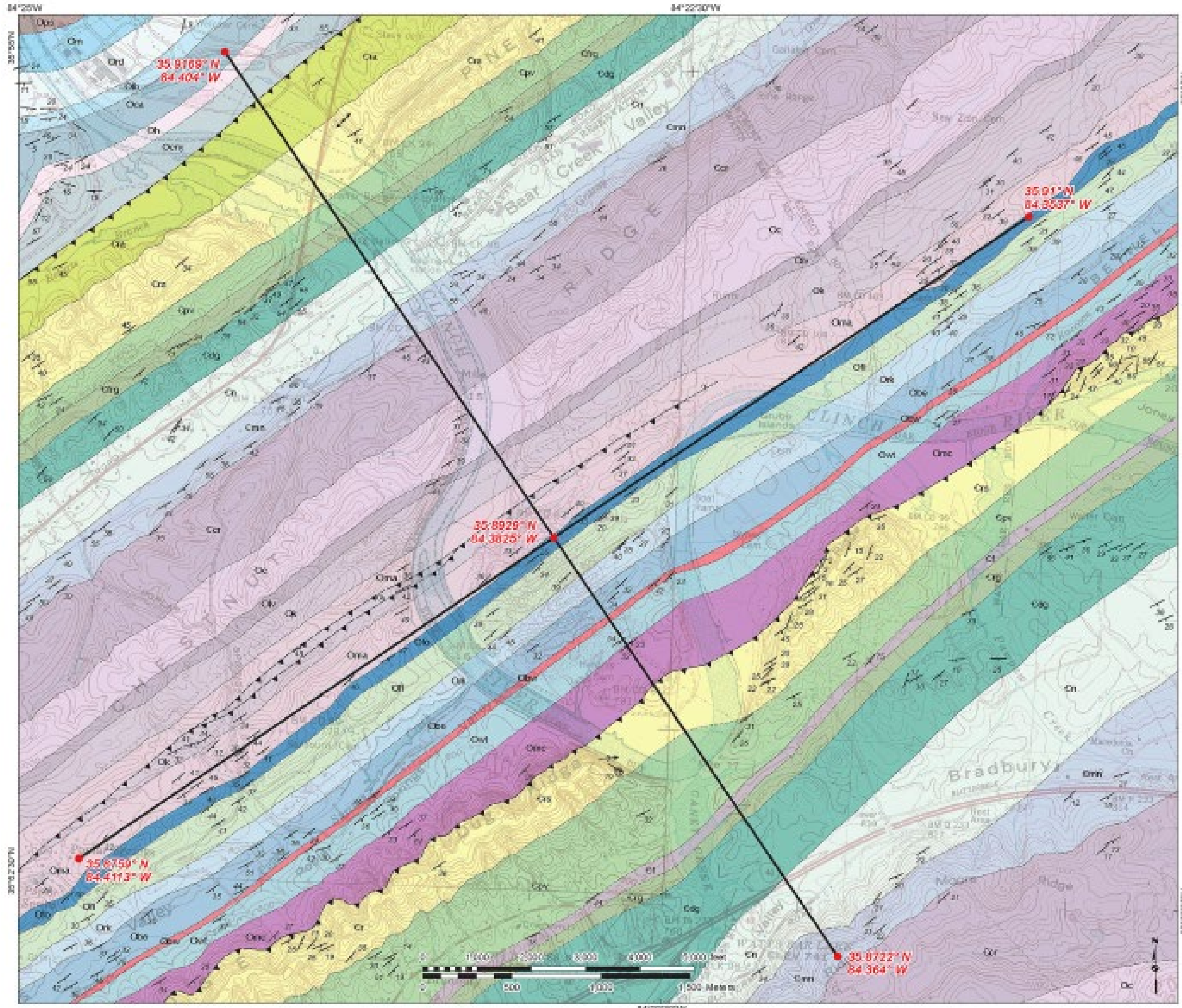
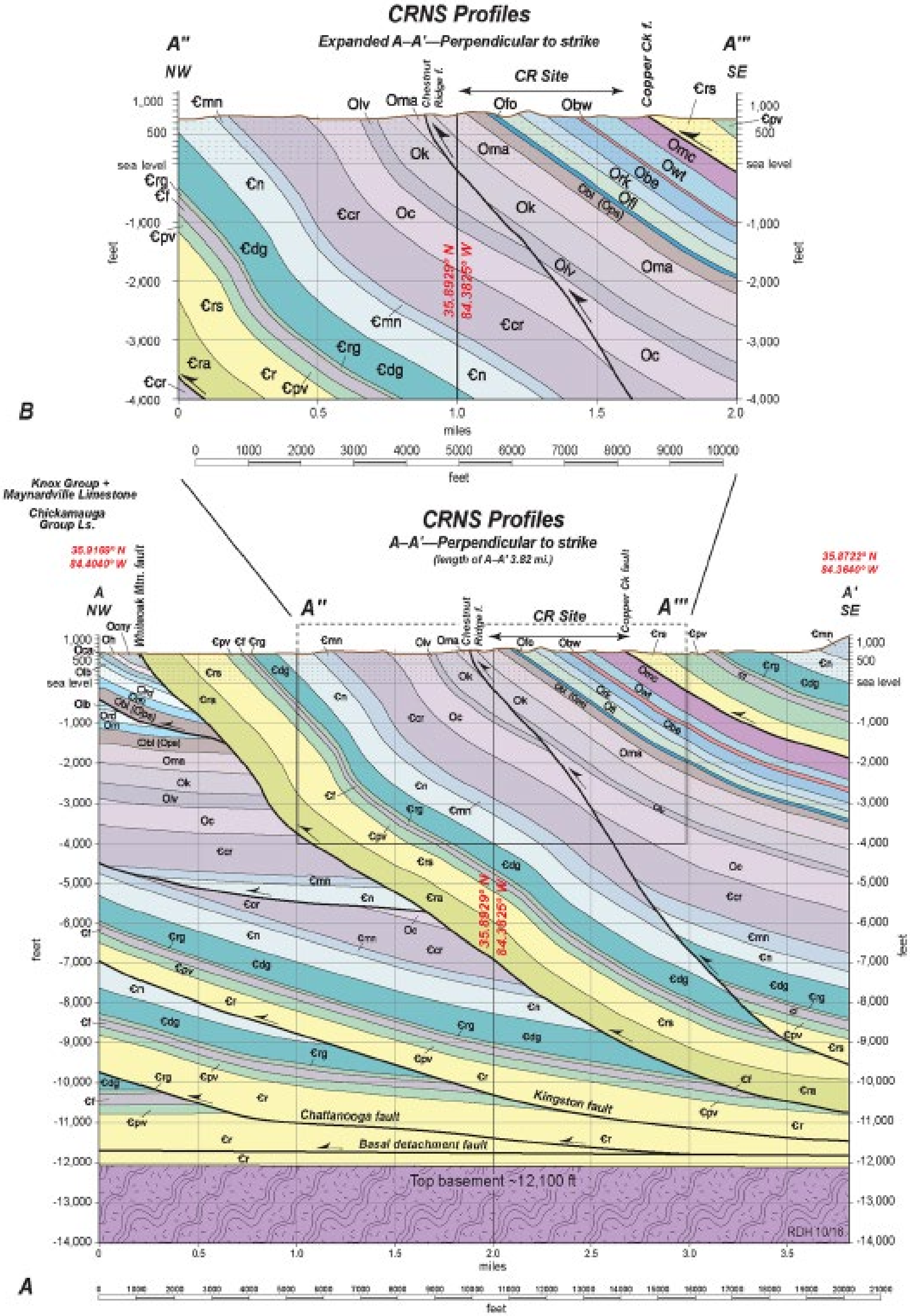


Figure 3-3. Geologic Map and Location of Cross-Section A-A' to Basement



Note: Across-strike geologic cross-section A-A' with an expanded section, the location of which is indicated in the rectangle in the center of the diagram.

Figure 3-4. Geologic Cross-Section A-A' Ground Surface to Basement (Sheet 1 of 2)

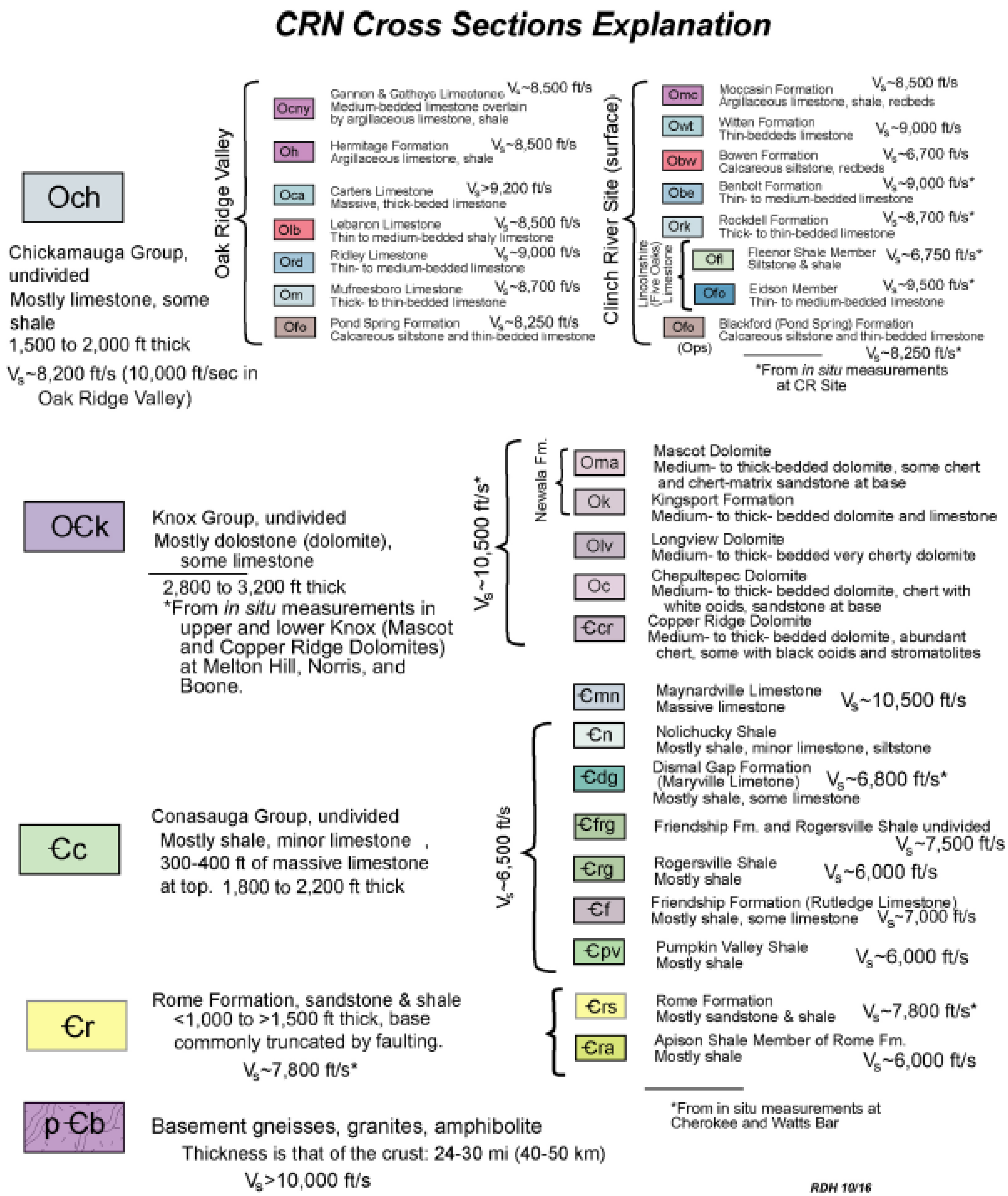


Figure 3-4. Geologic Cross-Section A-A' Ground Surface to Basement (Sheet 2 of 2)

Strata belonging to the Knox Group outcrop from the northwest boundary and progress southeast to the central portion of the CRN Site. The Knox Group is represented by five formations and include from the northwest to southeast (and oldest to youngest) the Upper Cambrian Copper Ridge Dolomite, the Lower Ordovician Chepultepec Dolomite, Longview Dolomite, Kingsport Formation, and the Mascot Dolomite. Where the Kingsport Formation and Mascot Dolomite contact is not recognized these units are combined and referred to as the Newala Formation. The Knox Group units are broadly similar and generally described as medium to thick bedded dolomite with variable amounts of interbedded sandstone, limestone, and chert. The contact of the Knox Group and the Chickamauga Group, located in the central portion of the CRN Site, marks a regional unconformity in which strata of the upper most Knox Group was exposed to extensive erosion due to regional uplift associated with the Taconic Orogeny and/or a drop in eustatic sea level at the end of the Early Ordovician. Eustatic sea level rise and inundation following the regional erosion event (Knox unconformity) resulted in the deposition of the Middle Ordovician Chickamauga Group on the disconformity surface. Paleotopographic relief in the Knox unconformity accounts for variable stratigraphic thicknesses and facies variation in the upper most Knox Group and lower most Chickamauga Group units in the region and at the CRN Site. Strata belonging to the Chickamauga Group outcrop starting from the central portion of the site and progress southeast towards the southern boundary of the CRN Site and the contact with the Rome Formation at the Copper Creek thrust fault. The Chickamauga Group is represented by seven formations at the site and include from the northwest to southeast (and oldest to youngest) the following formations:

- Blackford Formation, Middle Ordovician, a dolomitic limestone in the lower portion, and a calcareous siltstone in the upper portion of the unit
- Lincolnshire Formation – Eidson Member, Middle Ordovician, a laminated to thinly bedded argillaceous micritic limestone with few calcareous siltstone interbeds
- Lincolnshire Formation – Fleanor Shale Member, Middle Ordovician, a laminated to moderately bedded calcareous siltstone with few limestone interbeds
- Rockdell Formation, Middle Ordovician, a very thinly to moderately bedded micritic limestone with few calcareous siltstone interbeds
- Benbolt Formation, Middle Ordovician, a very thinly to moderately bedded limestone with few calcareous siltstone interbeds, locally fossiliferous
- Bowen Formation, Middle Ordovician, a maroon calcareous siltstone
- Witten Formation, Middle Ordovician, differentiated into three subunits including a lower fossiliferous nodular to ribbon limestone unit, a middle calcarenite unit, and an upper interbedded siltstone and limestone unit
- Moccasin Formation, Middle Ordovician, a laminated to moderately bedded argillaceous, micritic limestone with very thin calcareous siltstone interbeds; truncated by the Copper Creek thrust fault

3.2.1.1.3 Geologic Hazards

Carbonate rock dissolution and karst formation is the primary non-seismic geologic hazard in the Valley and Ridge Province. Karst features in the Valley and Ridge include sinkholes, caves, springs, seeps, sinking streams/underground drainage, and irregular soil-bedrock contact. Many of these features are common throughout the CRN Site area and some have been identified at the CRN Site (Figure 3-5).

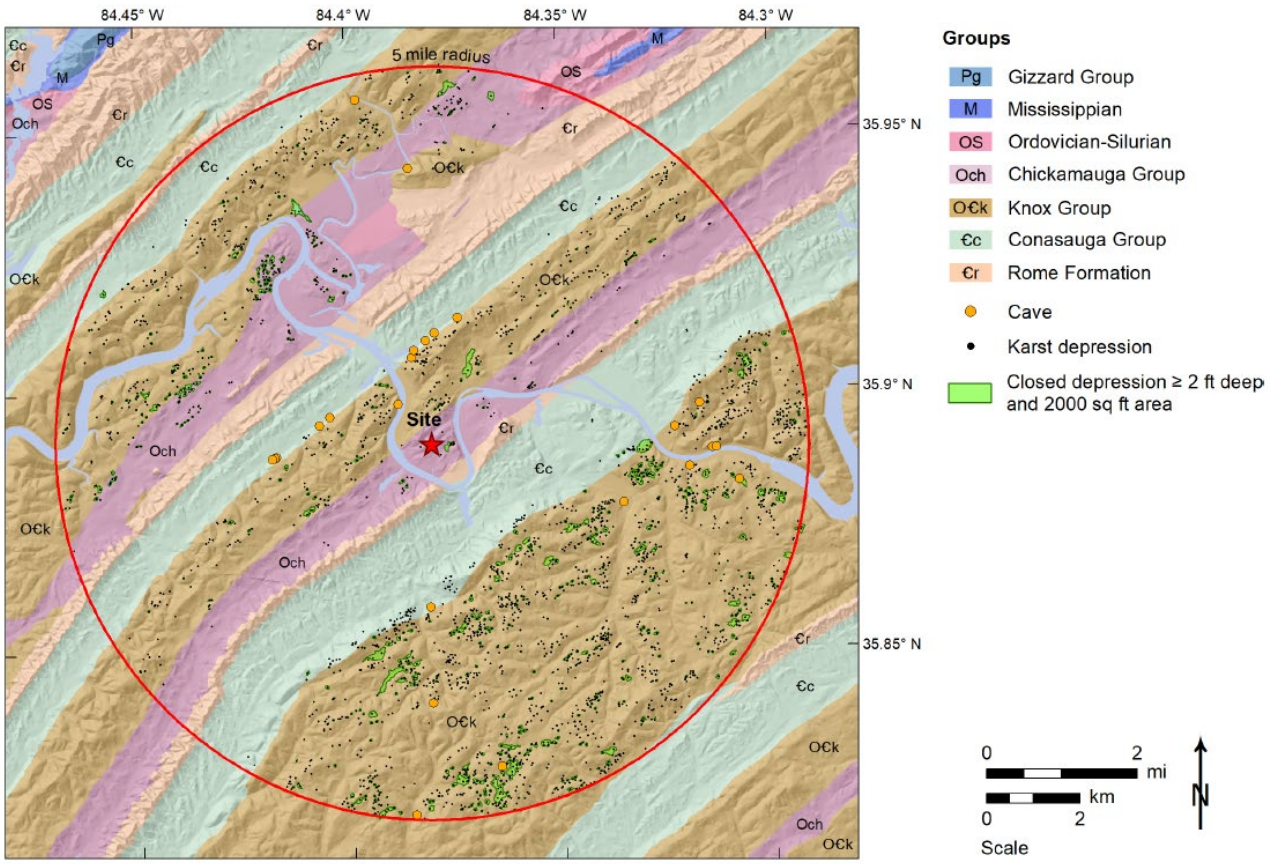


Figure 3-5. Distribution of Mapped Karst Features in the Site Area

The folded and faulted carbonates in the region contain fractures that provide conduits for fluid flow and enhanced carbonate dissolution. In general, the thickest and most pure carbonate units host the largest and most abundant karst features. Dissolution of the carbonate rock is dependent on several factors including bedrock geochemistry, location of the water table relative to the bedrock, and degree of fracturing. Karst development tends to follow geologic structural control such as bedding strike, joints, joint-bedding plane intersections and fractures. The Knox Group and Chickamauga Group strata present at the CRN Site contain formations that are susceptible to karst development and carbonate dissolution features. However, as illustrated in Figure 3-5 karst features are more abundant in the Knox Group formations (Area 2 and within the offsite 161-kV transmission line corridor) as compared to the Chickamauga Group (Area 1). Karstic features at the CRN Site are most common in the Knox Group formations and the Witten, Benbolt, Rockdell, and Eidson Member formations of the Chickamauga Group. Chickamauga Group units that contain interbedded carbonate and clastic lithologies such as the Bowen and Blackford Formations or mostly clastic lithologies such as the Fleanor Member have very few karstic features. In general, subsurface dissolution is most intense near the surface and decreases steadily with depth.

3.2.1.2 Soils and Prime Farmland

Land development projects are subject to Farmland Protection Policy Act (FPPA) (7 U.S.C. § 4201 et seq.) requirements if they may irreversibly convert farmland (directly or indirectly) to nonagricultural use and are completed by a federal agency or with assistance from a federal agency. For the Farmland Protection Policy Act, farmland includes prime farmland, unique farmland, and farmland of statewide or local importance.

Modern soil survey data produced by the USDA in which prime farmland soils are classified are not available for the CRN Site or associated offsite areas because they are federal land; however, the 1942 Soil Survey for Roane County includes the CRN Site and the ORR (Swann et al. 1942). This survey provides soil productivity classifications based on soil suitability for various uses including cropland, pasture, and forest. These soils have been previously disturbed by the CRBRP project.

Soils data from the 1942 USDA Soil Survey for Roane County was used to review the mapped soils and the Farmland Classifications of soils within the CRN Site and associated offsite areas (Swann et al. 1942). According to the survey, the majority of the mapped soils in the CRN Site are Clarksville cherty silt loam or Fullerton cherty silt loam with different phases (Swann et al. 1942). Other mapped areas within the CRN Site are Colbert silty clay loam or Upshur silt loam. These four soils are found in uplands of rolling, undulation topography, have developed from sedimentary rock residual and have good to excessive drainage. Smaller areas at the CRN Site are mapped as Armuchee silt loam, Wolftever silt loam, or Roane gravelly loam, and occupy uplands, terraces, and bottom lands, respectively. In the bottom lands near the Reservoir, soils are mapped as Pope very fine sandy loam and to a lesser extent Sequatchie very fine sandy loam. Both are second class soils and have good to slow drainage.

Clarksville soils are derived from highly cherty dolomitic limestone and occur on hilly ridge summits or side slopes. Fullerton soils are derived from moderately cherty dolomitic limestones and occur primarily on upper slopes or rolling ridge summits. Colbert soils come from highly clayey limestones that are primarily found in valley troughs (i.e., foot slopes). These soils are generally shallow to bedrock, free from chert, and have fair drainage. Upshur soils come from shaly limestones and occur in narrow strips in valleys. They are shallow to bedrock and free from chert with excessive drainage.

The modern prime farmland classification of soils is generally analogous to the first-class (good to excellent cropland) 1942 classification. There are no first-class soils within the CRN Site or associated offsite areas according to the 1942 soil classification. However, based on TVA coordination with the USDA Natural Resources Conservation Service in accordance with the FPPA, 178 acres of the CRN Site have been designated as prime and unique farmland (Appendix E).

3.2.1.3 Seismology

In 2012, the Central and Eastern United States Seismic Source Characterization for Nuclear Facilities (CEUS SSC) Project was published (EPRI et al. 2012). The study, co-sponsored by EPRI, DOE, and NRC, was conducted to provide a regional seismic source model for use in probabilistic seismic hazard analyses for nuclear facilities. The CEUS SSC Project devoted a major effort to developing a comprehensive and uniform earthquake catalog for use on the project. Starting with the U.S. Geological Survey (USGS) national catalog and a number of regional catalogs, the various catalogs were updated to include all earthquakes through 2008. Focusing on the earthquakes that occurred within 200 miles of the CRN Site, the CEUS SSC earthquake catalog concluded there were 355 earthquakes of uniform moment magnitude E[**M**] 2.9 and larger, of which 315 are identified as independent events (mainshocks), from 1568 to 2018. Greater detail regarding the catalog update methodology and findings is located in Appendix F.

Within the vicinity of the CRN Site, the Eastern Tennessee Seismic Zone (ETSZ), is a well-defined, northeasterly trending belt of seismicity, 186 miles long by less than 62 miles wide, within the Valley and Ridge and Blue Ridge physiographic provinces of eastern Tennessee and parts of North Carolina, Georgia, and Alabama. ETSZ is one of the most active seismic regions in eastern North America in terms of the rate of small earthquakes. Generally, earthquakes in the ETSZ produce minor or no damage (e.g., chimney collapse, cracks in plaster, and broken windows), consistent with MMI VI on the Modified Mercalli Intensity (MMI) scale. The MMI is a standard measure of the qualitative site-specific effects of an earthquake on a scale that ranges from Roman numeral I through XII.

3.2.1.4 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of geologic and soil resources within their respective project footprints. While the specific details regarding the scope of many of these actions are lacking, it is expected that each would entail land disturbance and the alteration of soils. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. However, because each of these projects has the potential to alter soils, further consideration of reasonably foreseeable future actions and their effects on soils and erosion are included in the following section as appropriate.

3.2.2 Environmental Consequences

3.2.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, there would be no construction or operation of a Nuclear Technology Park at the CRN Site. Therefore, there would be no impacts associated with geology, soils, or seismology under Alternative A.

3.2.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

Geologic impacts in conjunction with Alternative B construction relate to the stability of the underlying formation and the potential incidence of karst. Additional site-specific investigation would be conducted to evaluate the presence of karst features in areas proposed for structure development. Because the Chickamauga Group formation underlies much of Area 1 and the incidence of karst features is relatively low, impacts associated with the development of the CRN Site and most associated offsite areas is minor. While some localized karst may be evident within the offsite 161-kV transmission line corridor, it is expected that the designs of transmission tower foundations would either avoid karst features or would provide appropriate mitigative measures.

Impacts to soils are limited to disturbances during the construction phase. Under Alternative B, construction activities such as clearing, grubbing, grading, and excavation represent the largest source of soil related impacts in Area 1, the laydown area, and the associated offsite areas. Approximately 647 acres would be disturbed within the CRN Site and associated offsite areas under this alternative. Relatively minor additional soil disturbances are also expected in conjunction with tower construction for the 161-kV transmission line. Impacts from these soil disturbing activities would be localized within the CRN Project Area. Area 1 is dominated by uplands soils mostly mapped as Clarksville series with smaller areas consisting of terraces and bottom lands. This undulating topography can be susceptible to soil erosion from water and wind. Although much of Area 1 was previously disturbed and topsoil was removed as part of the CRBRP project, it was also revegetated and partially backfilled, graded, and compacted. Potential impacts from erosion are notably greater on sloped areas and in proximity to streams, other surface water resources, and in proximity to the Reservoir as well as in former areas of disturbance where soils have not fully recovered. BMPs as described in the Tennessee Erosion and Sediment Control Handbook (TDEC 2012) and outlined in the project SWPPP would be used to minimize soil erosion on the site. Impacts from these soil disturbing activities would be moderate and notable within the CRN Project Area, but with the implementation of erosion control procedures, would not destabilize the resource on a broader scale.

As part of the ESPA ER, TVA completed a Farmland Conversion Impact Rating (Form AD-1006) in consultation with the USDA's Natural Resources Conservation Service to quantify the potential impacts on prime farmland. The impact rating score considers the acreage of prime farmland to be converted, the relative abundance of prime farmland in the surrounding county, and other criteria such as distance from urban support services and built-up areas, potential effects of conversion on the local agricultural economy, and compatibility with existing agricultural use. Based on the USDA form, impacts to sites with a total score of at least 160 have the potential to adversely affect prime farmland. The impact rating score for the CRN Site was 102 points. Therefore, because the impact score was below the threshold for adverse impacts, the impact of the Alternative B on prime farmland would be minor.

Impacts related to seismic conditions of the CRN site pertain to the operation phase. Given the historic record of seismic activity in the CRN region described above, TVA would ensure that all safety related structures would be properly designed to meet hazards and risks associated with seismic conditions for the CRN Site. Specific design considerations and seismic mitigative measures would be developed as appropriate based upon the reactor technology selected and would meet NRC requirements. Design-basis analyses would be performed to demonstrate compliance with regulatory requirements. As such, under Alternative B, impacts related to seismology would be minor and mitigated, as appropriate.

3.2.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C, impacts related to geology are generally similar to those described for Alternative B. However, by comparison, the incidence of karst features is greater in the vicinity of Area 2 as compared to Area 1. Detailed designs for safety related features and other structures would include all appropriate karst related mitigative measures and a grouting plan would be implemented as applicable. Therefore, potential impacts under this alternative are greater than those described for Alternative B, but still minor.

Under Alternative C, construction activities such as clearing, grubbing, grading, and excavation represent the largest cause of soil related impacts in Area 2, the laydown area, and the associated offsite areas. Approximately 424 acres would be disturbed within the CRN Site and associated offsite areas under this alternative. Relatively minor additional soil disturbances are also expected in conjunction with tower construction for the 161-kV transmission line. Area 2 is dominated by uplands soils mostly mapped as Clarksville series with smaller areas consisting of terraces and bottom lands. Based on the acreage of soils affected, impacts to soils under Alternative C are moderate and notable within the CRN Project Area and are less than those under Alternative B, but with the implementation of erosion control procedures, would not destabilize the resource on a broader scale.

In Area 2, soils are identified as second class soils according to the 1942 soil survey and are therefore not considered prime farmland. The undulating topography in Area 2 can be susceptible to soil erosion from water and wind. As soils within the Area 2 footprint have not been previously disturbed, impacts to previously undisturbed soils would be greater than for Alternative B. However, BMPs, as described in the Tennessee Erosion and Sediment Control Handbook (TDEC 2012) and outlined in the project specific SWPPP, would be employed to minimize soil erosion on the site. Impacts to prime farmland are similar to those described for Alternative B and minor.

Impacts associated with seismology are similar to those described for Alternative B and are minor and mitigated, as appropriate.

3.2.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, impacts related to geology are predominantly associated with the incidence of karst and as such are incrementally greater than those described for Alternative C but are still considered minor.

Under Alternative D, a greater acreage of land would be disturbed in conjunction with the development of both Area 1 and Area 2. Approximately 728 acres would be disturbed within the CRN Site and associated offsite areas under this alternative. Relatively minor additional soil disturbances are also expected in conjunction with tower construction for the 161-kV transmission line. As such, impacts to soils and the potential for erosion would be incrementally greater than that described under Alternatives B and C, but still moderate and with the implementation of erosion control procedures, would not destabilize the resource on a broader scale. Impacts to prime farmland are similar to those described for Alternative B and minor.

Impacts associated with seismology are similar to those described for Alternative B and are minor and mitigated, as appropriate.

3.2.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.1.3, several reasonably foreseeable future actions were identified in proximity to the CRN Site. Depending on the local environmental setting and the design characteristics of these other proposed actions, direct land disturbance including site excavation and grading would be expected. As such, depending on the magnitude of soil disturbed, soil type and erodibility, slope and other factors, there is the potential for such erosion to affect receiving streams and water resources. None of the identified actions by others are adjacent to or geographically intersect with the same lands affected by the proposed project. Potential impacts from those reasonably foreseeable future projects are expected to be localized and minimized through use of BMPs and implementation of other soil erosion control measures. As such, these actions would likely have minimal cumulative impacts on soil resources in the area.

3.2.2.6 Summary of Impacts to Geology and Seismology

As shown in Table 3-2, TVA has determined that development for Alternatives B, C, and D would have minor construction impacts associated with geology and seismology and moderate impacts associated with soil. Impacts during operation are minor.

Table 3-2. Summary of Impacts to Geology and Seismology

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Potential impacts associated with karst features and structure stability.	Minor impacts, mitigated by additional site-specific investigation during design to evaluate the presence of karst features in areas proposed for structure development. Potential karst features would be avoided or mitigated, as appropriate. Impacts magnitude: Alternative D is greater than Alternative C, which greater than Alternative B.
		Soil disturbance and potential for erosion related to construction activities Impacts would occur to prime farmland soils, but soil conversion impact rating less than 160.	Moderate impacts to soils mitigated by employment of BMPs and stormwater pollution prevention plan SWPPP. Impacts magnitude: Alternative D is greater than Alternative C, which is greater than Alternative B. Based on impact rating, impacts are minor for each alternative.
	Operation	Potential impacts associated with low probability seismic event in Eastern Tennessee Seismic Zone (ETSZ).	Minor impacts for all alternatives, mitigated in accordance with NRC requirements, as applicable.

3.3 Water Resources

3.3.1 Affected Environment

3.3.1.1 Surface Water Resources

3.3.1.1.1 Surface Water Hydrology

3.3.1.1.1.1 Hydrologic Setting

The headwaters of the Tennessee River watershed originate in the mountains of western Virginia and North Carolina, eastern Tennessee, and northern Georgia. The Tennessee River is formed by the confluence of the Holston and the French Broad Rivers near Knoxville, Tennessee. The river flows to the southwest and receives water from three principal tributaries: Little Tennessee, Clinch, and Hiwassee Rivers. As the Tennessee River flows south, west, and then north, two other major tributaries, the Elk and Duck rivers, contribute to the flow that eventually joins the Ohio River at Paducah, Kentucky.

The Tennessee River and its tributaries have a drainage area of approximately 41,910 square miles and pass through 125 counties that cover much of Tennessee and parts of Alabama, Kentucky, Georgia, Mississippi, North Carolina, and Virginia. The USGS divides the Tennessee River Basin into two subbasins: the Upper Tennessee River Basin and the Lower Tennessee River Basin. The CRN Site is located in the Upper Tennessee River

Basin but within the Lower Clinch River Watershed (USGS Hydrologic Unit Code [HUC] 06010207). The Lower Clinch River Watershed includes portions of eight counties in East Tennessee including Anderson, Campbell, Grainger, Knox, Loudon, Morgan, Roane, and Union.

3.3.1.1.1.2 The CRN Site and Vicinity

The CRN Site is within the City of Oak Ridge, Tennessee approximately 10.7 miles southwest of the city center, on a peninsula created by a bend in the Reservoir (Figure 3-6). The Reservoir is the primary source of surface water of the CRN Site, which extends from approximately CRM 14.5 to approximately CRM 19.0.

Watts Bar Reservoir is one of a series of multi-purpose dams and reservoirs built on the Tennessee River and its tributaries to fulfill the three primary purposes of the river system of navigation, flood control, and power generation, and secondary purposes of water quality, recreation, and water supply, among others. Norris Dam is the furthest TVA dam upstream on the Clinch River, at CRM 79.8. The next dam, about 57 miles downstream, is Melton Hill, TVA's only tributary dam with a navigation lock. The Clinch River continues downstream, picking up the Emory River at CRM 4.4 before itself emptying into the Tennessee River on Watts Bar Reservoir at Tennessee River Mile (TRM) 567.8.

The upstream boundary of the CRN Site is approximately 4.1 miles downstream of Melton Hill Dam, and approximately 52.4 miles upstream of Watts Bar Dam. As shown in Figure 3-7 and summarized in Table 3-3, there are five dams and reservoirs upstream of the CRN Site that may affect the hydrology of Watts Bar Reservoir in the vicinity of the CRN site:

- Norris Dam and Reservoir, closed in 1936, located at CRM 79.8, approximately 61 miles upstream from the CRN Site.
- Melton Hill Dam and Reservoir, closed in 1963, located at CRM 23.1, approximately 4.1 miles upstream of the CRN Site.
- Watts Bar Dam and Reservoir, closed in 1942, located at TRM 529.9 or approximately 52 miles downstream of the CRN Site.
- Fort Loudoun Dam and Reservoir, closed in 1943, located at TRM 602.3, about 35 miles upstream from the Clinch River confluence, and releases water into Watts Bar Reservoir.
- Tellico Dam and Reservoir, closed in 1979, located at Little Tennessee River Mile 0.3, and TRM 601.1, about 34 miles upstream from the Clinch River confluence, and releases water into Watts Bar Reservoir.

White Oak Dam and White Oak Creek Embayment Sediment Control Dam (located near CRM 21.0) on White Oak Creek (see Figure 3-6) may also periodically influence local hydrology of the Watts Bar Reservoir in the vicinity of the CRN Site.

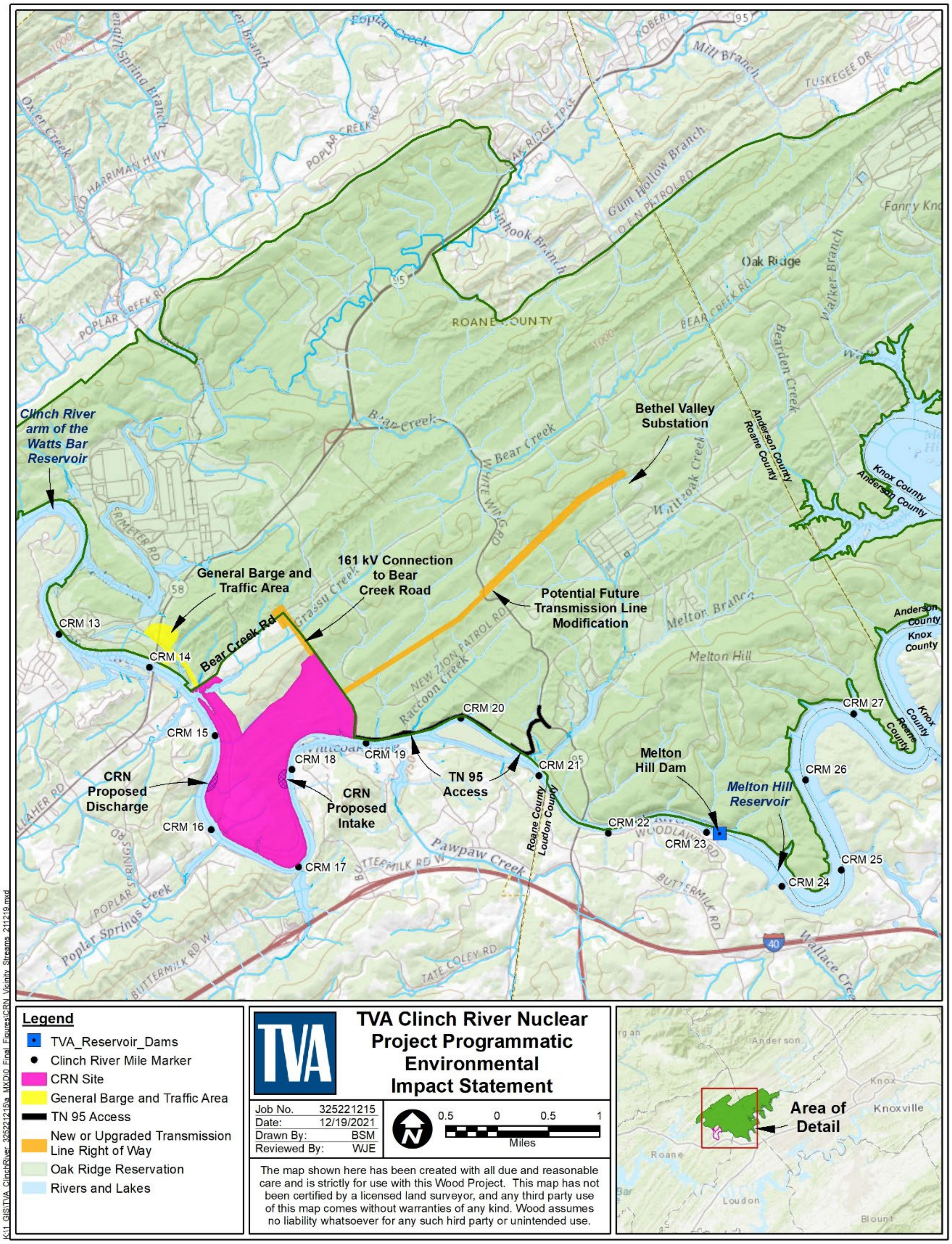


Figure 3-6. Local Hydrologic Features in the Vicinity of the CRN Site

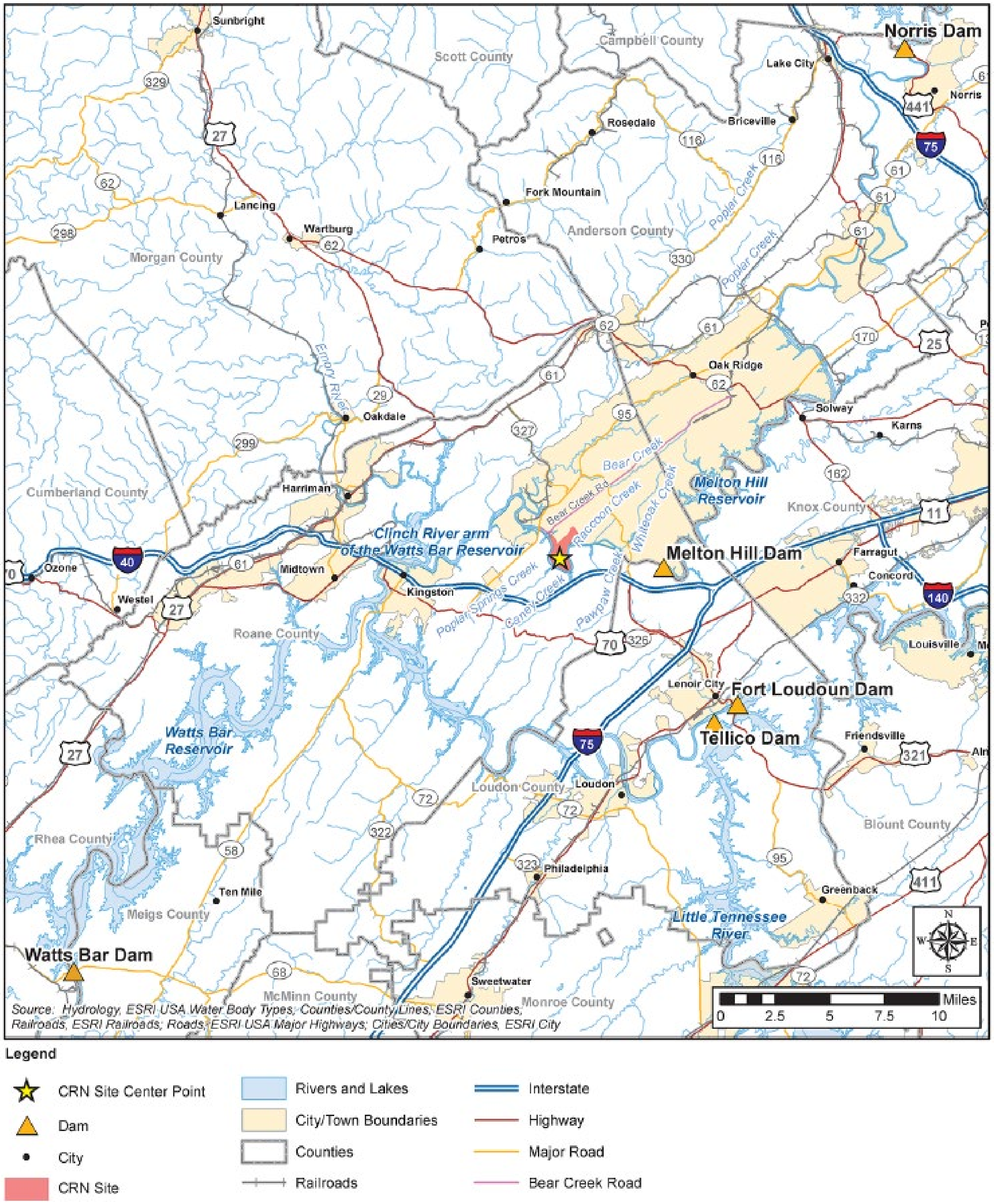


Figure 3-7. CRN Site Regional Water Resources

Table 3-3. Reservoirs that Influence Flows at the CRN Site

Reservoir	Waterbody	Purpose	Flood Storage (ac-ft)[1]	Area (ac)	Elevation Range (ft AMSL)
Norris	Clinch & Powell Rivers	Power Generation, Flood Control, Recreation	1,113,000	33,840	992-1,020
Melton Hill	Clinch River	Power Generation, Navigation, Recreation, Water Supply	negligible	5,470	793-795
Watts Bar	Tennessee, Clinch, & Emory Rivers	Power Generation, Flood Control, Navigation, Water Supply, Recreation	379,000	39,090	735-741
Fort Loudoun[2]	Tennessee River	Power Generation, Flood Control, Navigation, Water Supply, Recreation	111,000	14,600	807-812.8

(1) At January 1 Flood Guide
(2) Fort Loudoun Reservoir is connected by a canal to Tellico Reservoir on the Little Tennessee River. A regulated spillway on Tellico Dam is used only during extreme flooding

The CRN Site is located approximately 8.2 air miles east of the confluence of the Tennessee and Clinch Rivers. As shown on Figure 3-6, a number of creeks in the vicinity of the CRN Site discharge into the Reservoir from the right descending bank. These include: White Oak Creek, Raccoon Creek, Grassy Creek and Poplar Creek. Paw Paw Creek, Caney Creek and Poplar Springs Creek discharge to Watts Bar Reservoir from the left descending bank.

3.3.1.1.1.3 Clinch River Arm of Watts Bar Reservoir

The water surface elevation (WSEL) for the section of the Reservoir adjacent to the CRN Site generally follows the pool elevation at Watts Bar Dam (i.e., is backwater from the dam). Water flow is usually in the downstream direction but can be quiescent or in the upstream direction for short periods of time in conjunction with the peaking operations at the Watts Bar, Melton Hill, and Fort Loudoun hydroelectric plants.

The daily average WSEL at CRM 16.1 varies between 736 and 744.5 feet above mean sea level, a range of approximately 8.5 feet. The WSEL follows the general trend of Watts Bar Dam Headwater Elevation (HWEL) (Figure 3-8). However, differences occur between the WSEL at the CRN Site and WSEL at Watts Bar Dam due to hydraulic conditions between the site and Watts Bar Dam. At the CRN Site, discharges from Melton Hill Dam can influence Clinch River WSELs, especially as Melton Hill discharges increase. During periods when the daily average release from Melton Hill Dam was in excess of approximately 5,000 cfs (e.g., late January and early February 2013; January-March 2019; February-March 2020; and late March-early April 2021), it was not uncommon for the WSEL at the CRN Site to rise 1.0 feet or more above the HWEL at Watts Bar Dam. This dynamic also occurs at smaller time scales. For example, on an hourly basis, peaking operations at Melton Hill Dam can cause the WSEL at the CRN Site to rise above the HWEL at Watts Bar Dam. Sloshing of the reservoir from peaking operations at the Watts Bar, Melton Hill, and Fort Loudoun hydroelectric plants also can cause the opposite to occur, with the WSEL at the CRN Site falling below the HWEL at Watts Bar Dam. During these events, the current pattern in the Reservoir is reversed, with flow moving upstream rather than downstream.

Figure 3-8 shows the maximum, minimum, and average values of the daily midnight HWEL that are typical Watts Bar Dam as represented for the period of record from 2004 through 2021. As is evident in Figure 3-8, Watts Bar HWEL can spike above the target operating ranges due to storm runoff, flood operations to reduce flood impacts at Chattanooga, or both.

3.3.1.1.1.4 CRN Site and Associated Offsite Areas

TVA conducted field studies in 2021 to identify the surface water resources on the CRN Site and associated offsite areas (Table 3-4 and Figure 3-9). Identified surface water resources on or adjacent to the CRN Site include the Reservoir, 13 intermittent or perennial streams, 19 ephemeral streams and wet weather conveyances (WWCs), and four onsite ponds created during the CRBRP to serve as stormwater retention ponds. Chestnut Ridge is a prominent topographic feature that divides the drainages contributing to Grassy Creek north of the CRN Site and smaller drainage features in the northeastern portion of the CRN Site (Note: wetland resources and potential impacts to wetlands are discussed further in Section 3.4.2.1).

Notably, the central portion of Area 1 of the CRN Site generally lacks identified streams as this area was substantially disturbed by the prior CRBRP project. As noted in Figure 3-9, there are two ponds, one small (P07) and one large (P08), located on the southeast edge of the BTA. Several large wetlands are also located in three low areas near the shore of the Reservoir: in the BTA, south of Grassy Creek parallel to the CRN Site access road, and near the northeast edge of the CRN Site (associated with the cluster of streams) and along the TN 95 Access. Surface water features along the proposed offsite 161-kV transmission line consist of Grassy Creek in the vicinity of the transmission line crossing of Bear Creek Road. As indicated in Table 3-5, offsite surface water resources associated with the 500-kV line extending to the Bethel Valley Substation include four small intermittent and perennial streams. These streams include Ish Creek and several tributaries of White Oak Creek. Characteristics of these streams and their aquatic biota are described further in Section 3.6 (Aquatic Ecology).

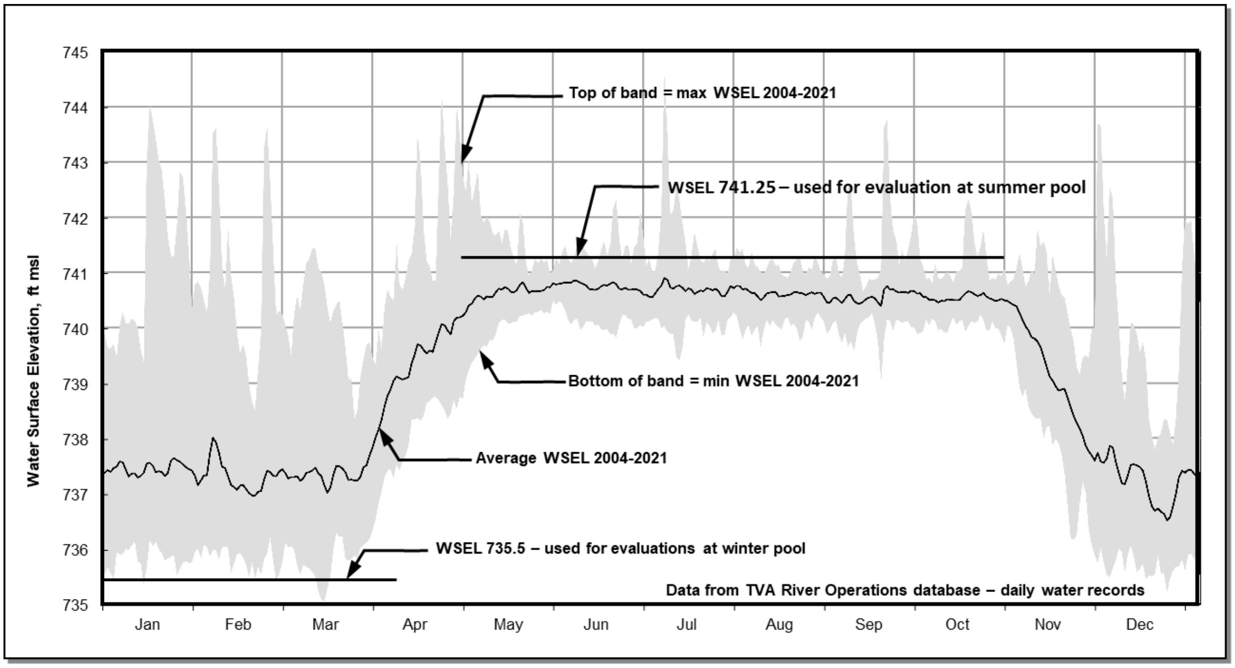


Figure 3-8. Headwater Elevation at Watts Bar Dam, Showing Max, Min, and Average Values of Daily Midnight Readings, 2004-2021

Table 3-4. Surface Water Resources (streams/ponds) on the CRN Site and Associated Offsite Areas

Location	Type	Identifier	Number	Length (Feet) / Area (Acres)
CRN Site				
	Ponds		**4**	**1.37**
		P01		0.28
		P02		0.18
		P03		0.75
		P04		0.16
	Perennial Streams		**3**	**2,525**
		STR07		681
		STR11		1,786
		STR12		58
	Intermittent Streams		**4**	**1,477**
		STR04		311
		STR05		286
		STR06		123
		STR10		757
	WWCs		**14**	**5,666**
		EPH03		144
		EPH04		55
		EPH05		113
		EPH06		118
		EPH07		115
		EPH08		124
		EPH09		614
		EPH10		673
		EPH11		1,052
		EPH12		919
		EPH13		540
		EPH14		322
		EPH18		83
		EPH19		794
Associated Offsite Areas				
Barge and Traffic Area				
	Ponds		**0**	**0**
	Perennial Streams		**1**	**117**
		STR03		117
	Intermittent Streams		**1**	**335**
		STR01		335
	WWCs		**2**	**812**
		EPH01		471

Location	Type	Identifier	Number	Length (Feet) / Area (Acres)
		EPH02		341
TN 95 Access				
	Ponds		**0**	**0**
	Perennial Streams		**3**	**594**
		STR13		305
		STR14		136
		STR15		153
	Intermittent Streams		**0**	**0**
	WWCs		**0**	**0**
161-kV Offsite Transmission Line				
	Ponds		**0**	**0**
	Perennial Streams		**0**	**0**
	Intermittent Streams		**1**	**1,271**
		STR08		1,271
	WWCs		**4**	**814**
		EPH15		101
		EPH16		294
		EPH17		161
		EPH18		258
500-kV Corridor to Bethel Valley Substation[1]				
	Ponds		0	-
	Streams		4	-
Project Area Total				
	Ponds		**4**	**0.62**
	Perennial Streams		**7**	**3,372**
	Intermittent Streams		**6**	**3,083**
	Undifferentiated Streams[1]		**4**	**-**
	WWCs		**19**	**7,292**

[1] based on desktop analysis within offsite 500-kV corridor, no site review conducted.
Note: WWC = wet weather conveyance

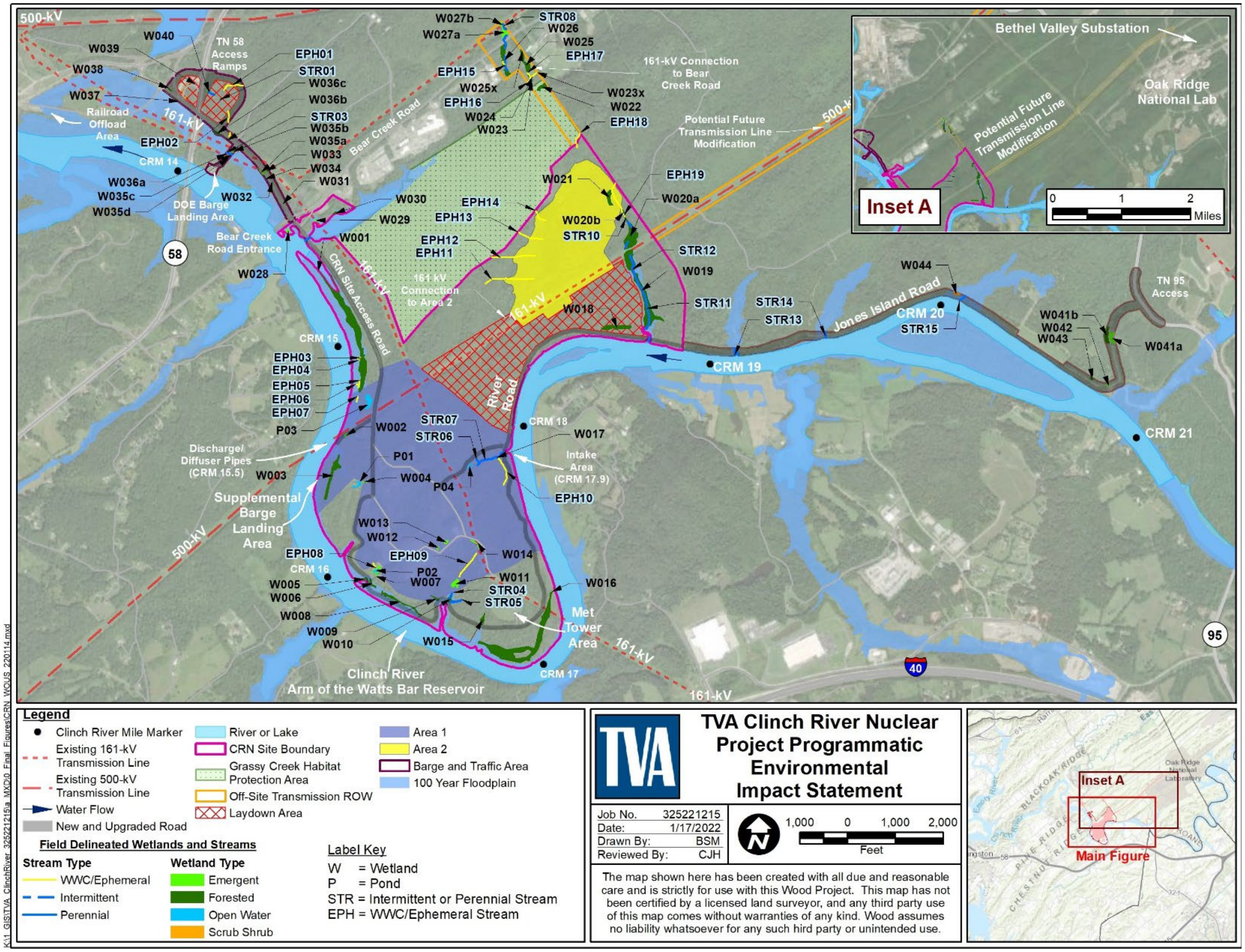


Figure 3-9. Identified Surface Water Resources on the CRN Site and Associated Offsite Areas

3.3.1.1.2 Water Use

USGS Categories of water use include thermoelectric power, industrial, public supply, and irrigation. Total water withdrawals from the Tennessee River watershed during 2015 were estimated to average 10,016 million gallons per day (MGD) for off-stream uses. In 2015, total withdrawal was about 16 percent lower than it was in 2010, which was primarily due to a reduction in thermoelectric withdrawal of about 18 percent as a result of lower energy generation in the watershed compared to 2010. Thermoelectric water use in the watershed was 82.1 percent of withdrawals, industrial use was 10.3 percent, and public supply was approximately 7 percent. Public supply use was the largest consumptive use in the Tennessee River basin, totaling 246 MGD in 2015 (Bowen and Springston 2018).

According to Bowen and Springston (2018), projected 2040 water withdrawals from the Tennessee River watershed are expected to decline relative to 2015 levels. Projected changes from 2015 levels are as follows: industrial will increase by 16 percent to 1,197 MGD, public supply will increase by 21 percent to 842 MGD, and irrigation will increase by 40 percent to 88 MGD. Thermoelectric water withdrawal is expected to decline by 27 percent to 5,981 MGD, reflecting changes in both generating and cooling technologies for TVA power plants. Although total withdrawals are expected to decrease, total net water demand will rise by 24 percent to 543 MGD. This is due to projected economic growth and continued population growth in the Tennessee Valley, as well as continued growth of irrigated agriculture (Section 3.15).

In the lower Clinch River watershed, water use levels reported by Bowen and Springston for 2015 are summarized in Table 3-5. Notably, the Bull Run Fossil Plant accounts for all surface water use within the Melton Hill Reservoir. As indicated by TVA, however, the Bull Run Fossil Plant located within the Melton Hill Reservoir is scheduled for retirement in 2023 (TVA 2021a).

Table 3-5. Water Use Characteristics within Melton Hill and Watts Bar Reservoirs in 2015

	Water Use by Source (MGD)				
	Surface Water	**Groundwater**	**Total Water Use**	**Total Return Flow**	**Net Water Demand**
Melton Hill	555.95	1.38	557.33	527.29	30.03
Watts Bar	1,127.41	2.23	1,129.64	984.06	145.58

	Water Use by Category (MGD)				
	Thermoelectric	**Industrial**	**Public Supply**	**Irrigation**	**Total Water Withdrawals**
Surface Water					
Melton Hill	528.62	0.32	26.35	0.65	555.95
Watts Bar	1,095.65	6.30	24.16	1.30	1,127.41
Groundwater					
Melton Hill	NA	0.00	1.36	0.02	1.38
Watts Bar	NA	0.00	2.19	0.04	2.23

Source: Bowen and Springston 2018

Water use may be either consumptive or non-consumptive. Consumptive use is that part of the water withdrawn that is evaporated, transported, incorporated into products or crops, consumed by humans or livestock, or otherwise removed from the immediate environment (Bowen and

Springston 2018). Most of the surface water use in the lower Clinch River watershed is non-consumptive, meaning either no water is withdrawn, or that the volume withdrawn is returned to the source waterbody and is thus available to downstream users. Non-consumptive water uses in the lower Clinch River watershed include hydroelectric power generation at Melton Hill Dam, navigation, aquatic habitat, and recreational activities such as fishing, boating, and swimming.

Consumptive water use occurs when more water is withdrawn than is returned to the source waterbody, resulting in a decrease in supply downstream of the user. Thermoelectric power generation accounts for the greatest amount of consumptive use within the Tennessee Valley. Consumptive uses within Melton Hill and Watts Bar Reservoirs in 2015 were approximately 30 and 145 MGD, respectively (Bowen and Springston 2018).

3.3.1.1.3 Water Quality

3.3.1.1.3.1 Regional Water Quality

The water quality data in the Upper Tennessee River Basin from 1994 to 1998 were summarized by the USGS in 2000. The report evaluated concentrations and distribution of bacteria, nutrients, pesticides, and volatile organic compounds (VOCs) in surface water and sediment, the influence of industry and mining on water quality, and the effects of toxic spills and releases. The study was performed as part of the USGS National Water-Quality Assessment Program, which, as of 2000, had evaluated 36 study areas throughout the U.S. The report compared water quality data from the Upper Tennessee River to data from the other study areas, as well as to national water quality benchmarks, such as those for drinking water quality and protection of aquatic organisms.

In general, the report concluded that surface water in the Upper Tennessee River Basin usually meets existing guidelines for drinking water, recreation, and the protection of aquatic life. Specific findings included:

- Bacteria levels frequently exceeded state standards in agricultural and urban areas. In agricultural areas, this was attributed to runoff from pastureland. In urban areas, this was attributed to wastewater infrastructure.
- Nutrients, including nitrogen and phosphorus, were found at elevated levels in some streams.
- Herbicides were detected in 98 percent of the stream samples collected, and insecticides were detected in 12 percent of samples. Concentrations were within drinking water standards but exceeded aquatic life guidelines for some chemicals.
- Contamination from past industrial and mining activities was still present in many areas. Contamination had resulted in fish consumption advisories for polychlorinated biphenyls (PCBs), dioxin, and mercury. Semi-volatile organic compounds (SVOCs) were found in sediment at concentrations that exceeded aquatic life guidelines and were attributed to coal mining.
- Spills and releases had resulted in fish and mussel kills in many parts of the basin.

Fish consumption advisories are published by TDEC on a recurring basis and those issued for 2020 near the CRN Site include those on East Fork of Poplar Creek (including Poplar Creek embayment and Bear Creek) for mercury and PCBs (all fish), the entirety of the Melton Hill Reservoir for polychlorinated compounds (PCBs, catfish advisory), and the Reservoir for PCBs (striped bass, catfish and sauger). Bacteriological advisories are effective for the East Fork of

Poplar Creek due to City of Oak Ridge urban runoff and collection system issues (TDEC 2020b).

3.3.1.1.3.2 State Monitoring and 303(d) List

TDEC conducts monitoring of surface waters that includes biological, chemical, and bacteriological analyses in wetlands, rivers, streams, reservoirs, and lakes.

TDEC monitoring stations include those located on the Reservoir, including four monitoring stations between Melton Hill Dam and the CRN Site, and eight stations between the CRN Site and the confluence of the Clinch River arm with the Tennessee River arm of Watts Bar Reservoir. The closest station is located directly adjacent to the CRN Site, on the eastern side of the peninsula near CRM 18. Another station is located at Route 58, directly adjacent to the BTA.

Section 303(d) of the federal Clean Water Act requires that states develop a list of surface water bodies that are "water quality limited" or are expected to exceed water quality standards in the next two years. Streams that are water quality limited have one or more characteristics that violate water quality standards. These streams are impaired by pollution and cannot fully meet their designated uses.

In 2020, TDEC issued its updated 303(d) list. Table 3-6 lists the water bodies near the CRN Site that are listed as impaired.

Table 3-6. 303(d)-listed Waterbodies in the Vicinity of the CRN Site

Waterbody Name	Location	Waterbody Type	Cause	Potential Source
Poplar Creek Embayment	Roane County	Lake/ Reservoir/ Pond	PCBs, Mercury	Contaminated Sediments
Clinch River Arm of Watts Bar Reservoir	Roane County	Lake/ Reservoir/ Pond	PCBs, Mercury, Chlordane	Contaminated Sediments
Poplar Creek Embayment	Roane County	Lake/ Reservoir/ Pond	PCBs, Mercury	Contaminated Sediments
Poplar Creek	Roane County	River	Nitrate/Nitrite (Nitrite + Nitrate As N), Phosphorous-Total	Sanitary Sewer Overflows (Collection System Failures)
Bear Creek	Roane County	River	PCBs, Mercury, Nitrate/Nitrite, Cadmium	CERCLA NPL (Superfund) Sites
East Fork Poplar Creek	Roane County	River	Phosphorous-Total, Nitrate-Nitrite, Sedimentation, Mercury, *Escherichia*	Municipal (Urbanized High Density Area)

Waterbody Name	Location	Waterbody Type	Cause	Potential Source
			coli, Nutrients, PCBs	
Melton Branch	Roane County	River	Strontium	CERCLA NPL (Superfund) Sites
White Oak Creek	Roane County	River	Cesium	CERCLA NPL (Superfund) Sites
White Oak Creek	Roane County	River	Strontium	CERCLA NPL (Superfund) Sites

Source: TDEC 2020a,b

3.3.1.1.3.3 River and Reservoir Compliance Monitoring Program

TVA initiated a reservoir monitoring program, formerly called the Vital Signs Monitoring Program, in 1990 to provide information on the ecological health or integrity of major reservoirs in the Valley. Through the current Reservoir Ecological Health Program, TVA monitors ecological conditions at 69 sites on 31 reservoirs. Each site is sampled every other year unless a substantial change in the ecological health score occurs during a 2-year cycle. If that occurs, the site is sampled the next year to confirm that the change was not temporary. Roughly half the sites are sampled each year on an alternating basis. The program includes five ecological indicators (chlorophyll-a, dissolved oxygen (DO), sediment quality, benthic macroinvertebrates, and fish assemblage), which are monitored at up to four locations in each reservoir. To complete the ecological health scoring process, the 20 to 100 percent scoring range is divided into categories representing good, fair, and poor ecological health conditions relative to what is expected given the hydrogeomorphology of the reservoir.

Melton Hill Reservoir

TVA has monitored three locations on Melton Hill Reservoir: the deep, still water near the dam, called the forebay; the middle part of the reservoir; and the riverine area at the upper end of the reservoir, called the inflow. Monitoring is usually done on a two-year cycle. The overall ecological condition of Melton Hill rated fair in 2018. Melton Hill received a good rating in 2006, 2010, and 2016 but rated fair in all other years monitored. The higher ecological health scores were primarily due to two indicators (chlorophyll and bottom life) rating near the upper end of their historic ranges, as well as fish community scores in 2016.

Watts Bar Reservoir

TVA has monitored four locations on Watts Bar Reservoir: the forebay; the middle part of the reservoir; and the Tennessee and Clinch River inflow locations. Samples are usually collected on a two-year cycle. The overall ecological health condition for Watts Bar Reservoir rated at the upper end of fair in 2018. Ecological health scores for Watts Bar have fluctuated between a "high fair" and poor and have generally followed reservoir flow conditions. Flow conditions in 2012 were low during most of the summer months in response to the generally dry weather pattern. The indicator most responsive to flow is DO, which rated poor at the forebay in 2012. In addition, common problems are elevated chlorophyll concentrations, poor bottom life, and the presence of metals and/or organic contaminants in the sediments.

3.3.1.1.3.4 CRN Site Preapplication Monitoring Program

Water Quality Monitoring

To support the evaluation of the suitability of the CRN Site and BTA, TVA monitored the surface water on and in the immediate vicinity of these areas from July 2013 to June 2015. This program consisted of characterization of surface water in the Reservoir, as well as characterization of stormwater runoff on both the CRN Site and BTA. The resulting data provides information to determine existing conditions for surface water. The parameters measured or analyzed include temperature, total metals, nutrients, acids/base/neutral compounds, PCBs, gross alpha, gross beta, radium 228, radium 226, oil and grease, pH, cyanide, phenols, biochemical oxygen demand, chemical oxygen demand, total suspended solids (TSS), color, bromide, surfactants, total organic carbon (TOC), sulfide, sulfate, ammonia-N, fluoride, and hardness. Pesticide monitoring was included in the July 2013 sampling.

Nutrient and sediment chemistry data (as indicators of ecological health) were also collected at four mid-channel locations, including three upstream locations at CRM 18.5, 19.7, and 22.0, and one downstream location at CRM 15.5. Water samples were analyzed for nutrients (Kjeldahl nitrogen, nitrate plus nitrite-nitrogen, ammonia nitrogen, total phosphorus, and orthophosphate), TOC, alkalinity, hardness, water clarity (turbidity and TSS), total dissolved solids (TDS) and total and dissolved metals. In June 2011, sediment samples were collected at three of the locations, including CRM 15.5, 18.5, and 22.0. Sediment samples were analyzed for metals and organochloride pesticides and PCBs.

Results of water quality, nutrients, and sediment chemistry as compared with State of Tennessee water quality criteria are summarized in Table 3-7. The water quality criteria included in Table 3-7 are the most restrictive values for the applicable designated uses. Maximum measured values of reported water quality parameters satisfied available water quality standards, with the exceptions of lead, mercury, and thallium.

Table 3-7. Maximum Values for Water Quality Parameters Measured by TVA in the Clinch River Arm of Watts Bar Reservoir

			Clinch River Arm of Watts Bar Reservoir		Stormwater
Parameter	**Units**	**Water-Quality Criteria[(a)]**	**Biological Monitoring Stations CRM 15.5, 18.5, 19.7, and 22.0 (all dates)**	**Pre-Application Monitoring Stations CRS8, CRS9, CRS10, CRS12 (all dates)**	**Pre-Application Monitoring Stations CRS1, CRS2, CRS3, CRS6 (all dates)**
Temperature	°C	30.5	-	26.8	31.3
pH		6.5 to 9.0	-	6.1-7.7	6.7-81
Oil and Grease	mg/L		-	<5.0	<5.6
Cyanide	µg/L	5.2	-	<5	<5
Total Phenols	mg/L	10	-	0.14	0.083
Biochemical Oxygen Demand	mg/L		-	8.85	< 5
TSS	mg/L		-	13.4	114
Color	PCU		-	50.0	80.0
Bromide	mg/L		-	0.10	2.0
Surfactants	mg/L		-	0.20	0.16
Total Organic Carbon	mg/L		3.6	18.1	37.0
Sulfide	mg/L		-	<0.10	< 0.10
Ammonia-N	mg/L	1.24[(b)]	0.19	0.21	0.13
Nitrate/Nitrite	mg/L	10	0.7	1.5	0.95
Total Organic Nitrogen	mg/L		-	< 0.50	1.1
Total Kjeldahl Nitrogen	mg/L		0.79	< 0.50	1.1
Total Phosphorus	mg/L		0.048	< 0.10	0.23
Chemical Oxygen Demand	mg/L		-	< 25	6.2
Total Fluoride	mg/L		-	< 0.50	0.25
Sulfate	mg/L		-	24.3	130
Alkalinity	mg/L		130	-	-
Suspended Solids	mg/L		11	-	-
Dissolved Solids	mg/L	500	200	-	-
Hardness, Total (as $CACO_3$)	mg/L			143	324
Phosphate, Ortho	mg/L			-	-
Total Organic Carbon	mg/L			-	-
Turbidity	NTU		12	-	-
Metals					
Total Aluminum	µg/L		800	747	2,180
Aluminum, Dissolved	µg/L		150 DT[(c)]	-	-
Total Magnesium	µg/L		11,000	11,400	33,100
Magnesium, Dissolved	µg/L		12,000	-	-
Total Calcium	µg/L		38,000	39,100	87,300

			Clinch River Arm of Watts Bar Reservoir		Stormwater
Parameter	**Units**	**Water-Quality Criteria[(a)]**	**Biological Monitoring Stations CRM 15.5, 18.5, 19.7, and 22.0 (all dates)**	**Pre-Application Monitoring Stations CRS8, CRS9, CRS10, CRS12 (all dates)**	**Pre-Application Monitoring Stations CRS1, CRS2, CRS3, CRS6 (all dates)**
Total Iron	µg/L		610	232	2,880
Iron, Dissolved	µg/L		<100	-	-
Total Copper	µg/L	g[(d)]	<2.0	1.5	5
Copper, Dissolved	µg/L	g[(d)]	2.2 DT	-	-
Total Zinc	µg/L	120[(d)]	<10	10.0	25.0
Zinc, Dissolved	µg/L	120[(d)]	<10	-	-
Total Barium	µg/L	2,000	-	38.4	81.5
Total Boron	µg/L		-	50	50
Total Cobalt	µg/L		-	1.0	5
Total Manganese	µg/L		58	895	884
Manganese, Dissolved	µg/L		42 DT	-	-
Total Molybdenum	µg/L		-	1.0	1.2
Total Tin	µg/L		-	50	50
Total Titanium	µg/L		-	< 10	36.9
Total Antimony	µg/L	6	-	1.0	1.0
Total Arsenic	µg/L	10	1.1	0.0	5.0
Arsenic, Dissolved	µg/L	10	<1.0	-	-
Total Beryllium	µg/L	4	-	1.0	0.18
Total Cadmium	µg/L	5	<0.5	0.1	0.10
Cadmium, Dissolved	µg/L	0.25[(d)]	<0.5	-	-
Total Chromium	µg/L	11(Cr-VI)[(e)]	<2.0	1.4	5
Chromium, Dissolved	µg/L	11(Cr-VI)	<2.0	-	-
Total Lead	µg/L	2.5[(d)]	8.6	2.1	3
Lead, Dissolved	µg/L	2.5[(d)]	1.5 DT	-	-
Total Mercury	µg/L	0.05[(e)]	-	-	1,220
Low-Level Mercury	µg/L	50[(e)]	-	5.33	5.64
Total Nickel	µg/L	100	3.1	1.0	5.0
Nickel, Dissolved	µg/L	52[(d)]	2.5	-	-
Total Selenium	µg/L	5	<1.0	1.0	5.0
Selenium, Dissolved	µg/L	5	<1.0	-	+
Total Silver	µg/L	3.2[(d,f)]	-	< 0.5	0.5
Total Thallium	µg/L	0.24	-	1.0	1.0
Radioactivity			-		
Gross Alpha	pCi/L	15	-	<MCD[(f)]	2.39 ± 1.21
Gross Beta	pCi/L		-	2.85 ± 1.0	3.12 ± 1.41
Total Alpha Radium	pCi/L		-	<MDC	<MDC

Parameter	Units	Water-Quality Criteria[(a)]	Clinch River Arm of Watts Bar Reservoir		Stormwater
			Biological Monitoring Stations CRM 15.5, 18.5, 19.7, and 22.0 (all dates)	Pre-Application Monitoring Stations CRS8, CRS9, CRS10, CRS12 (all dates)	Pre-Application Monitoring Stations CRS1, CRS2, CRS3, CRS6 (all dates)
Radium 226	pCi/L	5 (Ra-226	-	0.719 ± 0.217	<MDC
Radium 228	pCi/L	+ Ra-228)	-	<MDC	<MDC

(a) Chapter 0400-40-03, General Water Quality Criteria, Rules of the Tennessee Department of Environment and Conservation. Values shown are the most restrictive for the applicable designated uses.
(b) For pH 8 and 25°C (Chapter 0400-40-03, General Water Quality Criteria, Rules of the Tennessee Department of Environment and Conservation gives formulas for calculating Criteria Maximum Concentration depending on presence/absence of salmonids and pH)
(c) DT=dissolved fraction exceeded the total recoverable metal concentration.
(d) Criteria concentrations are a function of total hardness; values correspond to total hardness of 100 mg/L.
(e) Criteria concentration expressed as dissolved.
(f) Fish and Aquatic Life Criteria Maximum Concentration for dissolved silver from Chapter 0400-40-03, General Water Quality Criteria, Rules of the Tennessee Department of Environment and Conservation. MDC – minimum detectable concentration

Temperature

The water temperature in the Reservoir varies with meteorological conditions and operation of the upstream Norris and Melton Hill Reservoirs. Cold water released from storage in Norris Reservoir flows down to Melton Hill Reservoir where it receives heat from Bull Run Fossil Plant cooling water discharge. This contributes to thermal stratification in Melton Hill Reservoir, which affects the temperature of water at the Melton Hill Dam hydroelectric intakes and therefore affects the temperature of the water released downstream to the Clinch River arm of the Watts Bar Reservoir. Figure 3-10 presents the average and range of hourly water temperature in the tailwater below Melton Hill Dam. During thermal monitoring in 2013, TVA found that hourly water temperature at the proposed discharge location approximately 7.7 miles downstream of Melton Hill Dam could range from up to 1°F colder to 3°F warmer than the Melton Hill Dam tailwater temperature. As a result, TVA estimated a seasonal water temperature range of 38°F in winter to 78°F in summer at the discharge location. While Melton Hill Dam operations are expected to continue in the same manner during building and operating activities at the CRN Site, the Bull Run Fossil Plant is scheduled for closure at the end of 2023 (TVA 2021a). As such, future water temperature fluctuations and seasonal variability are expected to exhibit a reduced range and degree of stratification relative to existing conditions.

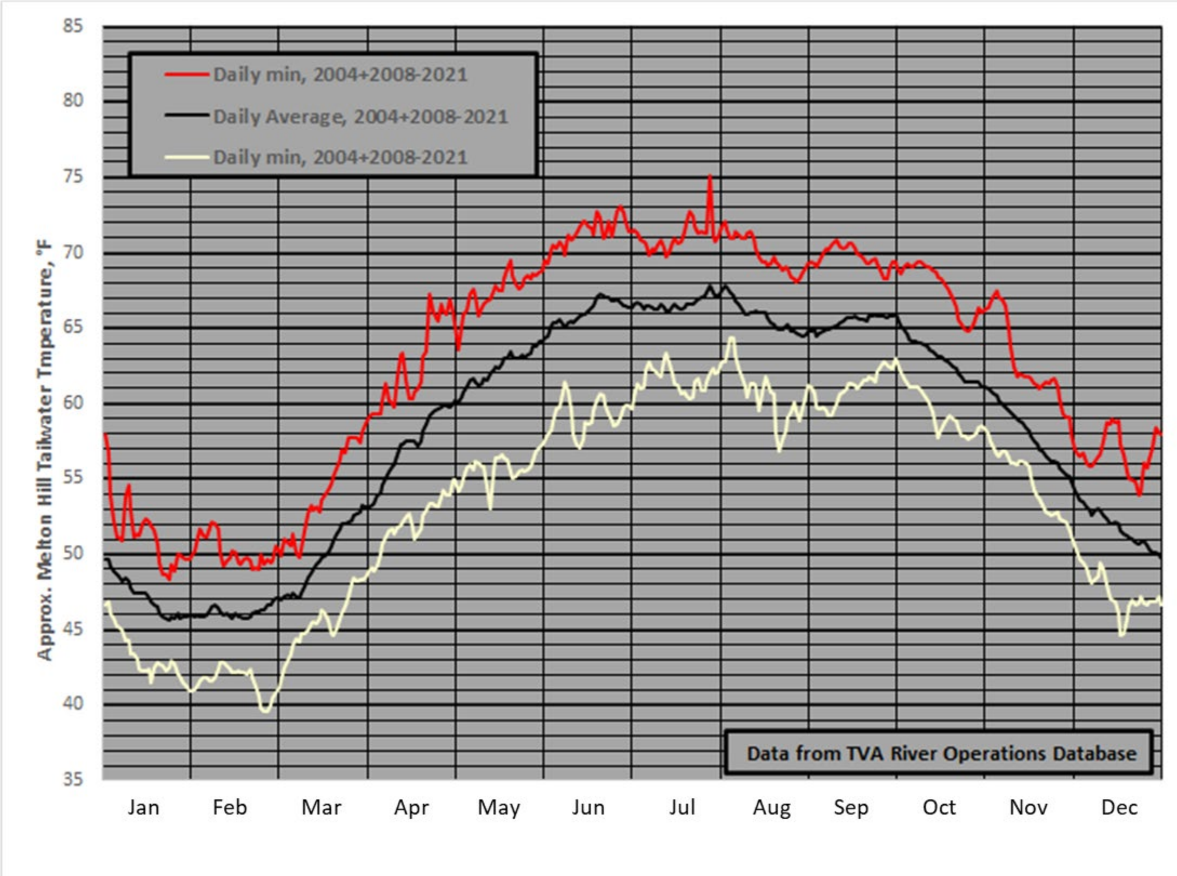


Figure 3-10. Average and Range of Hourly Water Temperature in the Tailwater below Melton Hill Dam by Date (data from 2004 and 2008–2021)

3.3.1.1.3.5 Sediments

Sediments present from CRM 0.0 to CRM 44 are a designated Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) site as the result of hazardous and radioactive contamination from past activities at ORR and other non-DOE municipal and industrial sources (EPA 1997). The current remedy includes maintenance of institutional controls on potential sediment-disturbing activities (i.e., the procedures of the Watts Bar Interagency Working Group), fish-consumption advisories, and monitoring to detect changes in contaminant levels or mobility. The 1991 Interagency Agreement (Watts Bar Interagency Agreement) was established in partnership with the USACE, DOE, TDEC, and the EPA, to coordinate review of permitting and other use authorization activities that could result in the disturbance, re-suspension, removal, and/or disposal of contaminated sediments in the reservoir. The agreement, signed in 1991, defines how each agency coordinates with the others to review proposed activities to determine their potential to disturb contaminated sediments. The CERCLA investigation concluded that metals and radionuclide contaminants occur in deep-water sediments, the highest concentrations are buried 20–60 centimeters deep, and little DOE-related contamination is in near-shore sediments (EPA 1997). Radionuclides detected in sediment during the CERCLA investigation included Cs-137, Co-60, uranium-238 (U-238), U-235, and Tc-99. DOE conducted annual sediment sampling at locations near the CRN Site through 2005, at which point the sampling frequency was reduced to once every five years; the closest monitoring location was at about CRM 14.5.

A number of metals and radionuclides have been present at greater than background concentrations (as measured at CRM 44.5-45). In 2015, sediment concentrations of aluminum, boron, lithium, potassium, and cesium-137 exceeded background levels. Cesium-137 concentration was very low, at 1.35 pCi/g sediment. PCBs were below detection levels in 2010 at CRM 14.5.

3.3.1.2 Groundwater

This section describes groundwater conditions associated with the CRN Site, including a description of regional aquifers and aquitards and those present at the CRN Site. The CRN Site is located within the Valley and Ridge Physiographic Province. The geologic units within the Valley and Ridge physiographic province are described in Section 3.2 and comprise the aquifers and aquitards found at the CRN Site.

3.3.1.2.1 Groundwater Hydrology

The principal aquifers in the Valley and Ridge Physiographic Province are found within the carbonate bedrock of Cambrian, Ordovician, and Mississippian age. The aquifers that underlie the Valley and Ridge Physiographic in Tennessee typically occur in the valleys and are rarely present on the broad dissected ridges. The carbonate-rock aquifers are often directly connected to surface-water features, such as rivers and lakes, that serve either as groundwater discharge points or as sources of recharge. The carbonate aquifers have little primary porosity, and permeability and groundwater movement in the Valley and Ridge aquifers is primarily a function of flow through apertures created along fractures, bedding planes, and solution openings which may be enlarged by dissolution (karst development). Groundwater flow also occurs within the primary pore spaces of alluvium occurring along stream courses, and residuum formed from the weathered rock that overlies bedrock.

Groundwater movement in the Valley and Ridge Physiographic Province in eastern Tennessee is localized due to the occurrence of thrust faults, which resulted in a repeated sequence of permeable and less permeable rocks. An example of this sequence can be seen in the cross-section shown in Figure 3-1. This repeated sequence together with the stream network, divides the area into a series of adjacent, isolated, shallow ground-water flow systems causing localized groundwater movement. Groundwater in the Valley and Ridge Physiographic Province generally moves from the ridges toward the valleys where it either discharges to streams running parallel to the valleys or flows along the geologic strike (down the valleys) toward more distant discharge points (springs or streams). Most of the groundwater flow occurs within 300 feet of the ground surface.

The principal aquifers of the Valley and Ridge Physiographic Province have well yields ranging from 1 to 2,500 gpm, with median yields ranging from 11 to 350 gpm. Spring discharges emanating from the principal aquifers range from 1 to 5,000 gpm, with median discharges of 20 to 175 gpm. Spring discharge during periods of abundant rainfall is significantly larger (as much as 10 times larger) than the discharge during extended dry periods which are associated with shallow groundwater flow. Well yields and spring discharge are highest in the carbonate-dominated sections of the aquifers due to dissolution along groundwater-flow pathways. As identified in Section 3.2, karst features (caves and surface depressions resulting from collapse of dissolution cavities) have been identified within the CRN Site and the vicinity.

Groundwater recharge rates are expected to be highest in areas that have a prevalence of carbonate-dominated rocks and karst development near the surface and occurs sporadically in response to precipitation events.

A sole source aquifer is defined by the EPA as the sole or principal source of drinking water that supplies 50 percent or more of drinking water for an area, with no reasonable available alternative sources should the aquifer become contaminated. Because surface water is abundant in the area of the CRN Site, the EPA's Sole Source Aquifer Program has not identified any sole source aquifers in east Tennessee (EPA 2021b). The identified sole-source aquifers in EPA Region 4 are beyond the boundaries of the local and regional hydrogeologic systems associated with the CRN Site. Therefore, the CRN Site would not impact any identified sole source aquifer.

Groundwater at the CRN Site is present in both the unconsolidated surface materials and bedrock. The weathered bedrock acts as a water table aquifer with depth to groundwater within the CRN Site ranging from near surface to 25 feet below ground surface. The presence and orientation of rock fractures and the extent of conduits and cavities resulting from dissolution controls the occurrence and movement of groundwater at the CRN Site. The Chickamauga Group is generally comprised of thinly bedded (0.5- to 4-inch) limestone and shale, which tends to reduce the occurrence of connected fractures and dissolution channels. The weathering and dissolution that allows for groundwater flow in the Chickamauga Group are more likely to occur in the more limestone-rich units, such as the Witten and Rockdell formations. While a few karst features (cavities) were observed at lower elevations, as low as 660 feet NAVD88, suggesting that groundwater circulation occurs at greater depths, most cavities were observed at elevations above the elevation of the Clinch River bed (approximately 720 feet NAVD88).

Groundwater monitoring wells were installed and screened in the Bowen, Benbolt, Rockdell, Fleanor, Eidson, and Blackford Chickamauga Group formations and in the upper portion of the Knox Group as clustered sets on Area 1 of the CRN Site as part of the ESPA process. Observation well data in combination with measured water-surface elevations in Watts Bar Reservoir indicate that the level of the Reservoir did not significantly affect the observed groundwater hydraulic head measurements. Additionally, the reported assessment of precipitation data with the observation well hydraulic head measurements indicated no strong seasonal variation in groundwater levels. However, some wells demonstrated seasonal fluctuations with higher levels in winter and early spring months. In groundwater wells that were continuously measured, water levels were observed to fluctuate by as much as 25 feet in response to precipitation events.

Generally, in the central portion of Area 1, the downward-vertical gradients between aquifer units are indicative of zones of groundwater recharge (e.g., Upper to Lower units, and in some cases Lower to Deeper units), whereas areas having upward-vertical gradients (e.g., deeper to lower to upper units) are zones of aquifer discharge. These discharge zones, where present in areas of shallow groundwater, may influence or contribute to the hydrology of associated wetlands and surface water features (springs, seeps, streams, ponds). In general, the vertical gradients tended to be downward in the center (upland areas) of the CRN Site and upward closer to the several wetlands and reaches of streams near the Reservoir, indicating groundwater recharge is likely occurring in the center of the site and groundwater is likely discharging to these surface water features and to the Reservoir, and to other incised drainage features (such as ephemeral streams).

Groundwater flow at the CRN Site generally occurs predominantly within the fractures and bedding planes of the bedrock and groundwater flow over significant distances and requires continuously connected fractures. The connectivity of the fracture network must be considered when interpreting hydraulic head measurements in wells. The available data indicates that bedrock fracturing decreases with depth, supporting that most groundwater flow occurs within the weathered rock and at shallow depths within the competent rock. The shallow groundwater is thought to discharge to the local streams and rivers, with the majority of groundwater recharged at the site, flowing through the uppermost aquifer units, and discharged to the Reservoir after a short time in the aquifer. However, it is noted that the Reservoir may not be a complete hydraulic barrier to deeper groundwater flow in the presence of significant hydraulic forcing and a connected fracture pathway. Such a pathway, however, is not known to exist at the CRN Site.

Groundwater flow at the CRN Site is characterized as occurring primarily within approximately 150 feet of the ground surface with little or no connection to groundwater at greater depths due to the observed decreasing fracture frequency with depth.

Groundwater primarily flows within the weathered rock and at shallow depths within the fractures of the competent rock primarily and discharges to the small streams and ponds onsite, or directly to the Reservoir based on vertical head gradients. Groundwater velocity was reported to be on the order of 3.9 feet/day based on an average horizontal hydraulic gradient (0.07 feet/feet), the maximum saturated hydraulic conductivity from the aquifer testing 2.6 feet/day), and an effective porosity of 0.0467.

3.3.1.2.2 Groundwater Use

The predominant source of water for all uses in the Tennessee Valley is surface water. As the primary source of water for drinking, agricultural, and industrial uses, this accounts for 98.1 percent of total withdrawals in 2015. Groundwater provided the balance at 1.9 percent, or about 189 MGD of withdrawals in the Tennessee Valley. Groundwater withdrawals within the Watts Bar arm of the Clinch River accounted for 2.23 MGD, whereas withdrawals from the Melton Hill arm of the Clinch River accounted for 1.38 MGD (Bowen and Springston 2018). EPA's Safe Drinking Water Information System database was searched for water systems near the CRN Site with a primary water source of groundwater. The closest system was a transient non-community water system (a campground) located south of the Reservoir about 2.5 miles from the CRN Site boundary (EPA 2021a). All other water systems using groundwater as a primary water source were much farther from the CRN Site.

TDEC records were used to identify groundwater well users within about 1.5 miles of the CRN Site. A total of 32 residential wells, three commercial wells, and one agricultural well were reported in TDEC records (Figure 3-11). Of the identified wells, it is reported that well depths range from 42 to 900 feet below ground surface (bgs), with about 50 percent of the wells less than 300 feet deep. While the geologic formations were not provided for these wells, most of the wells were inferred to penetrate the Knox Group and upper Conasauga Group formations based on regional geologic information. Reported estimated well yields ranged from 0.5 to 75 gpm, and 50 percent of well yields were less than 7 gpm.

3.3.1.2.3 Groundwater Quality

Groundwater samples were obtained in support of the ESPA from wells on the CRN Site in Area 1 during monitoring in 2013 and 2014. Results indicate CRN Site groundwater is characterized as mostly calcium bicarbonate to magnesium-bicarbonate, with pH levels between approximately 7 and 8, and TDS concentrations ranging from 190 to 520 mg/L. A sample collected from the deepest well sampled is screened in the Fleanor Shale unit (at a depth of 160 feet bgs) and reported to have a sodium-bicarbonate chemistry with a pH level of 9.6 and TDS concentration of 1,100 mg/L. The results from the deepest well are reported as being a characteristic of deeper groundwater and may have been biased by sampling difficulties. The reported TDS result from the CRN Site well sampling is within the reported TDS concentrations for Valley and Ridge Physiographic Province aquifers which range between 15 to 1,700 mg/L, with a median concentration of 150 mg/L. Additionally, a well on the ORR and adjacent to the CRN Site at a depth of approximately 400 feet bgs was reported to have a sodium-chloride chemistry with high TDS.

Water quality parameters have been evaluated and compared to established Tennessee and EPA drinking water maximum contaminant levels for metals, gross alpha and beta radioactivity, selected radionuclides, organic compounds, PCBs, and pesticides. The only parameters reported to exceed maximum contaminant levels are fluoride in five samples from two wells and lead in one sample.

In consideration of legacy contamination at the ORR, which is adjacent to the CRN Site, quarterly groundwater quality monitoring results for the CRN Site were also evaluated for the presence of ORR legacy contaminants associated with long-term mission and adjacent-area operational activities. There are 10 legacy contaminants that were identified in CRN Site water samples at low concentrations (Table 3-8). The detection of these contaminants does not indicate a direct transport pathway from the adjacent ORR because of the regional geologic structures that create separation of the ORR contamination plumes from the CRN Site. The existing groundwater contamination in Bear Creek Valley and Bethel Valley on the ORR is more than 2 miles from the CRN Site.

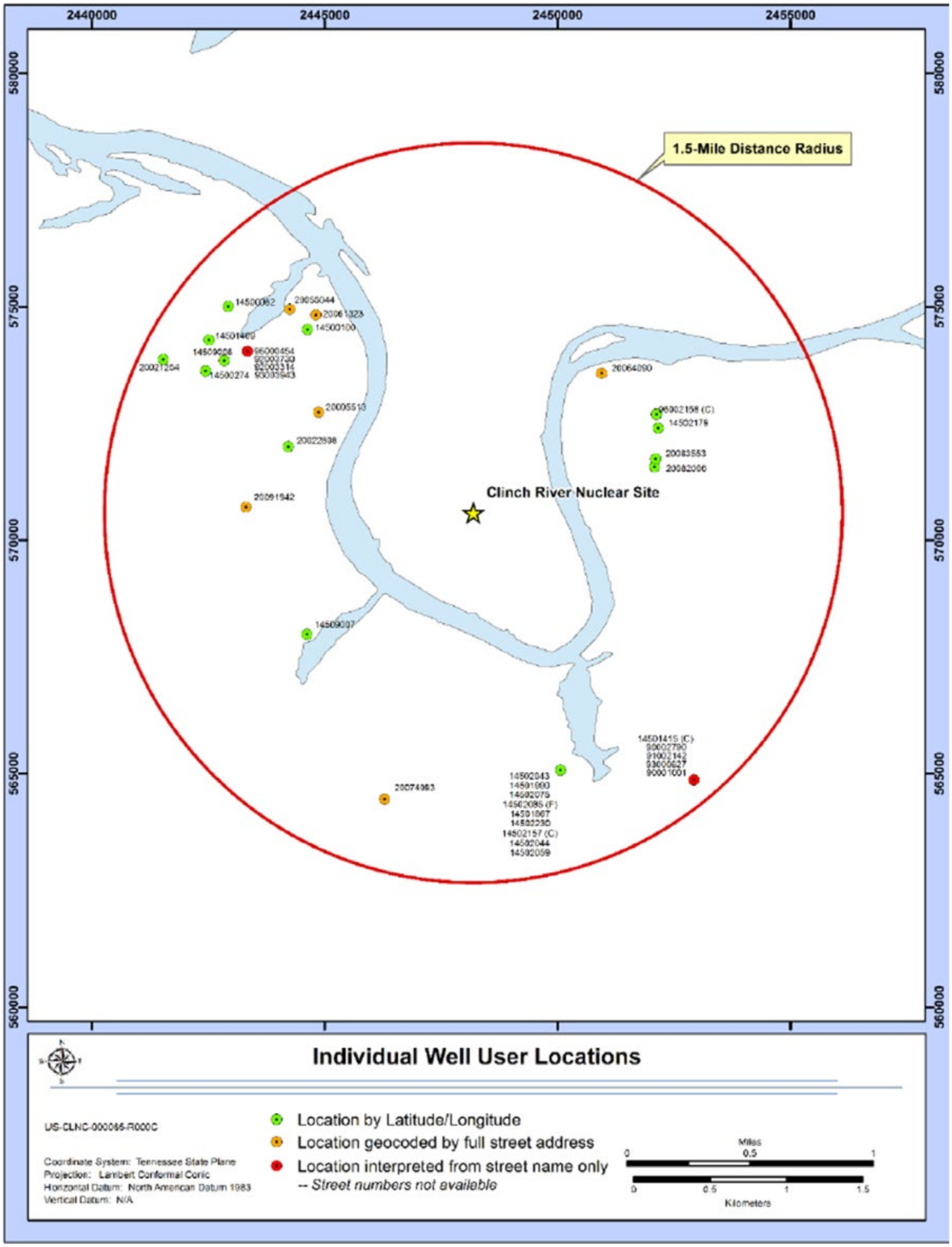


Figure 3-11. Wells Located within 1.5 Miles of the CRN Site

Table 3-8. ORR Legacy Contaminants Detected in CRN Site Groundwater Samples

Parameter	MCL	Maximum	# Detections
Nitrite + Nitrate, mg/L	NE[(a)]	2.62	54
Arsenic, µg/L	10	7	1
Barium, µg/L	2000	582	73
Cadmium, µg/L	5	1.2	2
Chromium, µg/L	100	11.6	5
Tritium, pCi/L	NE	847	4
Strontium-90, pCi/L	NE	0.428	5
Technitium-99, pCi/L	NE	8.16	3
Chloroform, µg/L	80	4.02	22
Tetrachloroethylene, µg/L	5	0.499	1

(a) Not established
MCL = maximum contaminant level.

Petroleum products were detected in a single well on the CRN Site during well completion activities in 2013, but the source of the contamination is reported to be localized around the well and no source was identified. The well cluster (upper, lower, and deep wells) is locked and not currently used for groundwater sampling.

3.3.1.3 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several reasonably foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of water resources within their respective project footprints. Depending on the local environmental setting and the design characteristics of these other proposed actions, direct alteration of surface water resources may occur. Furthermore, each of these projects entails land disturbance activities that have the potential to increase site runoff and contribute to pollutant loading and sedimentation within associated surface water resources. However, the specific details regarding the scope of these actions are lacking. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area and are not expected to directly impact the same resources as those potentially affected by activities at the CRN Site. Additionally, none of the identified projects are considered to have a causal relationship to the proposed development of the CRN Site. Further consideration of reasonably foreseeable future actions and their effects on water resources are included in the following section as appropriate.

3.3.2 Environmental Consequences

3.3.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not develop the CRN Nuclear Technology Park. Additionally, there are no existing uses of groundwater on the CRN Site. As such under this alternative there would be no alteration of surface water or groundwater resources or their associated hydrology, use, or quality. Therefore, there would be no impacts to surface water and groundwater resources with Alternative A.

3.3.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.3.2.2.1 Surface Water Resources

In conjunction with Alternative B, TVA would develop the CRN Nuclear Technology Park only at Area 1. Actions that would impact water resources include site preparation within temporary and permanent use areas (Area 1 and laydown areas), development and improvement of roadways and associated barge access infrastructure, expansion of transmission systems, and construction and operation of structures associated with the cooling system, and potential flow alteration associated with the operation of the Melton Hill Dam. The proposed surface water intake is located at CRM 17.9, and the proposed discharge is located at approximately CRM 15.5.

3.3.2.2.1.1 Surface Water Hydrology

<u>Construction</u>

A number of activities would be conducted under Alternative B that could result in hydrologic alterations within the CRN Site and associated offsite areas. These include the following:

- General clearing and grading at the project areas and building infrastructure (e.g., roads, laydown areas, parking lots, and stormwater-conveyance and -retention systems)
- Construction and refurbishing of transportation corridors and features (roads, barge facilities)
- Construction of new structures at the site (e.g., power-block structures, cooling towers, switchyard, and subgrade piping and systems)
- Installation of a 5-mile-long transmission line from the CRN Site to the Bethel Valley Substation and various offsite transmission system uprates and upgrades
- Installation of pipelines and other utility infrastructure
- Excavation of the nearshore area of the Clinch River arm of the Watts Bar Reservoir in support of the construction of the cooling water intake structure, discharge structure (including associated diffuser) and supplemental onsite barge facility
- Excavation of a discharge holding pond and refurbishment of previously developed stormwater management ponds on the CRN Site
- Excavation and dewatering for construction of the nuclear island

Construction phase site preparation would entail general land disturbance and impacts to surface waterbodies on and near the CRN Site, including the Reservoir, Grassy Creek, and small unnamed streams and ponds on the CRN Site and associated offsite areas including the BTA, the TN 95 Access, and the 161-kV offsite transmission line (see Figures 2-1 through 2-3).

Following selection of a technology, final site design, and prior to site development and permitting, the USACE would conduct a site visit and make a jurisdictional determination of all surface water and wetland features identified by TVA that could be impacted by the proposed action. Such features are regulated as “waters of the U.S.” (WOTUS). TDEC would also make a Hydrologic Determination to identify the features within their jurisdiction and regulated as “waters of the state.” Table 3-9 summarizes impacts to surface water resources within the CRN

Site and associated offsite areas, and Table 3-10 identifies the potential effects to each identified surface water resource. A summary of total impacts for each alternative is provided in Table 3-11.

A total of 25 onsite streams would be affected under Alternative B (Table 3-11). Impacts include effects to seven perennial streams (1,775 linear feet), six intermittent streams (2,655 linear feet), and 13 ephemeral streams (3,931 linear feet). Alterations to existing streams would result in direct alteration and loss of stream channel and associated riparian zones coupled with the alteration of runoff rates from associated drainage areas and changes to hydrology of remaining adjacent stream habitats. Additionally, four streams would be crossed in conjunction with the potential offsite upgrades within the 500-kV corridor extending to the Bethel Valley substation.

Alterations to these streams are subject to USACE jurisdiction and permitting and/or the TDEC ARAP, and local ordinances as applicable. Unavoidable alterations and losses of regulated streams would be minimized in conjunction with design and mitigated as appropriate. Appropriately designed culverts would be installed as needed to manage runoff and conveyance under proposed access roads and other site improvements. Runoff from the affected areas including potential hydrologic modifications associated with increased runoff from impervious areas and areas with altered land cover would be managed as part of the CRN Site stormwater management requirements. A Tennessee Stream Quantification Tool is required per TDEC regulations to assess the quality of impacted streams in order to calculate mitigation credits. Prior to construction, the Stream Quantification Tool evaluation would be conducted for the stream impacts and would be used to determine the appropriate number of stream credits to be purchased by TVA. Details of the stream mitigation and credits to be purchased would be determined based on final design and subject to permitting requirements.

In addition, the ponds on the CRN Site originally constructed for stormwater management purposes would be reconstructed to manage stormwater and minimize impact to receiving water quality of the Reservoir. As indicated in Table 3-10. Impacts to Identified Surface Water Resources on the CRN Site and Associated Offsite Areas, two ponds would be impacted (P03 and P04) totaling 0.9 acre. Stormwater detention would be incorporated into detailed site design to ensure that runoff rates and discharge requirements are in compliance with all appropriate state and local requirements.

Table 3-9. Summary of Impacts to Surface Water Resources (streams/ponds)

Location	Type	Number	Area (Acres) / Length (Feet)
CRN Site			
	Ponds	2	0.9
	Streams	7	2,133
	WWCs	10	3,861
Associated Offsite Areas			
Barge and Traffic Area			
	Ponds	0	0
	Streams	2	452
	WWCs	2	812
TN 95 Access Area			
	Ponds	0	0
	Streams	3	594
	WWCs	0	0
161-kV Offsite Transmission Line			
	Ponds	0	0
	Streams	1	1,271
	WWCs	4	814
500-kV Corridor to Bethel Valley Substation[1]			
	Ponds	0	0
	Streams	4	-
Project Area Total			
	Ponds	2	0.9
	Streams	17	6,823
	WWCs	16	11,784

[1] Based on desktop analysis within offsite 500-kV corridor, no site review conducted.
Note: WWC = wet weather conveyance

Table 3-10. Impacts to Identified Surface Water Resources on the CRN Site and Associated Offsite Areas

Feature ID	Type	Alternative B	Alternative C	Alternative D	Waters of the State	WOTUS (Federal Status)
CRN Site						
Ponds						
P03	Pond	*0.75*		*0.75*		
P04	Pond	0.16		0.16	Yes	Yes
Total (acres)		*0.91*	*0*	*0.91*		
Streams						
STR03	Perennial	100	100	100	Yes	Yes
STR07	Perennial	681	318	681	Yes	Yes
STR11	Perennial	283	283	283	Yes	Yes
STR04	Intermittent	150	125	150	Yes	Yes
STR05	Intermittent	19	19	19	Yes	Yes
STR06	Intermittent	123	0	123	Yes	Yes
STR10	Intermittent	757	757	757	Yes	Yes
EPH07	Ephemeral/WWC	115	0	115	No	No
EPH08	Ephemeral/WWC	25	0	25	No	No
EPH09	Ephemeral/WWC	614	0	614	No	No
EPH10	Ephemeral/WWC	673	393	673	No	No
EPH11	Ephemeral/WWC	0	567	567	No	No
EPH12	Ephemeral/WWC	0	463	463	No	No
EPH13	Ephemeral/WWC	0	287	287	No	No
EPH14	Ephemeral/WWC	0	240	240	No	No
EPH18	Ephemeral/WWC	83	83	83	No	No
EPH19	Ephemeral/WWC	795	794	794	No	No
Total (feet)		*4,418*	*4,429*	*5,974*		

Feature ID	Type	Alternative B	Alternative C	Alternative D	Waters of the State	WOTUS (Federal Status)
Associated Offsite Areas						
Barge and Traffic Area						
Ponds						
Total (acres)		*0*	*0*	*0*		
Streams						
STR03	Perennial	117	117	117	Yes	Yes
STR01	Intermittent	335	335	335	Yes	Yes
EPH01	Ephemeral/WWC	471	471	471	No	No
EPH02	Ephemeral/WWC	341	341	341	No	No
Total (feet)		*1,264*	*1,264*	*1,264*	*452*	*1,264*
TN 95 Access Area						
Ponds						
Total (acres)		*0*	*0*	*0*	*0*	*0*
Streams						
STR13	Perennial	305	305	305	Yes	Yes
STR14	Perennial	136	136	136	Yes	Yes
STR15	Perennial	153	153	153	Yes	Yes
Total (feet)		*594*	*594*	*594*	*594*	*594*
161-kV Offsite Transmission Line						
Ponds						
Total (acres)		*0*	*0*	*0*	*0*	*0*
Streams						
STR08	Intermittent	1,271	1,271	1,271	Yes	Yes
EPH15	Ephemeral/WWC	101	101	101	No	No
EPH16	Ephemeral/WWC	294	294	294	No	No
EPH17	Ephemeral/WWC	161	161	161	No	No

Feature ID	Type	Alternative B	Alternative C	Alternative D	Waters of the State	WOTUS (Federal Status)
EPH18	Ephemeral/WWC	258	258	258	No	No
Total (feet)		*2,085*	*2,085*	*2,085*	*1,271*	*2,085*
500-kV Corridor to Bethel Valley Substation[1]						
Ponds		0	0	0	0	0
Streams	Undifferentiated[1]	4	4	4	-	-
Clinch River Arm of the Watts Bar Reservoir						
Instream						
Intake Structure		0.23	0.23	0.23	Yes	Yes
Discharge Structure		0.23	0.23	0.23	Yes	Yes
Supplemental Onsite Barge Landing Area		0.23	0.23	0.23	Yes	Yes
Total (acres)		*0.69*	*0.69*	*0.69*	*0.69*	*0.69*
Shoreline						
Shoreline Restoration		9,050	9,050	9,050	Yes	Yes
Total (feet)		*9,050*	*9,050*	*9,050*		

[1] Based on desktop analysis within offsite 500-kV corridor, no site review conducted
Source: TVA 2021d
Note: WWC = wet weather conveyance

Table 3-11. Summary of Impacts to Identified Stream Resources on the CRN Site and Associated Offsite Areas

Feature	Alternative B	Alternative C	Alternative D	Waters of the State	WOTUS (Federal Status)[3]
CRN Site and Associated Offsite Areas					
Ponds (acres)	0.91	0	0.91		
Total (acres)	*0.91*	*0*	*0.91*		
Streams (linear feet)					
Perennial Streams	1,775	1,412	1,775	Yes	Yes
Intermittent Streams	2,655	2,507	2,655	Yes	Yes
Ephemeral/WWC	3,931	4,453	5,487	No	No
Total (linear feet)	*8,361*	*8,372*	*9,917*		
Clinch River Arm of the Watts Bar Reservoir					
Clinch River Instream (acres)	0.69	0.69	0.69	Yes	Yes
Clinch River Shoreline (linear feet)	9,050	9,050	9,050	Yes	Yes

Note: WWC = wet weather conveyance

During building activities in the central portion of the CRN Site, the power block and other structures for a new plant would be located and designed to direct drainage away from the facilities. Modifications to the land surface made during building activities would alter the local hydrology and site drainage. The CRN Site land surface would be developed to include surface water drainage ditches and stormwater retention ponds to manage and control stormwater flows prior to being discharged to the Reservoir. These land-surface modifications would alter surface water runoff flow patterns and the infiltration properties of the land surface. Runoff would increase by replacing vegetated surfaces with buildings and relatively impervious ground surfaces. Details of the required stormwater management system would be developed during final site design, which would include a SWPPP that would be developed in accordance with TDEC stormwater NPDES permit discharge requirements for erosion protection and stormwater management. Stormwater runoff from the CRN Site would be controlled via engineered structures, collected in engineered retention ponds, and infiltrated to the ground, or released to the Reservoir in a controlled manner. The SWPPP would incorporate BMPs to minimize erosion and stabilize the land surface. BMPs would include methods described in the State of Tennessee Erosion and Sediment Control Handbook (TDEC 2012).

Construction activities would also be conducted along the shoreline of the Reservoir. Specific actions to be undertaken include the construction of a CWIS, discharge structure and associated diffuser, supplemental onsite barge facility, and shoreline restoration areas. Development of the CWIS, discharge structure, and supplemental onsite barge facility would require some localized nearshore underwater excavation. These activities would produce temporary and localized effects on patterns of river flows in the immediate area of the building activities. A total of 0.69 acres of nearshore underwater habitat is expected to be impacted by construction activities (Table 3-11). As summarized in Table 2-5, a minor amount of instream habitat alteration would be expected within the Reservoir.

TVA also proposes to implement shoreline restoration measures at selected locations along the Reservoir both within the CRN Site boundary and along the proposed TN 95 Access area. In total, up to 9,050 feet of shoreline between CRM 20.75 and CRM 17.9 would be restored (see Table 2-5 and Table 3-11). These areas are locations that were observed to be characterized as having a higher incidence of bank erosion and failure. Shoreline restoration activities would entail the placement of stabilizing structures along the bank line to minimize further bank erosion and restore previously eroded areas. Placement of shoreline stabilization structures would result in minor localized changes in river flow and current velocity but would provide long-term beneficial effects in shoreline stabilization and reduced erosion. Detailed restoration measures would be determined during final design and would be subject to permitting by the USACE under Section 404 of the CWA and Section 10 of the Rivers and Harbors Act and/or TDEC ARAP process, as applicable. Because the proposed measures would stabilize and restore the shoreline and would be sufficiently designed to reduce bank erosion and scour impacts associated with the construction activities, impacts on hydrology of the Reservoir would be beneficial.

In summary, TVA has determined that all construction impacts to surface waters related to the development of the CRN Site and associated offsite areas would have both direct and indirect impacts to surface water resulting in moderate permanent impacts associated with conversion and loss of onsite streams and shoreline alteration of the Reservoir. These impacts would be minimized to the extent practicable during design and appropriately mitigated in accordance with applicable permit requirements. Impacts to streams would be mitigated by purchase of credits in mitigation bank in accordance with permits, as appropriate. Shoreline restoration activities would provide long term beneficial effects in shoreline stabilization and reduced erosion. All discharges would comply with current or future NPDES permit limits and other state and federal regulations.

Operation

Under Alternative B development of a nuclear plant at the CRN Site could include the use of water from the Reservoir for the cooling-water system and other plant water systems. Localized alterations in river velocity and flow patterns are expected to occur in conjunction with the operation of the CWIS and the discharge. For water use, TVA defined the average (expected) temperature and chemical constituent operating conditions as four cycles of concentration and maximum operating conditions as two cycles of concentration. The estimated average and maximum total withdrawal are 18,423 and 30,708 gpm (41.0 cfs and 68.4 cfs), respectively (Section 2.4.7 and Appendix A). Evaporation and drift from the cooling towers would consumptively use the majority of the water withdrawn, and the remainder would be returned to the river as blowdown. Because the heat load would be the same under the average and maximum operating conditions defined by TVA, the estimated average and maximum total consumptive use by a plant for Area 1 would both be 12,800 gpm (28.5 cfs) (Appendix A, item 3.3.9). The primary hydrologic alteration from this water use would be the reduction of flow in the Reservoir, which could affect the availability of water for other uses (see Section 3.3.1.1.2).

The CWIS would be designed to meet current CWA 316(b) requirements for new facilities, with design through-screen intake velocities less than 0.5 ft/s at the screen. Potential impacts of the intake structure operation on aquatic life are evaluated in Section 3.6 (Aquatic Ecology). The NPDES permit would also encompass requirements pursuant to Section 316(b) of the Clean Water Act that ensures the protection of aquatic ecological communities by regulating CWISs. Cooling tower blowdown and plant process water would be discharged to the Reservoir after appropriate treatment and in accord with the requirements of the NPDES permit. The estimated average and maximum discharge rates are 4,270 gpm and 12,800 gpm (12.5 cfs and 39.9 cfs), respectively, including the contribution from the liquid radioactive waste system.

Physical impacts on hydrologic conditions could occur from increased water velocity or unanticipated maintenance dredging that could result in sediment erosion, suspension, and transport. The discharge diffuser would be designed to minimize scour; the diffuser ports would be designed to enhance mixing. No dredging is anticipated to maintain the intake or discharge structures during operation, because sediment accumulation is not anticipated. In the event dredging were to be needed, TVA would perform an environmental review and the activity would be properly authorized in conjunction with a CWA Section 10/404 permit issued by USACE and the ARAP issued by TDEC. Dredge spoils would be placed in a permitted disposal area with appropriate containment and stormwater controls. These activities would disturb sediment containing contaminants from historical practices or spills that occurred offsite at upstream locations. To mitigate and control activities involving the potential disturbance of contaminated sediments in the reservoir, TVA would invoke the 1991 Watts Bar Interagency Agreement, in partnership with the USACE, DOE, TDEC, and the EPA, to coordinate review of permitting and other use authorization activities which could result in the disturbance, re-suspension, removal, and/or disposal of contaminated sediments in the reservoir. The agreement, signed in 1991, defines how each agency coordinates with the others to review proposed activities to determine their potential to disturb contaminated sediments.

In summary, because the associated river structures would be designed to minimize erosion and reduce scour the impacts of operation on hydrology associated with Alternative B would be minor.

3.3.2.2.1.2 Surface Water Use

Construction

Most of the water for building activities (e.g., concrete batch plant, potable, fire protection, and sanitary water systems) would be supplied by the City of Oak Ridge Public Works Department and as such are addressed in conjunction with effects on community facilities and services in Section 3.15.

During the construction phase, surface water use would be limited to relatively small volumes withdrawn from the Reservoir for dust suppression. As such, construction phase impacts associated with water availability and use would be minor and temporary.

Operation

Water-use and water-quality impacts involved with operating a nuclear power plant are similar to the impacts associated with any large thermoelectric power generation facility. Potable water would be supplied by the City of Oak Ridge Public Works Department. Impacts of water supply by the City of Oak Ridge are addressed in conjunction with effects on community facilities and services in Section 3.15.

Permits and certifications that TVA would be required to obtain in support of the operational phase under Alternative B would include the following:

- CWA (33 U.S.C. § 1251 et seq.) Section 401 Certification. This water quality certification would be issued by TDEC and would ensure that operation of a new nuclear power plant would not conflict with State water-quality management programs. This certification must be obtained before the NRC could issue a COL to TVA and before USACE would issue a CWA Section 404 permit.
- CWA (33 U.S.C. § 1251 et seq.) Section 402(p) NPDES Discharge Permit. This permit would be issued by TDEC and would regulate limits of pollutants in liquid discharges to surface water (stormwater and discharge system). A SWPPP would be required. The NPDES permit would also encompass requirements pursuant to Sections 316(a) and 316(b) of the CWA that provide protection to aquatic ecological communities by regulating thermal discharges and CWIS.
- CWA (33 U.S.C. § 1251 et seq.) Section 404 Permit. This permit would be issued by the USACE for the discharge of any dredged and/or fill material during operation into WOTUS. No dredging during operation is planned.
- Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.) Permit. This permit prohibits obstruction or alteration of navigable WOTUS and would be issued by the USACE for dredging activities that may be needed during operation. No dredging during operation is planned.
- Water Resources Information Act of 2002 (T.C.A. § 69-7-301 et seq.). State regulation requiring notification and water withdrawal registration for water withdrawals of 10,000 gpd or more. TDEC uses this information to identify water uses and resources that may require management during drought conditions.
- Water Quality Control Act (T.C.A. § 69-3-101 et seq.) ARAP. This permit is issued by TDEC to authorize physical alterations to waters of the state (stream, river, lake, or wetland), e.g., in the event maintenance dredging is needed.
- Spill Prevention, Control and Countermeasures rule (40 CFR Part 112) and EPA Facility Response Plan (40 CFR Part 9 and 40 CFR Part 112), and the EPA Hazardous Waste Contingency Plan. These regulations require pollution prevention and response plans for spills of oil and other hazardous materials. TVA would develop an IPPP to implement these regulations.
- City of Oak Ridge permits for use of City water and wastewater services.

Table 3-12 provides a comparison of the relative reduction to several Reservoir flow characteristics based on average and maximum withdrawal rates and for losses due to consumptive use. Average withdrawal and consumptive use would be less than 1 percent of the average annual discharge from Melton Hill Reservoir to the Reservoir. Therefore, operation of a plant at the CRN Site would have a minimal effect on average Reservoir flow at the CRN Site. Even the maximum withdrawal would be only 1.5 percent of the average annual flow. Withdrawal and consumptive use are a much larger fraction of the Reservoir flow during low-flow conditions.

For the minimum monthly river flow during the period 2004 to 2013, which occurred during the historically low-flow conditions of 2008, average withdrawal and consumptive use would result in 7.0 and 4.8 percent reductions, respectively, in Reservoir flow at the CRN Site.

Maximum withdrawal exceeds 11 percent of the minimum monthly river flow. For the base flow conditions, average and maximum withdrawals for a plant at the CRN Site would reduce Reservoir flow by 10.3 and 17.1 percent, respectively (see Table 3-12). Average consumptive use at the CRN Site would be 7.1 percent of the bypass flow. For evaluating water-use impacts, the effect of consumptive use is most relevant because the additional impacts on water resources from withdrawal would only occur between the intake and discharge locations, a region of the Reservoir where there are no active surface water withdrawals.

Table 3-12. Reduction in Clinch River Arm of Watts Bar Reservoir Flow from CRN Site Withdrawal and Consumptive Use

Flow Characteristic	Clinch River (cfs)	Flow Reduction from 41.0 cfs Withdrawal (%)	Flow Reduction from 68.4 cfs Withdrawal (%)	Flow Reduction from 28.5 cfs Consumptive (%)
Average Annual Flow[1]	4,670	0.9	1.5	0.6
Minimum Monthly Flow (November 2008)	589	7.0	11.6	4.8

[1]Flows are based 10-year period from 2004 to 2013

Because the minimum daily average discharge required at the Melton Hill Dam is not currently expected to change with operation of a plant at the CRN Site, operation of Melton Hill Reservoir is not expected to change from the current TVA policy for managing flows in the Clinch River arm of the Watts Bar Reservoir. As a result, water use for operation at the CRN Site would not have a noticeable effect on water users that obtain water from Melton Hill Reservoir. Consumptive use at Area 1 would reduce flows downstream of the site. Because the water below Melton Hill Dam is part of the Watts Bar Reservoir, the availability of water in the Reservoir depends not only on releases from Melton Hill Dam, but also on the much larger releases from Fort Loudoun Dam. The average release from Fort Loudon Dam during 2004 to 2013 was about four times larger than the average release from Melton Hill Dam. Additionally, as noted in Section 3.3.1.1.2, TVA plans to close the Bull Run Fossil Plant in 2023 (TVA 2021a), which would reduce both water use and water consumption within Melton Hill Reservoir from existing levels. Similarly, the operation of a plant at the CRN Site would consumptively use less than 1 percent of average flow in the Reservoir. During low-flow conditions (e.g., during drought periods), a plant at the CRN Site would consumptively use up to about 7 percent of the release from Melton Hill Reservoir under existing conditions (Table 3-12). Notably, the Clinch River at the CRN Site is an arm of the Watts Bar Reservoir, and existing water users on the Reservoir are located downstream near the confluence with the Tennessee River or upstream on Melton Hill Reservoir. As such, there are no other surface water users in proximity to the CRN Site that may potentially be affected by withdrawals from the cooling water intake structure.

In summary, the operational effects of Alternative B would not noticeably alter the availability of water supply for upstream or downstream users. Therefore, impacts associated with surface-water use from the operation of a plant at the CRN Site are minor and no additional mitigation would be required.

3.3.2.2.1.3 Surface Water Quality

<u>Construction</u>

Soil disturbances associated with construction activities within the CRN Site and associated offsite areas could potentially result in adverse water quality impacts. TVA expects to minimize potential impacts to streams through avoidance (if practical) and the implementation of erosion and sediment BMPs and a site-specific SWPPP developed for construction work in Tennessee, to reduce potential sediment-laden runoff into adjacent or downgradient streams. TVA plans to redesign and rebuild the existing site drainage and stormwater detention system on the CRN Site to accommodate the level of runoff expected from the new design(s). Soil erosion and sedimentation can accumulate in small streams and threaten aquatic life. During construction, TVA would comply with all appropriate state and federal permit requirements.

Discharges into jurisdictional streams would not occur unless authorized by the USACE through the CWA Section 404 permitting process and/or TDEC ARAP process, as applicable. In conjunction with permitting TVA would identify specific BMPs to address construction-related impacts. Appropriate BMPs would be followed, and all proposed project activities would be conducted in a manner to ensure that waste materials are contained, and the introduction of pollution materials to the receiving waters would be minimized. Temporary stream crossings and other construction and maintenance activities would comply with appropriate state permit requirements and TVA requirements as described in *A Guide for Environmental Protection and Best Management Practices for Tennessee Valley Authority* (TVA 2017). Areas where soil disturbance could occur would be stabilized and vegetated with native or non-native, non-invasive grasses and mulched. BMPs would be used to minimize impacts associated with clearing and site preparation. Mitigation measures would be incorporated into the final design of the project, if required through the permitting processes. As a result of implementing these measures, impacts to surface waters associated with the proposed offsite transmission line upgrades would be minor.

The construction of the supplemental onsite barge area, intake structure, discharge structure, and bank restoration areas would entail localized construction activities within the Reservoir. These activities would disturb sediment containing contaminants from historical practices or spills that occurred offsite at upstream locations. To mitigate and control activities involving the potential disturbance of contaminated sediments in the Reservoir, TVA would comply with the terms and practices of the Watts Bar Interagency Agreement described above (see Section 3.3.1.1.3.5).

TDEC requires monitoring of sediment in the area(s) where disturbance of sediment is proposed. In addition, Section 404 and Section 10 permit conditions intended to ensure that activities that disturb sediments would be followed. Any sediment removed may also contain manmade radionuclides; therefore, coordination with DOE for the disposition of the sediment in an appropriately permitted location is also anticipated.

Because engineering controls (e.g., BMPs, silt fences/curtains, detention/retention basins, cofferdams) regulated by a combination of TDEC and USACE permitting, and the Watts Bar Interagency Agreement, would be in use during all construction activities, the impacts of construction on surface water resources would be controlled, localized, and temporary. Therefore, the impacts on surface water quality associated with Alternative B are minor.

Operation

Stormwater Runoff

Permanent land-surface alterations, as indicated in Section 2.4.1 would affect stormwater runoff from the CRN Site and associated offsite areas. Runoff would increase with the increased impervious surface area and alterations in land cover. A stormwater-management system would be built to manage runoff, and it would be operated in accordance with a stormwater NPDES permit. A SWPPP would be in place to manage stormwater runoff and prevent erosion, as well as prevent and manage accidental spills. After construction, stormwater BMPs would continue to be implemented so that surface water runoff from parking lots and industrially used areas of the site would be diverted to retention pond(s) and stormwater management impoundments with a controlled rate(s) of release. Because BMPs would be used as required by TDEC under the SWPPP, and because the CRN Site constitutes less than 0.1 percent of the drainage area contributing flow to the Clinch River near the CRN Site, operational phase impacts to the surface-water quality of the Reservoir near the CRN Site are considered to be minor.

Thermal Discharge Effects

During the operational phase, blowdown from the CWS cooling towers would be discharged to the Reservoir using a discharge pipeline and diffuser. Thermal discharge would be regulated as part of the NPDES permit administered by TDEC. The applicable temperature-related Tennessee water-quality criteria (TDEC 2019) for the CRN Site discharge are applicable at a depth of 5 feet and include the following:

(1) maximum water temperature change shall not exceed 5.4°F relative to an upstream control point

(2) temperature of the water shall not exceed 86.9°F and

(3) the maximum rate of change shall not exceed 3.6°F per hour

These criteria would be required to be met outside the mixing zone, which would be determined by TDEC and stipulated as part of the NPDES permit along with any monitoring requirements. Tennessee's water-quality criteria (TDEC 2019) specify that mixing zones be restricted in area and not prevent the free passage of fish or cause aquatic life mortality, among other requirements.

To evaluate the thermal effects of the discharge and the potential mixing zone requirements, TVA completed a detailed, three-dimensional modeling study. This study modeled flow in the river from CRM 13.5 to CRM 21.0 (i.e., from about 2 miles downstream of the CRN Site discharge to about 3 miles upstream of the intake). TVA evaluated thermal discharge effects using the maximum PPE values for the withdrawal (25,600 gpm), for the discharge (12,800 gpm), and for the discharge temperature (90°F).

Simulation conditions included a maximum temperature difference of 31°F for a winter scenario and 15°F for a summer scenario (extreme winter and summer conditions with the plant at full power). Simulations evaluated the "sloshing" in the Reservoir over a 48-hour period, with one hydropower unit operating at Melton Hill Dam for 1 hour on, 46 hours off, and 1 hour on. For the ESPA, TVA determined that a steady 400-cfs release from the

Melton Hill Dam bypass was needed to meet water-quality standards. With a river flow of 400 cfs in the downstream direction, TVA's simulation results showed that thermal water-quality criteria would be exceeded outside a 150-feet-diameter mixing zone centered at the discharge diffuser location (Figure 3-12, Hour 24, winter conditions). A 150-feet-diameter mixing zone is about 45 percent of the river width at the discharge location. TVA's simulation results also showed that the unsteady river flows ("sloshing") resulted in occasional local excursions of high-temperature water beyond a 150-feet-diameter mixing zone (Figure 3-12, Hour 24, winter conditions). These excursions exceeded water-quality criteria locally but were over a small area and temporary due to the unsteady flow. The simulation results showed that the discharge plume did not circulate upstream to interact with the intake. Depending on the technology selected for deployment at the CRN Site, it is possible that this flow could be managed with releases from the Melton Hill Dam. Such flow augmentation would be accomplished using the existing dam and would not substantially disturb the Clinch River sediments. Details regarding the need for augmentation of Melton Hill Dam Flow and its associated impacts would be evaluated further in a subsequent NEPA review when more technology-specific design and construction information is available.

Based on TVA's simulation results, these exceedances would be temporary and localized to the area immediately surrounding the mixing zone. However, the NPDES permit administered by TDEC would regulate the thermal discharge and encompass requirements pursuant to Sections 316(a) of the CWA to ensure protection to aquatic ecological communities. Implementation of the NPDES permit in conjunction with a steady, downstream 400 cfs flow from the Melton Hill Dam, would mitigate the thermal effects of the discharge and would meet the applicable water quality criteria with a mixing zone about 150 feet in diameter. As a result, the thermal effects of the operation of Alternative B on the water quality of the Clinch River are localized, seasonally limited to winter conditions, and minor.

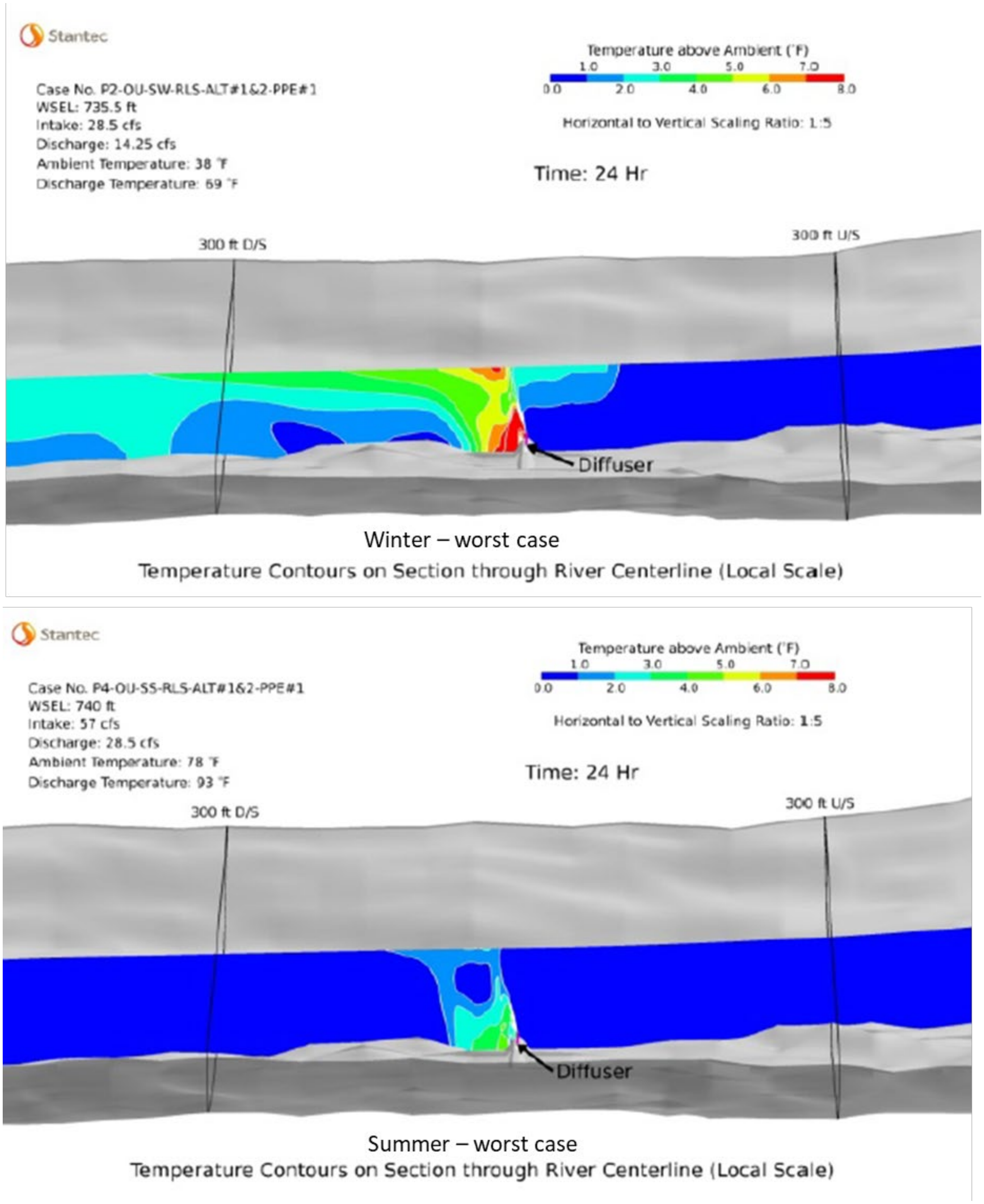


Figure 3-12. TVA Simulation Results of Thermal Discharge Effects under Bounding Conditions in Winter and Summer, 24 Hours from the Start of the Simulation Period

Concentrated Solutes and Residual Chemicals Discharge

Nonradioactive wastewater discharges during operation that may impact water quality include the following: cooling-tower blowdown; wastewater from the demineralized water system; wastewater from floor drains, sinks, and plant laboratories; and stormwater runoff.

Evaporation in the cooling towers would result in the concentration of solutes present in the makeup water that is withdrawn from the Reservoir. While some of these constituents (atmospheric mercury, sediment-associated polychlorinated biphenyl and chlordane) are presently causing water quality impairment in the Reservoir, these constituents would be diluted back to ambient concentrations within the Clinch River by discharge mixing. Therefore, the blowdown is not anticipated to contribute to water quality impairment in the Reservoir.

In addition to cooling-tower blowdown, liquid effluent from the CRN Site could contain residual water-treatment chemicals (e.g., scale inhibitors, pH adjusters, biocides, and coagulants) from treating water for various plant uses. Discharge from the cooling towers would contain anti-scaling compounds, corrosion inhibitors, and biocides to eliminate growth of bacteria and algae. The discharge could also contain concentrated minerals, salts, and organic compounds that enter the makeup water system. Pursuant to 40 CFR Part 423, discharge of these chemicals would be specifically regulated by the conditions of the NPDES permit administered by TDEC and would be subject to the numerical water-quality criteria and anti-degradation statement in the State of Tennessee's general water-quality criteria). Based on the expectation that the CRN Site would comply with all applicable NPDES discharge limits, environmental effects associated with surface water usage are considered minor.

Regular monitoring would be required to ensure that liquid effluent discharges comply with the conditions of the NPDES permit for stormwater and plant wastewater. TVA would develop an operational monitoring program as part of its NPDES permit application. The specific requirements for hydrologic monitoring, water-quality parameters, number of stations, station locations, frequency and method of measurement, and equipment type would be specified in the program. Temperature and contaminant concentration limits would be established, as would any modeling efforts needed to demonstrate compliance. The Reservoir would also be monitored as part of the radiological environmental monitoring program described in Section 3.20.

Summary of Surface Water Quality Impacts During Operation

Impacts of operation activities on surface water in the area would be limited because (1) stormwater and plant wastewater discharges would be subject to NPDES permit requirements, (2) stormwater BMPs would be implemented, and the stormwater runoff from the site would be small compared to the flow of the Clinch River arm of the Watts Bar Reservoir, (3) thermal and chemical mixing zones would be established in the NPDES permit for plant wastewater discharges, and (4) maintenance dredging is not anticipated but, if needed, would meet the terms of applicable permits and the Watts Bar Interagency Agreement. Therefore, impacts to surface water under Alternative B resulting from the operation of a new nuclear plant at the CRN Site are minor.

3.3.2.2.2 Groundwater

3.3.2.2.2.1 Groundwater Hydrology

<u>Construction</u>

Land surface modifications would result in local alterations to groundwater recharge where previously vegetated surfaces are replaced by impervious or low permeability lands. These activities are expected to noticeably alter the spatial and temporal patterns of infiltration and recharge and influence groundwater flow directions in the uppermost aquifer. However, effects on infiltration, recharge, and groundwater flow would be localized within the CRN Site and minor.

Construction phase site preparation would entail general land disturbance and possible impacts to groundwater beneath the CRN Site. Constructing the main plant facilities would require excavation of overburden and weathered rock to reach competent bedrock on which to foundations can be placed. After construction is completed, groundwater hydrology is expected to be altered within the excavations by the placement of fill materials that have hydraulic properties different than native materials removed during excavation.

Depending on the reactor technology selected, excavation may extend to a depth of about 140 feet bgs, to an elevation of 683 feet NAVD88. At this depth, the bottom of the excavation would be approximately 40 feet below the channel bottom of the Reservoir. Because uppermost groundwater at the CRN Site is in communication with the Reservoir (as described in Section 3.3.1.2.1 Groundwater Hydrology), dewatering of the excavated area would likely be required. Dewatering would be accomplished using a gravity-type system(s): water that drains into the excavation under gravity would be collected at the bottom perimeter of the excavation, drained to sumps, and pumped out to a stormwater-retention basin for eventual infiltration or discharge to the Reservoir. Horizontal pressure-relief wells drilled into the excavation walls may be used to reduce hydrostatic pressure behind these walls to facilitate stabilizing the excavation. Thus, construction dewatering would lower groundwater levels in the areas surrounding excavation. To minimize this effect and reduce the need for dewatering, fractures and cavities transmitting large amounts of water—whether groundwater and/or storm flow water— would be appropriately blocked or grouted. This may also influence hydraulic gradients beyond the excavation. As appropriate, TVA would assess the effects of dewatering by monitoring groundwater levels surrounding the excavation and water levels in potentially affected surface waterbodies.

A qualitative evaluation of the effects of excavation dewatering was conducted on the surrounding groundwater levels and ponds, streams, and wetlands on the CRN Site. However, because identified surface water features are generally distant from the center of Area 1, such features are unlikely to be appreciably affected by dewatering based on the smaller radius of influence for the aquifer pumping test. Streams and wetland resources in proximity to excavation and construction areas (including laydown areas) may also be affected by groundwater flow disruptions where such resources have a hydrology that is dependent upon groundwater discharge (e.g., wetlands W019, W020a and W020b, see Figure 3-9). Subsequent to construction, the water table is expected to return to natural conditions.

Groundwater would be extracted as a consequence of dewatering for the power-block excavation. Effects of dewatering would be limited to the shallow groundwater of the CRN Site and not be noticeable at the locations of offsite groundwater users. Because groundwater flow alterations would be temporary and limited to the CRN Site, no impacts to groundwater availability to offsite users would be evident and no cumulative impacts would be anticipated.

In summary, impacts to groundwater hydrology at the CRN Site and associated offsite areas could occur from construction dewatering activities. Impacts would be temporary, limited to excavation and periods of subsurface construction and would have minimal potential for direct and indirect impacts to localized groundwater resources. As a result of engineering controls and final design measures, impacts associated with land disturbance on groundwater hydrology of the CRN Site are minor.

Operation

Land-surface modification in conjunction with the development of the CRN Site under Alternative B would alter the pattern and rate of groundwater infiltration because of the increased amount of impervious surface at the CRN Site. These alterations could affect groundwater flow in the shallow groundwater at the site, but the effects are expected to be localized and minor. The existing pattern of groundwater discharge to the Reservoir is not expected to be altered. No groundwater from onsite sources would be used during operation of the CRN Site.

In summary, impacts to groundwater hydrology at the CRN Site and associated offsite areas from operation are minor.

3.3.2.2.2.2 Groundwater Use

Most of the water for building activities (e.g., concrete batch plant, potable, fire protection, and sanitary water systems) would be supplied by the City of Oak Ridge Public Works Department and as such are addressed in conjunction with effects on community facilities and services in Section 3.15.

During the construction phase, groundwater would not be used for construction purposes and removal of groundwater by dewatering methods to maintain excavations in the dry during construction of foundations, substructure, and below grade infrastructure are relatively short term, i.e., limited to the period of construction. As such, construction phase impacts associated with groundwater resource availability and use are temporary and minor.

No groundwater would be used under Alternative B during operation and groundwater availability would not be affected.

3.3.2.2.2.3 Groundwater Quality

Construction

During construction, gasoline, diesel fuel, hydraulic lubricants, and other similar products would be used for construction equipment. Inadvertent spills of these fluids have the potential to contaminate groundwater. Pursuant to 40 CFR Part 112 and 40 CFR Part 9, TVA would implement an IPPP at the CRN Site, which would include the use of BMPs to minimize the occurrence of spills and limit their effects. These BMPs include actions such as proper vehicle and equipment maintenance, spill precautions such as use of absorbent pads under equipment, containment for fuel or oil storage tanks, and the maintenance of spill response equipment and materials. Four wells no longer in use were found to be present in Area 1. These wells had been used for groundwater characterization of the CRBRP. These would be properly abandoned and closed in accordance with TVA and TDEC requirements. With proper closure these wells would not provide potential pathways of preferential transport of contaminants to groundwater. Based on implementation of an IPPP, the use of BMPs, and closure of CRBRP wells, the effect on groundwater quality of an inadvertent chemical spill would be localized and temporary. As a result, the impacts on groundwater quality would be minor.

As noted previously (Section 3.2.2), a SWPPP would be developed in accordance with TDEC stormwater NPDES permit discharge requirements for erosion protection and stormwater management. Stormwater runoff from the CRN Site would be controlled via engineered structures, collected in engineered retention ponds, and infiltrated to the ground, or released to the Reservoir in a controlled manner. The SWPPP would incorporate BMPs to include not only guidance to minimize erosion and stabilize the land surface, but to also provide BMPs for dewatering methods as described in the State of Tennessee Erosion and Sediment Control Handbook (TDEC 2012).

Groundwater quality impacts identified above would be localized and temporary. Additionally, groundwater discharges would be regulated by NPDES permit and engineering controls and BMPs would be used to minimize and control inadvertent spills. Therefore, the impact on groundwater quality associated with Alternative B would be minor.

Operation

During plant operation(s), gasoline, diesel fuel, hydraulic lubricants, and other similar products would be used for operational equipment. Inadvertent spills of these fluids have the potential to contaminate groundwater. Pursuant to 40 CFR Part 112 and 40 CFR Part 9, TVA would implement an IPPP at the CRN Site, which would include the use of BMPs to minimize the occurrence of spills and limit their effects. These BMPs include actions such as proper vehicle and equipment maintenance, containment for fuel or oil storage tanks, and the maintenance of spill response equipment and materials. Based on implementation of an IPPP, and the use of BMPs, the effect on groundwater quality of an inadvertent chemical spill would be localized and temporary. As a result, the impacts on groundwater quality would be minor.

The stormwater drainage system would direct stormwater to retention basins designed to control the rate, volume, and water quality of runoff that would eventually reach the Reservoir. Stormwater discharge would be regulated under the NPDES permit. Retention basins and the discharge system holding pond may increase infiltration over the area of the basin and increase local recharge to groundwater, potentially affecting groundwater quality. Because stormwater pond design and effluent water quality would conform to the terms of the NPDES permit, infiltration from these basins would have a minor effect on shallow groundwater quality.

In conjunction with operation, a groundwater monitoring program would be defined that would include water level, radiological, and chemical monitoring as well as groundwater modelling to assess future changes from the baseline conditions. The monitoring would be conducted in accordance with TVA’s Groundwater Protection Program which is focused on the prevention, early detection, and mitigation of impacts from potential subsurface or groundwater contamination. As part of the program, a monitoring plan would be developed to specify locations, sampling frequencies, protocols, and procedures for sampling and analysis.

In summary, impacts to groundwater quality at the CRN Site and associated offsite areas from operation are minor and mitigated with the implementation of an IPPP and adherence to NPDES permitting requirements. Site-specific potential effects of groundwater would be further studied under subsequent NEPA analysis once specific technologies are selected and proposed for deployment.

3.3.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

3.3.2.3.1 Surface Water Resources

In conjunction with Alternative C, TVA would develop the CRN Nuclear Technology Park only at Area 2. Actions include site preparation within permanent and temporary use areas (Area 2 and laydown areas), develop and improve roadways and associated infrastructure, expand transmission systems, and construct and operate structures associated with the cooling system. The proposed surface water intake and the proposed discharge would be the same as that proposed for Alternative B.

Notable differences in impacts to surface water relate to the effects of development within the proposed footprints of Area 1 under Alternative B versus Area 2 under Alternative C.

3.3.2.3.1.1 Surface Water Hydrology

Under Alternative C, construction phase site preparation activities would generally be similar to those described for Alternative B, but they would differ based on the degree of stream alteration within Area 1 verses that which would occur in Area 2. General land disturbance and impacts to surface waterbodies on and near the CRN Site would also include those effects to the Reservoir, Grassy Creek, and small unnamed streams and ponds on the CRN Site (Area 2 instead of Area 1) and associated offsite areas including the BTA, the TN 95 Access Area, and the 161-kV transmission line (see Figure 2-2).

Twenty-five streams would be affected under Alternative C within the CRN Site and associated offsite areas (Table 3-10 and Table 3-11). Impacts include effects to seven perennial streams (1,412 linear feet), five intermittent streams (2,507 linear feet), and 13 ephemeral streams (4,453 linear feet). Additionally, four streams would be crossed in conjunction with the potential offsite upgrades within the 500-kV corridor extending to the Bethel Valley substation. As described for Alternative B, alterations to existing streams under Alternative C would result in direct alteration and loss of aquatic habitat and associated riparian zones coupled with the alteration of runoff rates from associated drainage areas. However, unlike Alternative B, Alternative C would not result in impacts to ponds. Table 3-11 summarizes impacts to each of the identified stream resources in conjunction with actions on the CRN Site and associated offsite areas.

All other impacts to hydrology including minimization measures, permitting requirements, and mitigative measures are similar to those previously described for Alternative B. Therefore, because the number and length of streams (perennial and intermittent) altered under Alternative C would be less than those described for Alternative B, impacts to hydrology under Alternative C would be less than Alternative B but would still be moderate.

3.3.2.3.1.2 Surface Water Use
Impacts of water use under Alternative C are similar to those described for Alternative B. As such, impacts from water use under Alternative C would be minor.

3.3.2.3.1.3 Surface Water Quality
Impacts to water quality under Alternative C are similar to those described for Alternative B. Differences in water quality relate to the magnitude of impacts to surface water systems (streams). Impacts to water quality during construction are primarily related to construction stormwater runoff and sedimentation, which would be minimized through the use of BMPs under the CSWP/SWPPP. Operational impacts to water quality include potential increases to stormwater runoff due to increased area of hard surfaces, increases in thermal discharge in the Reservoir, and discharge of water-treatment associated chemicals. Under Alternative C, the impacts on perennial and intermittent streams, in terms of linear feet, is less than the overall impact of Alternative B. Therefore, impacts to water quality under Alternative C would be minor and would be mitigated through use of BMPs, monitoring and measurement programs, and adherence to NPDES permitting limits.

3.3.2.3.2 Groundwater

3.3.2.3.2.1 Groundwater Hydrology
In conjunction with Alternative C, impacts to groundwater hydrology are similar to those described for Alternative B; however, grading and excavation operations during construction are expected to encounter more varied conditions in Area 2 because of differing physical characteristics of the uppermost aquifer units (Knox Group). As such, the site may exhibit a broader range of groundwater flow conditions and require a range of dewatering approaches. Depending on proximity of construction and operation to the northeastern side of Area 2 where karst features may be present, there would likely be notable influences on groundwater flow, transient storage following precipitation events, and challenges associated with construction dewatering. This depends upon the interconnectivity of the epikarst (the thin zone near the karst surface) and its relative permeability, storage properties, and vertical gradients between aquifer units. Construction dewatering may be more irregular and varied depending on depths of excavation and means by which to control groundwater seepage through pit (and/or trench) walls and possible flow into the excavation. Therefore, impacts to groundwater hydrology under Alternative C would be minor because of potential for dewatering uncertainties, but impacts would be mitigated through use of BMPs, monitoring and measurement.

3.3.2.3.2.2 Groundwater Use
Impacts of groundwater use under Alternative C are similar to those described for Alternative B. Therefore, impacts to groundwater use under Alternative C would be minor during construction. No groundwater would be used under Alternative C during operation and groundwater availability would not be affected.

3.3.2.3.2.3 Groundwater Quality
Impacts of groundwater quality under Alternative C are similar to those described for Alternative B. However, grading and excavation operations during construction may encounter more varied conditions with a broader range of groundwater flow conditions and dewatering approaches. Depending on proximity of construction and operation to the northeastern side of Area 2 where karst features may be present in the Knox Group, Alternative C may influence water quality. This would depend upon the interconnectivity of the epikarst and its relative permeability, storage properties, and vertical gradients between

aquifer units. Construction dewatering may be more irregular and varied depending on depths of excavation and means by which to control groundwater seepage and possible flow into the excavation. Therefore, impacts to water quality under Alternative C may be considered moderate to minor, because of potential for dewatering uncertainties, but would be mitigated through use of BMPs, monitoring and measurement, a flexible dewatering program, and adherence to NPDES permitting limits.

3.3.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

3.3.2.4.1 Surface Water Resources

In conjunction with Alternative D, TVA would develop the CRN Nuclear Technology Park at both Areas 1 and 2. Actions include site preparation within temporary and all permanent use areas, develop and improve roadways and associated infrastructure, expand transmission systems, and construct and operate structures associated with the cooling system. The proposed surface water intake and the proposed discharge would be the same as that proposed for Alternative B.

Notable differences in impacts to surface water relate to the combined effects of development within the proposed footprints of both Area 1 and Area 2 under Alternative D as compared to more limited site disturbances associated with Alternative B and Alternative C.

3.3.2.4.1.1 Surface Water Hydrology

Under Alternative D, construction phase site preparation activities would generally be similar to those described for Alternative B and would include the additional stream alteration within Area 2 as described under Alternative C. General land disturbance and impacts to surface waterbodies on and near the CRN Site would also include those effects to the Reservoir, Grassy Creek, and small unnamed streams and ponds on the CRN Site (Area 2 coupled with those of Area 1) and associated offsite areas including the BTA, the TN95 Access Road, and the 161-kV transmission line (see Figure 2-3).

A total of 29 streams would be affected under Alternative D within the CRN Site and associated offsite areas. Impacts include effects to seven perennial streams (1,775 linear feet), six intermittent streams (2,655 linear feet) and 16 ephemeral streams (5,487 linear feet) (Table 3-10 and Table 3-11). Additionally, four streams would be crossed in conjunction with the potential offsite upgrades within the 500-kV corridor extending to the Bethel Valley substation. As described for Alternative B, alterations to existing streams under Alternative D would result in direct alteration and loss of aquatic habitat and associated riparian zones coupled with the alteration of runoff rates from associated drainage areas. Similar to Alternative B, Alternative D would impact two ponds totaling 0.9 acres. Table 3-10 summarizes impacts to each of the identified stream resources in conjunction with actions on the CRN Site and associated offsite areas.

All other impacts to hydrology including minimization measures, permitting requirements, and mitigative measures are similar to those previously described for Alternative B. Therefore, because the number and length of streams altered under Alternative D are greater than those previously described under both Alternative B and Alternative C, impacts to hydrology under Alternative D would be incrementally greater than those under Alternatives B and C but still would be moderate.

3.3.2.4.1.2 Surface Water Use
Impacts of water use under Alternative D are similar to those described for Alternatives B and C. As such, impacts from water use under Alternative D are minor.

3.3.2.4.1.3 Surface Water Quality
Impacts to water quality under Alternative D are similar to those described for Alternative B and Alternative C. Differences in water quality relate to the relative magnitude of impacts to surface water (streams). Impacts to water quality during construction are primarily related to disturbances from stormwater runoff and sedimentation, which would be minimized through the use of BMPs under the site CSWP/SWPPP. Operational impacts to water quality include potential increases to stormwater runoff from the increased area of hard surfaces, increases in thermal discharge in the Reservoir, and discharge of water-treatment-associated chemicals. Under Alternative D, impacts to water quality are expected to be similar to those under Alternative B and Alternative C, with the exception being an increase in the number of linear feet potentially impacted under Alternative D. Therefore, impacts to water quality under Alternative D would be greater than that for Alternatives B and C but still minor, and would be mitigated through use of BMPs, monitoring and measurement programs, and adherence to NPDES permitting limits.

3.3.2.4.2 Groundwater

3.3.2.4.2.1 Groundwater Hydrology
Impacts of groundwater hydrology under Alternative D are similar to those described for Alternative B and Alternative C, but greater due to the increased land disturbance area and increased areas for deep excavation of safety-related structures. Therefore, impacts to groundwater hydrology under Alternative D would be minor but greater than Alternatives B and C, and they would be mitigated through use of BMPs, SPPC Plans, monitoring and measurement.

3.3.2.4.2.2 Groundwater Use
Impacts of groundwater use under Alternative D are similar to those described for Alternatives B and C. Therefore, impacts to groundwater use under Alternative D are minor during construction. No groundwater would be used under Alternative D during operation and groundwater availability would not be affected.

3.3.2.4.2.3 Groundwater Quality
Impacts to groundwater quality under Alternative D are similar to those described for Alternative B and Alternative C. Therefore, impacts to groundwater quality under Alternative D may be considered moderate to minor, because of potential for dewatering uncertainties, but would be mitigated through use of BMPs, monitoring and measurement, flexible dewatering program, and adherence to NPDES permitting limits.

3.3.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.3.1.3, several reasonably foreseeable future actions were identified in proximity to the CRN Site. Depending on the local environmental setting and the design characteristics of these other proposed actions, direct alteration of surface water resources may occur. Furthermore, each of these projects entails land disturbance activities that have the potential to increase site runoff and contribute to pollutant loading and sedimentation within associated surface water resources. None of the identified actions by others geographically intersect with the same surface water resources affected by the proposed project. However, these other projects have the potential to increase demands on water use, wastewater treatment, and pollutant loading during both construction and operational phases. Example projects include the Kairos Hermes reactor project, proposed actions at ORNL, construction of the DOE Environmental Management Disposal Facility on ORR, development of the Horizon Center, and the development of the municipal airport near the ETTP. Because both the Kairos project and the proposed airport project are located adjacent to Poplar Creek near the Reservoir, they have the potential to result in increased pollutant loading to the same waterbody as that affected by the proposed project. However, it is also recognized that these and all other reasonably foreseeable actions are also subject to the same regulatory requirements for implementing a SWPPP and associated BMPs, and they would be required to comply with all relevant NPDES permitting requirements that would effectively minimize pollutant loading to the Reservoir. Construction and operation of other facilities, including the Kairos Hermes reactor, the proposed DOE disposal facility, and potential development of the Horizon Center, have the potential for increasing risk of contamination to groundwater resources. Each of these facilities is expected to include appropriate mitigative measures and design features to minimize potential contamination of groundwater. Additionally, because the impacts to groundwater quality at the CRN Site and associated offsite areas from operation are minor and mitigated with the implementation of an IPPP and adherence to NPDES permitting requirements, the potential effects of development of the CRN Site are minor. Furthermore, operation of the Advanced Nuclear Technology Park at the CRN Site would not utilize groundwater. As such, these actions would likely have minimal cumulative impacts on water resources in the area but could contribute to collectively increased demands on municipal water supply and wastewater treatment services (see Section 3.15.2.5).

3.3.2.6 Summary of Impacts to Surface Water and Groundwater Resources

As summarized in Table 3-13, TVA has determined that all impacts to surface waters and groundwater related to the development of the CRN Site and associated offsite areas would have both direct and indirect impacts. Overall, moderate permanent impacts would be associated with conversion and loss of onsite streams and shoreline alteration of the Reservoir. Water quality impacts expected from construction activities would be temporary and minor with adherence to the requirements of the SWPPP and implementation of proper BMPs. Direct effects to jurisdictional waters resulting in permanent impacts would be minimized through final design and mitigated as required by authorized permits. Operational Impacts associated with hydrology, water use (including consumptive use), and water quality from operation of each of the alternatives are similar and result from the effects of cooling water withdrawal and discharges to the Reservoir. Discharges to receiving waters would be minor when proper treatment and BMPs are implemented prior to discharge from the site.

Table 3-13. Summary of Impacts to Water Resources

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Potential impacts to Project Area jurisdictional streams and riparian zones and near-shore instream areas of the Reservoir.	Moderate permanent impacts associated with conversion and loss of onsite streams and shoreline alteration of the Reservoir. Based on the length of stream alteration, the magnitude of impact is as follows: Alternative D, greater than Alternative B, which is greater than Alternative C. Impacts to streams mitigated by purchase of credits in mitigation bank in accordance with permits, as appropriate. Shoreline restoration activities to provide long term beneficial effects in shoreline stabilization and reduced erosion.
		Water use during construction for dust control measures.	Impacts associated with water use for dust control minor.
		Localized sedimentation and reduced water quality from stormwater during construction activities.	Temporary minor water quality impacts to surrounding surface waters with the implementation of SWPPP, redevelopment of stormwater management ponds, and appropriate BMPs. All impacts to surface water resources would be subject to Section 10/404 permitting under the CWA issued by the USACE and TDEC ARAP permit requirements. Discharges would comply with NPDES permit limits and other state and federal regulations. Unavoidable impacts to surface water features on site would be minimized during final design and mitigated as required by applicable permits.
		Potential impacts to groundwater hydrology during dewatering and land disturbance activities.	Impacts would be temporary, limited to excavation and periods of subsurface construction and would have minimal potential for direct and indirect impacts to localized groundwater resources. Impacts would be minor as a result of engineering controls and final design measures.

Alternative	Project Phase	Impact	Severity
		No groundwater would be used during construction and groundwater availability would not be affected.	No impact.
		Inadvertent spills of gasoline, diesel fuel, hydraulic lubricants, and other similar products have the potential to contaminate groundwater.	Minor and localized impacts as groundwater discharges would be regulated by NPDES permit and engineering controls and BMPs would be used to minimize and control inadvertent spills.
	Operation	Water diversion and use associated with CWIS operation. Potential for alteration of hydrology and scour.	Diversion and use of cooling water would result in minor localized alteration of hydrologic patterns and limited scour potential due to low intake velocity. Impacts of consumptive use of surface water would not noticeably alter the availability of water supply for upstream or downstream users. Impacts of consumptive use of surface water are therefore minor.
		Alteration of hydrology, flow patterns and water quality of the Reservoir due to discharge operation.	Effects on hydrology, flow patterns and water quality from discharge operation demonstrated to be localized and minor.
		Potential stormwater related pollutant loading from impervious surfaces.	Minor impact of stormwater runoff to water quality of receiving streams with use of stormwater ponds and proper treatment of runoff. Cooling water withdrawal, discharge of effluents (thermal, radiological and non-radiological constituents) subject to NDPES permit requirements and associated monitoring and mitigative measures. Therefore, impacts from runoff are minor.
		Alteration of the pattern and rate of groundwater infiltration due to increased impervious surface.	Effects on flow patterns would be localized and minor.
		No groundwater would be used during operation and groundwater availability would not be affected.	No impact.
		Inadvertent spills of gasoline, diesel fuel, hydraulic lubricants, and other similar products have	Minor impacts to groundwater quality, mitigated with the implementation of an IPPP and adherence to NPDES permitting

Alternative	Project Phase	Impact	Severity
		the potential to contaminate groundwater.	requirements. A groundwater monitoring program would be conducted in accordance with TVA's Groundwater Protection Program focused on the prevention, early detection, and mitigation of impacts from potential subsurface or groundwater contamination.

3.4 Floodplains and Flood Risk

3.4.1 Affected Environment

A floodplain is the relatively level land area along a stream or river that is subject 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 area subject to a 0.2 percent chance of flooding in any given year is normally called the 500-year floodplain.

The CRN Site is situated between CRM 14.5 and 19, right descending bank, on the Reservoir, in Roane County, Tennessee. Based on Profile 08P in the 2009 Roane County, Tennessee, Flood Insurance Study, the 100- and 500-year flood elevations vary from 747.6 to 749.3 feet and 750.1 to 752.6 feet, respectively, referenced to NAVD 1988. The CRN Project Area would encompass portions of the floodplains of the Clinch River, Grassy Creek, Raccoon Creek, White Oak Creek, and several unnamed tributaries of the Clinch River. The Project Area is also encompassed by Roane County, Tennessee, Flood Insurance Rate Map (FIRM) Panel Numbers 47145C0120F, effective 9/28/2007, and 47145C0140G, effective 11/18/2009. Floodplain locations within the CRN Project Area are shown on Figure 3-9 in Section 3.3 Surface Waters. No FEMA 100-year floodplains are associated with the potential future offsite transmission upgrades within the 500-kV line extending to the Bethel Valley Substation.

A regulatory floodway is normally associated with the National Flood Insurance Program (NFIP). It refers to that portion of the channel of a river or other watercourse and the adjacent land areas that must be reserved to convey the 100-year flood without cumulatively increasing the water surface elevation more than a designated height. There is no floodway on this reach of the Reservoir.

Flood storage is the space available in a reservoir to store flood waters in order to reduce downstream flooding impacts. In TVA reservoirs, the Flood Storage Zone (FSZ) is the range of elevations used to store such flood water. The FSZ on the Reservoir extends from elevation 735.0 to elevation 750.1 at CRM 14.5 and 752.6 at CRM 19.0. TVA manages development within the FSZ in order to minimize the loss of flood storage space while still achieving project objectives using the TVA Flood Storage Loss Guideline (FSLG).

3.4.2 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of floodplains within their respective project footprints. The specific details regarding the scope of these actions are unknown; however, any development within 100-year floodplains would be subject to City of Oak Ridge or Roane County floodplain regulations, as appropriate.

Floodplain regulations serve to both protect floodplains and the structures, activities, and facilities constructed within them. With adherence to local floodplain regulations, cumulative impacts due to construction within 100-year floodplains are expected to be minor and insignificant.

3.4.3 Environmental Consequences

As a federal agency, TVA adheres 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" (EO 11988, Floodplain Management). 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 (U.S. Water Resources Council 1978). The EO requires that agencies avoid the 100-year floodplain unless there is no practicable alternative.

For certain "critical actions," the minimum floodplain of concern is the 500-year floodplain. The U.S. Water Resources Council defines "critical actions" as "any activity for which even a slight chance of flooding would be too great" (U.S. Water Resources Council 1978). Critical actions can include facilities producing hazardous materials (such as liquefied natural gas terminals), facilities whose occupants may be unable to evacuate quickly (such as schools and nursing homes), and facilities containing or providing essential and irreplaceable records, utilities, and/or emergency services (such as large power-generating facilities, data centers, hospitals, or emergency operations centers).

EO 13690, Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input was reinstated in May 2021. However, implementation of EO 13690 is still in development at the national level. TVA is working with other federal agencies to develop consistent implementing plans for these EO requirements. When those implementing plans are finalized, TVA would incorporate floodplain analysis with respect to EO 13690, in addition to EO 11988. Depending upon the results of these inter-agency efforts, TVA may update the floodplain implementing plan in subsequent NEPA analysis.

3.4.3.1 Alternative A – No Action Alternative

Under the No Action Alternative, there would be no development on the CRN Site, and thus no changes to conditions found within the local floodplains.

3.4.3.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

Impacts to floodplains under Alternative B are limited to the construction phase only. No impacts to floodplains are expected during the operation phase. Area 1 is located between CRM 15.1 and 17.9 and outside of the 100-year floodplain. With the exception of a small area near CRM 16.6, the proposed discharge diffuser pipes, and the proposed intake, proposed actions under Alternative B would be located outside 100- and 500-year floodplains. The exact location of structures and facilities that would be constructed in Area 1 are not known at this time. However, to minimize adverse impacts, flood-damageable structures and facilities would be located outside 100-year floodplains. If they cannot be located outside 100-year floodplains, additional floodplains review would be required.

The intakes and outfalls would be located within the 100-year floodplain and FSZ of the Reservoir. Consistent with EO 11988 and the TVA FSLG, intakes and outfalls are considered to be repetitive actions in the 100-year floodplain and FSZ that would likely result in only minor impacts. To minimize adverse impacts, these structures would be constructed using the least amount of fill practicable.

Areas of improvements to River Road on the CRN Site and the TN 95 Access may partially occur within 100-year floodplains. A detailed analysis of potential flood impacts would be undertaken during the design phase for these road facilities. However, to minimize adverse impacts, roads would be designed and constructed such that upstream flood elevations would not increase more than 1.0 foot and fill within the Reservoir would be minimized.

A portion of the laydown area on the CRN Site crosses the floodplain of an unnamed tributary to the Clinch River at CRM 18.8. At this location, the 100-year flood elevation would be 749.1 feet (NAVD 1988). Laydown areas are temporary uses of the floodplain; however, equipment and material could be damaged should a flood occur while the laydown area is in use. To minimize adverse impacts, flood-damageable material and equipment would be stored outside the floodplain and/or above elevation 749.1 feet.

The improvements within the BTA at TN 58 and Bear Creek Road and the new 161-kV transmission line connection from the existing 161-kV transmission line along Bear Creek Road southeast to the 500-kV transmission line near the northern CRN Site boundary, would be located outside 100-year floodplains, which would be consistent with EO 11988.

Improvements within the BTA at the existing DOE barge facility at CRM 14.1 and the supplemental barge facility being considered at approximately CRM 16.5 would involve construction within the 100-year floodplain. Improvements to or structures associated with these facilities would include retaining walls, mooring cells, bollards, riprap, engineered fill, sheet piles, or other structures to support the facility. Consistent with EO 11988, barge facilities are considered to be repetitive actions in the 100-year floodplain and TVA Flood FSZ that would likely result in only minor impacts. To minimize adverse impacts, only water-use or water-dependent facilities and structures would be located below the 100-year flood elevation at these locations.

If refurbishment of the existing rail spur offloading area is necessary, new construction would be limited to the north side of the rail spur, and thereby avoid the 100- and 500-year floodplains, which would be consistent with EO 11988.

Generally, water-use and water-dependent structures and facilities constructed under Alternative B would be located within 100-year floodplains, and flood-damageable equipment and facilities would be located at a minimum outside 100-year floodplains. Critical Actions would be located at a minimum outside 500-year floodplains, which would be consistent with pertinent EOs, associated guidance and the FSLG. Therefore, impacts to floodplains and flood risk under Alternative B would be minor.

3.4.3.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Area 2 is located outside of the 100-year floodplain, which would be consistent with EO 11988. Potential impacts associated with the intake, outfall, laydown area on the CRN Site, and barge facilities, and mitigation measures are the same as in Alternative B. Therefore, impacts to floodplains would be minor for Alternative C.

3.4.3.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

As noted under Alternative B and Alternative C, Area 1 and Area 2 are located outside of 100- year floodplains, which would be consistent with EO 11988 and EO 13690. Potential impacts associated with the intake and outfall, laydown area on the CRN Site, and the BTA and mitigation measures are the same as in Alternative B. Therefore, impacts to floodplains would be minor for Alternative D.

3.4.3.5 Summary of Impacts to Floodplains and Flood Risk

As summarized in Table 3-14, TVA has determined that development of the CRN Site would have minor impacts to floodplains and flood risk. Construction of the intake, outfall, and barge facility improvements would be located within the 100-year floodplain. All other facilities associated with the nuclear technology park on the CRN Site would be constructed outside of the 100-year floodplain and, therefore, consistent with applicable EOs. Potential impacts associated with portions of the River Road and TN 95 Access improvements would be determined by TVA during project design and further environmental review would be conducted as appropriate. To minimize adverse impacts within floodplains, standard BMPs would be used during construction activities, and any new structures would adhere to the TVA subclass review criteria for location in floodplains. To minimize adverse impacts due to temporary use of the laydown area on the CRN Site, flood-damageable material and equipment would be stored outside the floodplain area.

Table 3-14. Summary of Impacts to Floodplains and Flood Risk

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Potential impacts from intake, discharge, improvements to River Road and the TN 95 Access, and barge facility improvements are considered repetitive actions. No impact from site facilities which would be located outside of the 100- and 500-year floodplains, consistent with EO 11988 and FSLG.	Impacts are associated with repetitive actions or minimized in site design and, therefore, would be minor.

3.5 Wetlands

3.5.1 Affected Environment

3.5.1.1 Wetlands of the CRN Project Area

Waters of the United States (WOTUS) include lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, and other water resources. Activities resulting in the placement of fill within WOTUS are subject to USACE jurisdiction and require authorization under Section 404 of the CWA for planned fill activities. In conjunction with Section 404, a state-issued Section 401 Water Quality Certification may be required for impacts to WOTUS. In Tennessee, the TDEC Division of Water Resources administers Section 401 Water Quality Certifications through the ARAP [33 US Code § 1344]. Additionally, EO 11990 – Protection of Wetlands requires federal agencies to minimize the destruction, loss, or degradation of wetlands when carrying out their responsibilities, and to preserve and enhance the natural and beneficial values of wetlands. Before performing certain activities in wetlands, a Section 404 permit from the USACE may be required, depending on the size of the wetland or stream and its hydrologic connectivity to a navigable waterway. Section 401 of the CWA provides states with the ability to verify whether activities allowed under Section 404 are compliant with state water quality standards.

For the purposes of the CWA, wetlands are defined as those areas that are "inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas" [33 CFR 328.3(b)]. Wetlands and wetland fringe areas can also be found along the edges of many watercourses and impounded waters (both natural and man-made). Wetlands provide valuable public benefits including improved water quality, erosion control, flood abatement, habitat enhancement, water supply, recreation, partnerships, education, and aesthetic appeal (TDEC 2021b).

The CRN Site and associated offsite areas are situated within the Ridge and Valley Level III ecoregion (Griffith et al. 1998), which is characterized by ridgelines and wide valley bottoms trending northeast to southwest. Hydrology in this ecoregion typically constitutes small upland drainage features intersecting lower gradient streams tributary to river bottoms meandering through wide valley flats. Wetland habitat across the region is most commonly associated with the floodplains of these stream and river systems, although springs and seepage wetlands are also known to occur. The study area is located in the Lower Clinch watershed basin (HUC-06010207). The National Wetlands Inventory (NWI) classifies wetland and deepwater habitats from aerial imagery. Within the Clinch River watershed, approximately 340 acres of wetland habitat have been mapped by NWI, which includes approximately one percent of the entire watershed.

The CRN Project Area comprises approximately 868 acres adjacent to the north side of the Reservoir, between CRM 14 and 21. The CRN Site includes the former CRBRP construction site, where construction ceased in the early 1980s after extensive grading and site preparation. These previously disturbed areas generally consist of leveled land over shallow soils or gravel substrate where vegetation is routinely mowed, and sporadic trees and shrubs persist. The remainder of the CRN Site is dominated by upland forest situated on gently sloped, rolling, or steep terrain, dissected by tributaries to the Reservoir. Bottomland riparian habitat is present along the Reservoir floodplain and tributary wetland flats. Existing gravel and unmaintained forestry roads are present throughout the CRN Site. Within the study area, two TVA transmission line ROWs cross perpendicular to each other. Vegetation with the ROWs is routinely maintained in accordance with conductor clearance requirements. No NWI wetlands are associated with the potential future offsite transmission upgrades within the 500-kV line extending to the Bethel Valley Substation. TVA would conduct additional surveys to assess these habitats based on future planning needs.

Field reconnaissance of the CRN Project Area was conducted by TVA between January and June 2021 to determine wetland presence, extent, and condition (TVA 2021d). The 2021 wetland assessment included a review of delineations conducted between 2011 and 2015 within the CRN Project Area, with previously mapped wetland features verified and their condition updated in addition to mapping wetlands not previously documented. Wetland determinations were conducted in accordance with USACE methods, which require documentation of hydrophytic vegetation, hydric soils, and wetland hydrology

(Environmental Laboratory 1987; USACE 2012; USACE 2018). Broader definitions of wetlands, such as those provided by EO 11990, the USFWS, and the TVA Environmental Review Procedures, also were considered in the wetland determinations for the Project Area.

Wetland condition was evaluated using the Tennessee Rapid Assessment Method (TRAM) wetlands, which quantifies wetland function and ranks wetlands into three categories, including low, moderate, or exceptional resource value based on six metrics coordinating to indicator functions (TDEC 2015). Low quality wetlands are degraded aquatic resources that may exhibit: low species diversity; minimal hydrologic input and connectivity; recent or on-going disturbance regimes; and/or predominance of non-native species. These wetlands provide low functionality and are considered low value. Moderate quality wetlands provide more functions than low quality wetlands due to less degradation and/or their habitat, landscape position, or hydrologic input. Moderate quality wetlands are considered healthy water resources of value. Disturbance to hydrology, substrate and/or vegetation may be present to a degree at which valuable functional capacity is sustained. Wetlands with exceptional resource value provide high quality functions and value and are considered Exceptional Tennessee Waters. Those wetlands would: exhibit little, if any, recent disturbance; provide essential and/or large-scale stormwater storage, sediment retention, and toxin absorption; contain mature vegetation communities; and/or offer habitat to rare species.

Within the CRN Project Area, 51 wetlands, totaling approximately 37.2 acres, were delineated and assessed during the field reconnaissance, as depicted on Figure 3-9 (Section 3.3.1.1.1). Identified wetlands include approximately 1.2 acres of emergent wetlands, 0.9 acres of emergent-scrub shrub wetlands, 0.7 acres of emergent-scrub shrub-forested wetlands, 0.2 acres of emergent wetland-open water complex, 0.2 acres of scrub-shrub wetlands, 0.2 acres of scrub shrub-forested wetlands, and 33.3 acres of forested wetlands (TVA 2021d). Identified wetlands cover approximately four percent of the study area, a greater percentage than mapped by the NWI at the watershed scale. Delineated wetlands are summarized in Table 3-15. Representative wetland descriptions are detailed below.

Table 3-15. Wetlands Delineated in the Project Area

Wetland ID	Wetland Type[1]	TRAM Category[2]	Location[3]	Total Wetland Acreage
CRN Site				
W001	PFO1E	Moderate	CRN Site	7.8
W002	PEM/PSS1E	Low	CRN Site	0.1
W003	PFO1E	Moderate	CRN Site	1.7
W004	PEM/PSS1E	Low	CRN Site	0.1
W005	PFO1E	Moderate	CRN Site Access Road	0.3
W006	PFO1E	Moderate	CRN Site Access Road	0.3
W007	PEM1Hx	Low	CRN Site Access Road	0.2
W008	PFO1E	Low	CRN Site Access Road	0.9
W009	PFO1E	Low	CRN Site Access Road	0.2
W010	PFO1E	Moderate	CRN Site Access Road	0.4
W011	PSS1Ex	Low	CRN Site	0.5

Wetland ID	Wetland Type[1]	TRAM Category[2]	Location[3]	Total Wetland Acreage
W012	PEM1E	Low	CRN Site	0.1
W013	PEM1E	Low	CRN Site	0.1
W014	PEM1E	Low	CRN Site	0.2
W015	PFO1E	Moderate	CRN Site Access Road	0.4
W016	PEM PFO1E	Moderate	CRN Site	1.4 6.5
W017	PFO1E	Low	CRN Site	0.2
W018	PFO1E	Moderate	CRN Site	1.2
W019	PFO1E	Exceptional	CRN Site	5.7
W028	PEM/SS/FO1E	Moderate	CRN Site	0.2
W020a W020b	PFO1E	Moderate	CRN Site & TL ROW	2.5 0.2
W021	PFO1E	Low	CRN Site & TL ROW	0.7
W029	PEM1E	Low	CRN Site	0.1
W030	PFO1E	Low	CRN Site	0.1
Total				*28.7*
Associated Offsite Areas				
Barge and Traffic Area				
W031	PEM1E	Low	Bear Creek Road	0.02
W032	PEM1E	Low	Bear Creek Road	0.02
W033	PEM1E	Low	Bear Creek Road	0.1
W034	PFO1E	Moderate	Bear Creek Road	0.03
W035a	PSS1E	Low	Bear Creek Road	0.1
W035b W035c W035d	PSS1E	Low	Barge Terminal Access	0.1 0.01 0.01
W036a	PSS1E	Moderate	Barge Terminal Access	0.1
W036b W036c	PSS1E PFO1E	Moderate	Bear Creek Road	0.01 0.3
W037	PEM1F	Low	Bear Creek Road	0.1
W038	PFO1E	Low	TN 58 Ramp	0.1
W039	PSS1E	Low	TN 58 Ramp	0.2
W040	PEM1F	Moderate	TN 58 Ramp	0.1
Total				*1.3*
TN 95 Access				
W041a W041b	PEM/SS/FO1H PFO1E	Moderate	Jones Island Road	0.549 0.7
W042	PEM1E	Moderate	Jones Island Road	0.1
W043	PFO1E	Moderate	Jones Island Road	0.1
W044	PSS/FO1F	Moderate	Jones Island Road	0.2
Total				*1.6*
161-kV Offsite Transmission Line				
W022	PFO1E	Low	CRN Site & TL ROW	0.5
W023	PFO1E	Low	CRN Site & TL ROW	0.02
W024	PFO1E	Low	CRN Site & TL ROW	0.1

Wetland ID	Wetland Type[1]	TRAM Category[2]	Location[3]	Total Wetland Acreage
W025	PEM/FO1E	Moderate	CRN Site & TL ROW	0.05/1.1
W026	PEM/FO1E	Moderate		0.01/1.4
W027a	PFO	Moderate	TL ROW	0.6
W027b	EM1E			0.2
Total				*7.4*

[1] Classification codes as defined in Cowardin et al. 1979: E = seasonally flooded/saturated; F = semi-permanently flooded; H = permanently flooded; P = Palustrine; EM1 = emergent, persistent vegetation; FO1= forested, broad-leaved deciduous vegetation,seasonally flooded/saturated; SS1= scrub-shrub, broad-leaved deciduous vegetation; UB = unconsolidated bottom; x = excavated.
[2] TRAM Category as defined by TDEC 2015: Low = low resource value; Moderate = moderate resource value; Exceptional = exceptional waters.
[3] TL = Transmission Line
Source: TVA 2021d

W001, W003, and W016 comprise forested bottomland wetland habitat within larger backwater depressions of the Reservoir floodplain. The central portions of these wetlands exhibited evidence of regular or seasonal inundation, and all wetlands contained soil coloration indicative of hydric conditions. These wetlands were dominated by common wetland trees, including sweetgum (*Liquidambar styraciflua*), American elm (*Ulmus americana*), silver maple (*Acer saccharinum*), red maple (*Acer rubrum*), and sycamore (*Platanus occidentalis*). Saplings of these species also persisted in the understory. Due to landscape position, buffer composition, hydrologic influence, disturbance history, and interspersion of habitat features, these wetlands are considered moderate quality, offering healthy and desirable wetland function to the surrounding landscape.

W002 and W004 are small emergent/scrub-shrub interspersed wetlands, both exhibiting low value due to their recent disturbance history, small size, and associated lack of influence on downstream waters. Fox sedge (*Carex vulpinodea*) dominated the ground layer of both of these wetlands. The shrub layer in W002 was dominated by Chinese privet (*Ligustrum sinense*) and W004 contained a shrub layer dominated by box elder (*Acer negundo*) saplings. W002 is a wetland swale located within an existing transmission line ROW at the east side of the site, where woody vegetation growth is deterred to ensure safe clearance for overhead conductors. W004 is located on a slope to a created sediment pond where woody vegetation clearing and seepage from an altered hydrologic source was evident.

W005, W006, W010, and W017 are forested wetland features dominated by sycamores and associated with onsite embayments of small inlets along the Reservoir. W005 and W006 are separated from each other by the perimeter road; similarly, W010 and W017 are separated from the Reservoir by the same perimeter road but at different locations. Regularly inundated soils have resulted in greyed and mottled soil coloration, indicative of hydric conditions. W005, W006, and W010 exhibit moderate value and healthy wetland function within the landscape. However, disturbance with W017 coupled with its small size and associated minimal hydrologic influence provides for low resource value.

W007 and W011 are isolated wetland features that have developed in retention basins created during previous site grading and preparation activities. W007 has developed emergent wetland vegetation along the periphery of the inundated basin, including soft path rush (*Juncus effusus*) and rice cut grass (*Leersia oryzoides*). The basin of W011 has become vegetated with wetland plants, including an interspersion of black willow (*Salix nigra*) and green ash (*Fraxinus pennsylvanica*) saplings and marsh seedbox (*Ludwigia palustrus*). Due to their recent development in constructed basins, these wetlands are considered low value.

W008 and W018 have developed in similar wide, linear backwater swales within the floodplain onsite; however, both of these wetlands are separated from the Reservoir by the perimeter road. These wetland features exhibit signs of inundation and associated soil coloration indicative of hydric conditions. W008 is dominated by box elder, an opportunistic wetland shrub. This wetland is considered low value due to its disturbance history within and adjacent to the wetland boundary. W018 is dominated by American elm, sweetgum, red maple, and silver maple trees, and is considered moderate value, with less indication of recent disturbance.

W009 and W015 receive hydrology from upgradient runoff and drain beneath the perimeter road directly to the Reservoir. These wetlands formed in a natural valley, but hydrology has increased to the wetlands from road construction and/or partially blocked culverts at their terminus. Evidence of sufficient wetland hydrology has resulted in hydric soil coloration. W009 is dominated by box elder, an opportunistic wetland shrub, and is considered low value due to evidence of more recent disturbance. W015 is dominated by sweetgum and sycamore and is considered moderate value due to less indication of recent disturbance.

W012, W013, and W014 are located within the large, previously graded footprint central to the Area 1 of the CRN Site. Site preparation resulted in a wide swale and associated flat where W012 has formed; a depression comprising W013; and another swale and associated flat where W014 was identified. These wetlands exhibited signs of inundation, such that hydric soil coloration has developed over gravel substrate. W012 was dominated by a wetland panic grass (*Coleataenia rigidula*). W013 is a cattail pond (*Typha latifolia*). W014 is dominated by soft path rush. All of these wetlands are maintained as emergent habitat, where woody vegetation is repressed by mowing or herbicide use. These wetlands have low resource value due to their historical and current disturbance regime coupled with their small size and lack of influence on downstream waters.

W019 is a relatively large, diverse forested wetland complex associated with an unnamed, perennial tributary near the eastern boundary of the site. Wetland hydrology has been affected by a beaver dam that impounds the southern end of the wetland. Hydrology in northern end of W019 is influenced by groundwater and fed by numerous seeps and springs. The wetland includes diverse habitats that transition from semi-permanently flooded scrub-shrub community in the southern end, to a seasonally flooded forested community in the south-central area, to a saturated forested wetland in the north-central area, and to a saturated emergent and scrub-shrub community maintained at the northern end of a transmission line corridor. Groundwater seeps and braided channels throughout this wetland provide sufficient hydrology for development of hydric soil coloration near the soil surface. Dominant vegetation includes green ash, sycamore, buttonbush, silky dogwood (*Cornus amomum*), black willow, *Aster* sp., blunt broom sedge (*Carex tribuloides*), fox sedge, and Frank's sedge (*Carex frankii*). Due to its size, intact habitat, interspersion of plant communities, and hydrologic influence, this wetland scored as an exceptional water resource offering high value to the surrounding watershed.

W020a and W020b comprise the northern portion of the W019 wetland, separated by a culverted road within the existing ROW. This area has been more recently disturbed and exhibits less hydrology than its southern counterpart. W020a and W020b are separated by a berm and exhibit similar wetland features. Disturbance was apparent throughout this wetland. Hydrology is supported through seepage and groundwater influence was evident. Soils contained hydric color indicators near the surface. Vegetation was dominated by young forest comprised of sweetgum, red maple, and loblolly pine in the overstory and Nepalese browntop grass in the understory. This wetland offers moderate value and desirable retention and impediment of stormwater, regardless of disturbance history.

W021 is located immediately upstream and adjacent to the same drainage associated with W020 and W019. This wetland flat is seasonally saturated and has developed hydric soil coloration. Young sycamore and sweetgum were dominant and ground cover consisted extensively of Nepalese browntop grass, which are all hydrophytic species. W021 provides low wetland value due to the predominance of invasive species, and lack of hydrologic influence on downstream waters.

W023 and W024 consist of linear drains, where young, forested wetland has developed. Saturated soils with grey and mottled coloration indicate sufficient hydrology for wetland presence. Young box elder trees are dominant in both drains. These wetlands are of low value due to their small size and disturbance history.

W025 and W026 are forested wetlands containing sedge meadow habitats. These wetlands exhibit inundated and saturated soils that are grey and mottled in coloration, indicative of hydric conditions. Forest canopy is a mixture of young and mature trees dominated by American elm, sweetgum, and red maple. These wetlands provide habitat for state-listed plants, including pale green orchid (*Platanthera flava* var. *herbiola*) and rigid sedge (*Carex tetanica*) (see Section 3.8). This wetland offers moderate value and functions at a healthy capacity to retain and impede stormwater and support a diverse interspersed community that includes desirable botanical habitat.

W027a and W027b consist of the same wetland drainage north of Bear Creek Road from W026, and tributary to Grassy Creek. W027a is forested wetland habitat and W027b contains adjacent emergent wetland habitat maintained at low stature within a transmission line easement. W027 exhibited saturated soils with a grey and mottled coloration near the surface, indicative of hydric conditions. W027a was dominated by mature wetland trees, including American elm, sweetgum, and red maple. W027b was dominated by wetland forbs, including soft path rush, giant goldenrod (*Solidago gigantea*), and wetland sedges. This wetland offers moderate value and functions at a healthy capacity to retain and impede stormwater and support native wetland vegetation.

W028, W029, and W030 are wetlands associated with the Grassy Creek embayment at its confluence with the Reservoir along the northern boundary of the site. W028 is an island wetland, dominated by black willow and sycamore, and exhibiting moderate resource value. W029 is an emergent wetland maintained within a transmission line ROW where it meets the shoreline. W030 has formed in a small flat immediately upstream along the same shoreline as W029. Due to their small size and lack of influence on downstream waters, W029 and W030 are considered low value wetlands.

Both W031 and W032 are linear drainage features along Bear Creek Road that drain to W033. These wetland features have developed wetland vegetation, hydric soil, and exhibit indicators of wetland hydrology. W033 is located at the intersection of a valley flat on the east side of Bear Creek Road and drains through a culvert to an embayment of a Reservoir inlet bound by the wetland habitat identified as W034 and W035a. W031, W032, and W033 are considered low value due to small size and disturbance history. W034 is comprised of forested wetland habitat where the road easement transitions from upland to wetland. W035a is maintained as scrub-shrub vegetation beneath an existing ROW. W036b and W036c are part of a Clinch River floodplain wetland complex representing scrub-shrub and forested habitat, respectively. W034 and W036 are considered moderate in value; W035 is considered low value.

The offsite DOE barge landing abuts wetland habitat on either side of the existing road. However, wetlands are not present along the Reservoir shoreline where barge terminal infrastructure is proposed. W035 and W036 are wetlands that exist along the access road to the barge terminal across two separate wetland areas that enter the access easement four times and total 0.18 ac. These wetland areas are entirely scrub-shrub habitat and located within a maintained overhead transmission line ROW where it crosses floodplain wetland habitat of the Reservoir. W035 and W036 are separated by the barge terminal access, located on the south and north side, respectively. These wetlands contain saturated soils, hydric soil coloration, and a dominance of black willow saplings. They provide low to moderate value dependent on disturbance regime and hydrologic influence.

W037 comprises shoreline fringe dominated by cattails along a ponded area associated with the floodplain on the west side of Bear Creek Road. This shoreline is inundated, and soils exhibit hydric coloration. Due to its small size, this wetland scored a low value to the surrounding watershed. Similarly, W038 is located east of Bear Creek Road within a forested wetland flat tributary to the extended floodplain associated with W037. W038 contains inundation, hydric soils, and common wetland trees over an understory dominated by fowl manna grass (*Glyceria striata*), a hydrophyte. W038 is also considered low value.

W039 is located within the existing TN 58 entrance/exit ramp. This wetland is a linear drainage feature that appears associated with runoff from W040 east of TN 58 and drains through a culvert to the inundated floodplain flat associated with W037 west of TN 58. W038 is dominated by young black willow trees with wetland forbs, grasses, and rushes in the understory. Due to its disturbance history, this wetland exhibits low wetland value. W040, which is tributary to W038, represents a more intact form of a valley bottom wetland, although it is bound at its downstream side by the highway. This wetland was dominated by jewelweed (*Impatiens capensis*) and soft path rush under adjacent intact forest canopy and provides moderate wetland value.

W041a and W041b are hydrologically connected via a culvert under Jones Island Road. This wetland complex is associated with the floodplain of Melton Branch and regularly inundated. W041a exhibited a mixture of interspersed forest, shrub, and emergent habitat; whereas W041b exhibited similar forested wetland habitat to that identified in W041a. Dominant vegetation consisted of common wetland species including American elm, sycamore, red maple, silky dogwood, soft path rush, marsh seedbox, and redtop panic grass. W041 is considered a wetland of moderate value.

W042 is an emergent wetland depression that retains stormwater to provide adequate hydrology for wetland development and allow dominate emergent wetland vegetation. W043 is a forested wetland within and extending north outside of the road easement. Drift deposits and drainage patterns indicate sufficient presence of wetland hydrology, and established common wetland trees, including red maple, dominate over a depauperate ground layer. W044 is located in a flat associated with an embayment feeding the Clinch River via a culvert within the road easement. This wetland exhibited an interspersion of forest and scrub-shrub habitat, dominated by similar wetland trees in the overstory and tag alder below. Each of these wetlands is considered moderate value.

3.5.1.2 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of wetlands within their respective project footprints. However, the specific details regarding the scope of these actions are unknown at this time. Should one or more of these projects result in unavoidable adverse effects to wetlands, they would be subject to permitting requirements pursuant to Section 404 of the Clean Water Act by TDEC and the USACE. As such, all unavoidable adverse effects would be appropriately minimized and mitigated by compensatory measures such that there would be no net loss of wetlands. Furthermore, none of the identified reasonably foreseeable future actions are overlapping geographically with the CRN Project Area nor are considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on wetlands are included in TVA's analysis.

3.5.2 Environmental Consequences

Activities in wetlands are regulated by state and federal agencies to ensure long-term maintenance of wetland resources nationwide. The USACE regulates the discharge of dredged or fill material and associated secondary impacts to WOTUS, including wetlands, under the CWA Section 404 [33 USC § 1344]. CWA §401 mandates state water quality certification for projects requiring USACE approval. In Tennessee, an ARAP authorized by the TDEC provides water quality certification under CWA §401. An ARAP is required for any alteration to the physical, chemical, or biological properties of any waters of the state, including wetlands, pursuant to the Tennessee Water Quality Control Act (§69-3-108, 0400-40-07). TDEC's permit process ensures compliance with Tennessee's anti-degradation policy as well (§69-3-108, 0400-40-04). Tennessee's jurisdiction would apply to regulated activities affecting wetlands within the study area, including both isolated and hydrologically connected wetland features tributary to the Reservoir. This regulatory oversight ensures no more than minimal impacts to the aquatic environment and no net loss of wetland resources (EPA 1990). Similarly, EO 11990 – Protection of Wetlands requires federal agencies, such as TVA, to avoid wetland impacts to the extent practicable, minimize wetland destruction, net loss, or degradation, and preserve and enhance natural and beneficial wetland values, while carrying out agency responsibilities.

3.5.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, the proposed project would not proceed. As such, no project-related disturbance to wetlands within the Project Area would occur. The CRN Site and associated offsite areas would continue to be maintained in their current state, in accordance with existing transmission line vegetation management and the Watts Bar RLMP (TVA 2009; 2021k). Wherever vegetation management activities are not conducted, previously disturbed wetland habitat would naturally regenerate and mature. Therefore, no impacts to wetlands would occur in conjunction with Alternative A.

3.5.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

Within the Alternative B footprint of Area 1, laydown, and associated offsite areas, proposed impact would affect approximately 14 acres within 45 wetlands (Table 3-16). Approximately 7.8 acres of wetlands would be permanently altered by fill activities. These include the following wetland types or complexes: emergent (0.9 acre), emergent-scrub shrub (0.9 acre), emergent-scrub shrub-forest (0.5 acre), scrub-shrub (0.2 acre), scrub shrub-forest (0.2 acre), and forest (3.9 acres). Approximately 1.2 acres of forested wetland (W018) would be impacted by construction of the laydown area. Effects to wetlands adjacent to construction zones would be minor with the adherence to the requirements of the SWPPP and implementation of proper BMPs. Wetlands permanently impacted by fill activities would wholly or partly lose all wetland function and benefits. TVA would avoid and minimize impact to wetlands and other sensitive resources during the design phase when practicable. Impacts that are not avoidable would be subject to CWA permitting with the USACE and TDEC and associated compensatory mitigation, as appropriate. As such, all unavoidable adverse effects would be appropriately minimized and mitigated by compensatory measures such that there would be no net loss of wetlands. The permit process institutes an evaluation of wetland resources being impacted and imposes compensatory mitigation requirements to offset proposed loss of wetland. TVA would ensure applicable permitting and required mitigation is obtained such that wetland impacts would be compensated through the wetland mitigation process. Mitigation measures would be incorporated into the final design of the project for unavoidable impacts to wetlands, as required through the permitting processes.

Establishing a transmission line corridor requires tree removal and future maintenance of low stature vegetation to accommodate clearance and abate interference with overhead wires. Approximately 0.6 acre of an emergent-forested wetland complex and approximately 6.3 acres of forested wetlands that are present within the transmission line ROW would need to be cleared of tree species that could interfere with the transmission lines; therefore, these wetlands would be converted to emergent wetland habitat and maintained at that stature for the perpetuity of the transmission line ROW. Woody wetland vegetation, in general, have deeper root systems and contain greater biomass (quantity of living matter) per area than do emergent wetlands which do not grow as tall. As a result, forested wetlands tend to provide higher levels of wetland functions, such as sediment retention, carbon storage, and pollutant retention and transformation (detoxification), all of which support better water quality. Consequently, the clearing and conversion of forested wetlands to lower-growing wetlands reduces wetland functions that would otherwise support healthier and improved downstream water quality (Wilder and Roberts 2002; Ainslie et al. 1999; Scott et al. 1990). Although the 6.9 acres of converted emergent wetland habitat would provide the same combination of wetland functions as their previously forested counterpart, it would be at a reduced functional level due to the removal of the woody vegetation. Habitat conversion is considered a secondary impact of transmission line construction. Therefore, and because of the degradation to wetland function, the proposed wooded wetland conversion to emergent wetland habitat is subject to the regulation of the USACE Nashville District and TDEC and their associated mitigation requirements to ensure no net loss of wetland resources across the landscape. TVA would minimize impacts to wetlands and other sensitive resources within a 120-foot ROW within the 280-foot corridor during the design phase to the extent practicable.

Table 3-16. Wetland Impacts on the CRN Site and Associated Offsite Areas

Feature ID	Wetland Type[1]	Impact Type	Onsite Acreage	Impact Area (acres) Alternative B	Alternative C	Alternative D
CRN Site						
W001	PFO	Permanent	6.9	0.1	--	0.1
W002	PEM	Permanent	0.1	0.1	0.1	0.1
W003	PFO	Permanent	1.7	1.7	0.6	1.7
W004	PEM/PSS	Permanent	0.1	0.1	--	0.1
W005	PFO	Permanent	0.2	0.1	0.1	0.1
W006	PFO	Permanent	0.3	0.1	0.1	0.1
W008	PFO	Permanent	0.9	0.1	0.1	0.1
W009	PFO	Permanent	0.2	0.2	0.1	0.2
W010	PFO	Permanent	0.4	0.1	0.1	0.1
W011	PEM/PSS	Permanent	0.5	0.5	--	0.5
W012	PEM	Permanent	0.1	0.1	--	0.1
W013	PEM	Permanent	0.1	0.1	--	0.1
W014	PEM	Permanent	0.2	0.2	--	0.2
W015	PFO	Permanent	0.3	0.0	0.0	0.0
W016	PFO	Permanent	7.9	0.2	--	0.2
W017	PFO	Permanent	0.2	0.2	0.2	0.2
W018	PFO	Permanent	1.2	1.2	1.2	1.2
W020a	PFO	Conversion	2.5	2.5	2.5	2.5
W020b	PFO	Conversion	0.2	0.2	0.2	0.2
W021	PFO	Conversion	0.7	--	0.7	0.7
Associated Offsite Areas						
Barge and Traffic Area						
W031	PEM	Permanent	0.0	0.0	0.0	0.0
W032	PEM	Permanent	0.0	0.0	0.0	0.0
W033	PEM	Permanent	0.1	0.1	0.1	0.1
W034	PFO	Permanent	0.0	0.0	0.0	0.0
W035a	PEM/PSS	Permanent	0.1	0.1	0.1	0.1
W035b	PEM/PSS	Permanent	0.1	0.1	0.1	0.1
W035c	PEM/PSS	Permanent	0.0	0.0	0.0	0.0
W035d	PEM	Permanent	0.0	0.0	0.0	0.0
W036a	PEM/PSS	Permanent	0.1	0.1	0.1	0.1
W036b	PEM/PSS	Permanent	0.0	0.0	0.0	0.0
W036c	PFO	Permanent	0.3	0.3	0.3	0.3
W037	PEM	Permanent	0.1	0.1	0.1	0.1
W038	PFO	Permanent	0.1	0.1	0.1	0.1
W039	PSS	Permanent	0.2	0.2	0.2	0.2
W040	PEM	Permanent	0.1	0.1	0.1	0.1

Feature ID	Wetland Type[1]	Impact Type	Onsite Acreage	Impact Area (acres) Alternative B	Alternative C	Alternative D
TN 95 Access						
W041a	PEM/PSS/PFO	Permanent	0.5	0.5	0.5	0.5
W041b	PFO	Permanent	0.6	0.6	0.6	0.6
W042	PEM	Permanent	0.1	0.1	0.1	0.1
W043	PFO	Permanent	0.1	0.1	0.1	0.1
W044	PSS/PFO	Permanent	0.2	0.2	0.2	0.2
161-kV Offsite Transmission Line						
W022	PFO	Conversion	0.4	0.4	0.4	0.4
W023	PFO	Conversion	0.0	0.0	0.0	0.0
W024	PFO	Conversion	0.1	0.1	0.1	0.1
W025	PFO	Conversion	1.0	1.0	1.0	1.0
W026	PFO	Conversion	1.4	1.4	1.4	1.4
W027a	PEM/PFO	Conversion	0.6	0.6	0.6	0.6
Total Impacts by Wetland Type						
	PEM	Permanent		0.9	0.5	0.9
	PEM/PSS	Permanent		0.9	0.3	0.9
	PEM/PSS/PFO	Permanent		0.5	0.5	0.5
	PEM/PFO	Conversion		0.6	0.6	0.6
	PSS	Permanent		0.2	0.2	0.2
	PSS/PFO	Permanent		0.2	0.2	0.2
	PFO	Permanent		5.1	3.6	5.1
	PFO	Conversion		5.6	6.3	6.3
All Wetland Impacts						
		Permanent		7.8	5.3	7.8
		Conversion		6.2	6.9	6.9

[1] Classification codes as defined in Cowardin et al. 1979: PEM = emergent wetland, PSS = scrub-shrub wetland; PFO= forested.
Source: TVA 2021d

Wetland disturbance impacts to W025 and W026 would also impact the diverse meadow community persisting in the ground layer below the shaded canopy. These wetlands provide habitat for state-listed plant species. Impacts to these species from proposed wetland habitat conversion is addressed in Section 3.8 (Threatened and Endangered Species). Under Alternative B, a buffer has been established around a forested wetland (W019) that is rated with exceptional value; thus, it would not be impacted.

In summary, construction under Alternative B would result in direct and indirect impacts to 14 acres of wetlands in the Project Area. Fill activities would result in loss of wetlands, and partially filled wetlands would result in a loss, reduced quality, and benefit of the impacted wetlands. Temporarily filled wetlands would incur direct impact during construction and indirect impact post-construction until the wetlands are restored to pre-existing function. Forested wetlands converted to emergent wetlands within the proposed transmission line would incur indirect impact by quality reduction. Wetlands W025 and W026 would incur both direct and indirect impact due to the potential for permanent vegetation community alterations and potential degradation. The high-quality wetland, W019, would be avoided and not impacted by the project. Overall wetland impacts would be relatively small and not notable on a regional scale. Additionally, unavoidable impacts to wetlands would be mitigated in accordance with Section 404 of the CWA as required by both USACE and TDEC permitting requirements. Therefore, with restoration processes and mitigation requirements in place that ensure no net loss of wetland function, impacts to wetlands are considered minor.

3.5.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Alternative C would impact approximately 12.2 acres within 39 wetlands located in Area 2, the laydown area, and associated offsite areas, as shown in Table 3-16.

Approximately 5.3 acres of wetlands would be permanently altered by fill activities. These include the following wetland types or complexes: emergent (0.5 acre), emergent-scrub shrub (0.3 acre), emergent-scrub shrub-forest (0.5 acre), scrub-shrub (0.2 acre), scrub shrub-forest (0.2), and forest (3.6 acres). As with Alternative B, approximately 1.2 acres of forested wetland, W018, would be impacted by construction of the laydown area for an unknown period of time and approximately 6.9 acres of forested wetlands will be converted to emergent wetlands within the proposed transmission lines.

Overall impacts to wetlands under Alternative C would be similar as those described for Alternative B but would result in fewer permanent impacts (5.3 acres) because there are less wetlands within Area 2. As such, wetland impacts would be relatively small and not notable on a regional scale. Additionally, unavoidable impacts to wetlands would be mitigated in accordance with Section 404 and 401 of the CWA as required by both USACE and TDEC permitting requirements. Therefore, with restoration processes and mitigation requirements in place that ensure no net loss of wetland function, impacts to wetlands are considered minor.

3.5.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Alternative D would result in direct and indirect impacts to onsite wetlands that are the same as those previously described for Alternative B and Alternative C (14.7 acres within 46 wetlands), as shown in Table 3-16. Fill activities would result in loss of wetlands. A forested wetland within the laydown yard and partially filled wetlands abutting other construction areas would result in a loss of wetlands and reduced quality and benefit. Forested wetlands converted to emergent wetlands within the proposed transmission line would incur indirect impact by quality reduction.

As such, wetland impacts would be relatively small and not notable on a regional scale. Additionally, unavoidable impacts to wetlands would be mitigated in accordance with Section 404 of the CWA as required by both USACE and TDEC permitting requirements. Unavoidable adverse impacts would be subject to compensatory mitigative measures as appropriate. As such, impacts to wetlands are considered minor.

3.5.2.5 Summary of Impacts to Wetlands

As summarized in Table 3-17, TVA has determined that there would likely be direct and indirect impacts to wetlands related to the development of the CRN Site and associated offsite areas. Most impacts expected from construction activities would be minor with adherence to requirements of the SWPPP and implementation of proper BMPs. Direct effects to jurisdictional wetlands resulting in permanent impacts would be minimized through final design and mitigated as required by authorized permits. Forested wetlands within the proposed transmission line ROW may incur a conversion impact by a change of dominant vegetation; however, many wetland functions would still occur. Wetland impacts, permanent or conversion, would be avoided as feasible during final design. Unavoidable wetland impacts would be mitigated to compensate for the loss of wetland function. Therefore, with restoration processes and mitigation requirements in place that ensure no net loss of wetland function, impacts to wetlands are considered minor. Any site-specific impacts that are analyzed in the future that are expected to fall outside of the bounding analysis in this PEIS will be analyzed in subsequent NEPA analysis.

Table 3-17. Summary of Impacts to Wetlands

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Potential permanent impacts to Project Area wetlands. Potential conversion impacts to Project Area wetlands within the proposed transmission line.	Permanent impact from fill activities would occur with each alternative with Alternative B and D resulting in the same amount of permanent impact and Alternative C resulting in slightly less. Temporary and conversion impacts would be the same for each proposed alternative.
		All impacts to wetland resources would be subject to CWA Section 10/404 (USACE) permitting and TDEC ARAP permit requirements. Discharges would comply with NPDES permit limits and other state and federal regulations. Functional loss associated with the conversion of forested wetlands to emergent wetlands.	Impacts associated with the offsite 161-kV transmission line would be minimized through design for all alternatives. Unavoidable impacts to wetlands on site would be minimized during final design and mitigated as required by applicable permits. With restoration processes and mitigation requirements in place that ensure no net loss of wetland function, impacts to wetlands are considered minor.

3.6 Aquatic Ecology

3.6.1 Affected Environment

Aquatic habitats present at the CRN Site and in the vicinity include those streams and ponds located within Area 1 and Area 2 of the CRN Site, the Reservoir and within associated offsite areas. The most recent aquatic ecological field surveys of the study area were conducted between May and June 2021. These efforts were focused on verifying streams documented on the CRN Site from past surveys and aquatic features in new areas added to the project footprint. Hydrologic determinations were made using the Tennessee Division of Water Pollution Control (Version 1.5) field forms by a Tennessee qualified hydrologic professional (Craig Phillips, #1036-TN11).

3.6.1.1 CRN Site and Associated Offsite Areas

The CRN Site and associated offsite areas currently contains 36 waterbodies that include perennial streams, intermittent streams, WWCs (ephemeral streams), and ponds. Notably, the central portion of Area 1 of the CRN Site generally lacks identified streams and their aquatic environments as this area was substantially disturbed by the prior CRBRP project. Four ponds are located within the CRN Site. All of the onsite ponds were created during the CRBRP to serve as stormwater retention ponds. More information on the characteristics of the ponds in the CRN Site can be found in Section 3.3 (Water Resources).

A total of seven perennial streams and six intermittent streams are documented to occur within the current project footprint. Three perennial streams are located within the CRN Site, one perennial stream in the BTA, and three perennial streams in the TN 95 Access. There are four intermittent streams on the CRN Site, one in the BTA, none in the TN 95 Access, and one within the associated 161-kV offsite transmission corridor. A total of 19 ephemeral streams or WWCs (see Section 3.3) are also located within the project footprint, but these features generally lack established aquatic ecological communities due to limited water permanence and are, therefore, not evaluated further in this section. Perennial streams are characterized by a well-defined channel and contain flowing water under normal weather conditions through the year. Perennial streams provide permanent habitat for aquatic organisms. Intermittent streams also have a well-defined channel, but only contain water during certain times in the year and may temporarily provide habitat for aquatic organisms when water is present (TDA 2003).

Additional offsite aquatic habitats associated with the 500-kV line extending beyond the CRN Site to the Bethel Valley Substation include four small streams that may include aquatic biota. These include Ish Creek and three tributaries of the White Oak Creek drainage. Aquatic biota including fish such as the Tennessee dace, a state listed species, has been observed in the vicinity of the Project Area on the ORR and potentially could occur in some streams within aquatic habitats associated with the potential future offsite transmission upgrades within the 500-kV transmission line. TVA would conduct additional surveys to assess these habitats as needed once the project design matures.

A 2015 biological assessment conducted by TVA evaluated four perennial streams and three intermittent streams that possessed habitat likely to contain aquatic biota. Surveys consisted of electrofishing and the use of seines. The only stream on the CRN Site where crayfish were observed was STR07. This stream contained small crayfish that were unable to be identified to species due to size. One fish, a banded sculpin (*Cottus carolinae*), and one unidentified crayfish (a crustacean) were found on the CRN Site in STR11. In the BTA, one stream exhibited aquatic organisms, with only one crayfish, *Cambarus dubius*. Grassy Creek, a stream located within the offsite transmission line corridor but not within the site, was also sampled as a control site. In total, 70 individual fish of nine species were identified in Grassy Creek. The most numerous species were logperch (*Percina caprodes*), largescale stoneroller (*Campostoma oligolepis*), and bluegill (*Lepomis macrochirus*) (Henderson and Phillips 2015).

Management of the areas in and around streams is facilitated through streamside management zones (SMZs). SMZs include the stream itself and additional adjacent areas (i.e., riparian areas). SMZs serve to provide protection to water quality and riparian habitat associated with the stream (TDA 2003). SMZs are developed along the border of perennial streams and intermittent streams that have a well-defined channel and flow occurs 40 to 90 percent of the time. TVA has defined a 50-foot SMZ for all ponds, intermittent streams, and all but two of the perennial streams across the CRN Site and in the BTA. The two perennial streams that do not have a 50-foot SMZ instead have a designated 100-foot SMZ. These are S06 on the east side of the CRN Site and S07 in the southeast corner of the BTA. Within a SMZ, BMPs are used to minimize negative impacts on the associated waterbodies.

3.6.1.2 Clinch River Arm of the Watts Bar Reservoir

The CRN Site is located between approximate CRM 14.5 and 19.0 on the Reservoir. Within the vicinity of the CRN Site, the Reservoir is both influenced by the impoundment by Watts Bar Dam below the CRN Site and by releases from Melton Hill Dam located upstream of the CRN Site (see Section 3.3.1.1.1 Surface Water Hydrology). Aquatic ecological communities in the Reservoir are described in the following sections.

3.6.1.2.1 Fish

Fish sampling within the Reservoir was conducted by TVA in 2011 at two locations downstream of the CRN Site (CRM 14 and 15) and two locations upstream of the TVA Site (CRM 18 and 19.8) in February, May, July, and October. Sampling methods included electrofishing and gillnetting. The survey found an average of 33 species downstream of the site and an average of 36 species upstream.

Common fish species within the reservoir in the vicinity of the CRN Site include bluegill (*Lepomis macrochirus*), Mississippi silverside (*Menidia audens*), gizzard shad (*Dorosoma cepedianum*), spotted sucker (*Minytrema melanops*), white bass (*Morone chrysops*), yellow bass (*Morone mississippiensis*), yellow perch (*Perca flavescens*), green sunfish (*Lepomis cyanellus*), redear sunfish (*Lepomis microlophus*), black redhorse (*Moxostoma duquesnii*), and sauger (*Sander canadensis*).

The fish community in the Reservoir was characterized using reservoir fish assemblage index (RFAI) methodology, which describes the fish community in the reservoir relative to similar reservoirs. TVA characterized the fish community for species richness and composition, trophic composition, abundance, and fish health. Overall, the ecological health rating for the fish community in the Reservoir ranged from Fair to Good. The downstream sampling location (CRM 15.0) was rated Fair across all sampling months (February, May, July, October). The upstream location was rated Fair for all sampling dates except May, which scored a Good ecological health rating. There are several thermally sensitive species documented in the Reservoir. These species include greenside darter (*Etheostoma blennioides*), logperch (*Percina caprodes*), spotted sucker (*Minytrema melanops*), and white sucker (*Catostomus commersoni*).

Sampling of ichthyoplankton in 2011-2012 within the Reservoir found that over the course of the one-year study, a total of 7,814 eggs were collected. Freshwater drum composed 53.6 percent of the total eggs collected, followed by clupeids (i.e., gizzard shad, threadfin shad, skipjack herring) at 23.4 percent of total, and moronids (i.e., white bass, yellow bass) at 14.3 percent of total catch. A total of 3,949 larval fish were collected as a part of this monitoring period. A higher volume of larval fish was captured at the downstream location than the upstream location. Clupeids (i.e., gizzard shad, threadfin shad, skipjack herring) were the dominant taxa and constituted 67.4 percent of total catch (TVA 2012).

The Reservoir provides an important recreational fishery. Species of interest for recreational fishing in the Reservoir include those species that are directly targeted by anglers, but also species that serve as important forage species for those game fish. The Tennessee Wildlife Resources Agency (TWRA) stocks certain species of recreational interest in the reservoir, including largemouth bass, striped bass, and walleye in the Watts Bar Reservoir. Stocking in the Melton Hill Reservoir consisted of the stocking of 500 muskellunge. Notably, as discussed in Section 3.3.1, fish consumption advisories have been issued by TDEC for 2020 near the CRN Site including those on the Reservoir and other adjacent waters for PCBs, mercury, and other constituents (TDEC 2020b). There is no commercial fishing activity in the Reservoir.

3.6.1.2.2 Other Aquatic Biota

Phytoplankton and zooplankton make up the lowest trophic levels within the aquatic ecosystem within the Reservoir and provide an important base of the aquatic trophic food web. Aquatic sampling conducted by TVA in 2011 included plankton community sampling effort at the CRN Site. Phytoplankton consisted of both drifting algae and photosynthesizing organisms. Bluegreen algae (Cyanophytes) comprised 90-99 percent of the samples regardless of location or season, whereas all other phytoplankton types comprised less than two percent of total catch during sampling events. Overall, the zooplankton community in the vicinity of the CRN Site was characterized by both low abundance and low diversity during the sampling period. Much of this is likely due to high turbulence within the sampling reach, limiting zooplankton populations and affecting their distribution. No notable differences in zooplankton communities were evident either spatially or temporally in the vicinity of the CRN Site. Rotifers were the dominant taxonomic group in May and Cladocera dominated during summer peak zooplankton abundance and biomass. This peak in abundance was associated with warmer water temperatures and generally low flow.

Aquatic macrophytes (i.e., aquatic plants) were also assessed by TVA in the vicinity of the CRN Site. However, no macrophytes were observed on either bank at any sampling location

Benthic macroinvertebrates are an important forage base for other aquatic organisms, including fish, and provide important indicators of overall system health. TVA assessed the benthic macroinvertebrate community using the Reservoir Benthic Index (RBI) at two locations, downstream (CRM 15.0) and upstream (CRM 18.8). RBI metrics are used to assess relative benthic community characteristics and is not an absolute measure of diversity or community health but is instead a measure of community metrics relative to similar reservoir-influenced sites within the TVA reservoir system. Overall, the ecological health rating for the benthic macroinvertebrate community was rated Good to Excellent across all sites. The ecological health rating for the downstream location was Good in spring and autumn and Excellent in summer. The ecological health rating for the upstream location was Good in spring and Excellent in summer and autumn.

A mollusk survey conducted by TVA in 2011 found a total of 74 living native mussels from six different species, as noted below:

- Pimpleback (Quadrula pustulosa)
- Fragile papershell (*Leptodea fragilis*)
- Purple wartyback (Cyclonaias *tuberculata*)
- Pink heelsplitter (*Potomilus alatus*)
- Giant floater (*Pyganodon grandis*)
- Elephant ear (*Elliptio crassidens*)

Zebra mussel (*Dreissena polymorpha*), an invasive species, was observed to be growing on native mussels. Overall, the 2011 survey concluded that the quality of the mussel community in the sampled sites was Poor and that the habitat in the Reservoir is generally inadequate for mussels.

3.6.1.2.3 Invasive Species

Invasive species that are present in the Reservoir include clams and mussels, fish, and aquatic plants. Non-native species present are the Asiatic clam (*Corbicula fluminea*), zebra mussel, Eurasian watermilfoil (*Myriophyllum spicatum L.*), hydrilla (*Hydrilla verticillate*), spiny-leaf naiad (*Najas minor*), curly-leaved pondweed (*Potamogeton crispus L.*), common carp (*Cyrpinius carpo*), Mississippi silverside, muskellunge, redbreast sunfish (*Lepomis auritus*), striped bass, yellow perch (*Perca flavescens*), and fathead minnow (*Pimephales promelas*). Some of these species, including striped bass and muskellunge, are stocked for recreational fishing activities.

Two of these species, Asiatic clam and zebra mussel, have already significantly altered the biota of the Reservoir. These species compete with native species for resources including food and habitat. They are also well known to have significant negative impacts regarding biofouling in power plant intakes and industrial water systems.

Details on protected aquatic species at the CRN Site and in the vicinity can be found in Section 3.8 (Threatened and Endangered Species).

3.6.1.3 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of aquatic resources within their respective project footprints. However, the specific details regarding the scope of these actions are lacking. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor are considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on aquatic ecology are included in TVA's analysis.

3.6.2 Environmental Consequences

3.6.2.1 Alternative A – No Action Alternative

Under Alternative A, a Nuclear Technology Park would not be constructed, operated, or maintained at the CRN Site. Under this alternative, no development of the CRN Site would occur, and the site would continue to be managed under provisions of the Watts Bar RLMP. Therefore, under Alternative A, there are no impacts to aquatic resources resulting from TVA's action.

3.6.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.6.2.2.1 CRN site and Associated Offsite Areas

3.6.2.2.1.1 Construction

Impacts from construction associated with Alternative B are primarily from direct, physical alteration to aquatic systems on the CRN Site, associated offsite areas, and aquatic habitats within the Reservoir. Such effects include in-filling of streams and ponds, associated alteration of adjacent riparian zones, placement of cofferdams, installation of new or replacement culverts, and localized dredging activities.

Aquatic resource impacts on the CRN Project Area include impacts to seven perennial streams (1,775 linear feet), six intermittent streams (2,655 linear feet) and two ponds (0.9 acre) (see Table 3-9). Impacts to streams would result in direct alteration and loss of aquatic habitat and associated riparian zones. Impacts under Alternative B would include alteration to three perennial streams (STR03, STR07, and STR11) located on the CRN Site, one (STR03) in the BTA, and three (STR13, STR14, STR15) located within the TN 95 Access. Additionally, one intermittent stream would be crossed by the offsite 161-kV transmission line. Aquatic biota were only observed within STR07 (near the proposed CWIS), on the CRN Site in STR11, within STR03 in the BTA, and within Grassy Creek located within the offsite transmission line corridor, and along the access to the BTA. Filling of these streams would result in the direct loss of resident aquatic biota and their associated habitats, and potential changes to hydrology of remaining adjacent stream habitats. The total linear footage of perennial and intermittent streams impacted within the Project Area of Alternative B is 4,430 feet (see Table 3-11). In contrast, the upper portion of Grassy Creek would be subject to some alteration of associated riparian zones but is expected to be spanned and not filled by transmission development activities. Impacts on streams from the construction of the 161-kV transmission line and other potential future transmission upgrades would be minimized through avoidance and the use of BMPs such as hand clearing of sensitive areas, silt fencing, and other erosion control methods.

Construction activities would also entail the installation or replacement of several culverts in association with improvements to roads. These include the replacement of a damaged culvert across the Grassy Creek embayment at the entrance to the CRN Site, and several culverts on River Road and the TN 95 Access/Jones Island Road, and new culverts along the Area 2 access road. Such culvert installations would be localized activities and would not result in substantial losses to aquatic habitats. BMPs would assist in minimizing any impacts related to construction or replacement of culverts.

There are four small, constructed stormwater retention ponds within Area 1 (see Figure 3-9). These ponds are shallow and generally have only intermittent connections to the Reservoir during precipitation events. These ponds provide a small amount of suitable habitat for aquatic communities. Under Alternative B, each of these ponds would require redevelopment for continued used as stormwater retention ponds during construction and operation. Because the ponds would continue in their intended use, the associated impacts of construction on aquatic communities within ponds on the CRN Site would be minor.

To minimize impacts to aquatic resources and habitats from erosion and stormwater runoff during and immediately following construction activities, established BMPs would be implemented. Further, a SWPPP would prescribe methods for collection and control of runoff from construction activities in accordance with state and federal regulations and permit requirements. Spill prevention BMPs would be used to prevent chemical contamination of surface waters during construction activities.

In summary, impacted streams on the CRN Site and associated offsite areas are small and do not support specialized or unique aquatic communities. Additionally, surface water ponds on the CRN Site are constructed and are expected to contain relatively common and unspecialized aquatic communities of relatively low quality. As such impacts to the aquatic communities of these streams and ponds would be minor.

3.6.2.2.1.2 Operation
The only impacts to ponds and streams during normal operation would be related to stormwater runoff at the CRN Site. To minimize stormwater runoff impacts, BMPs would be used. Further, a SWPPP would prescribe methods for collection and control of runoff from any future construction activities related to plant operations, for site disturbance greater than one acre, in accordance with state and federal regulations and permit requirements. Therefore, impacts to the aquatic ecological resources of streams and ponds on the CRN Site would be minor.

3.6.2.2.2 Clinch River Arm of the Watts Bar Reservoir

3.6.2.2.2.1 Construction
Construction activities that are likely to affect aquatic systems within the Reservoir include development of the CWIS, discharge structure, supplemental onsite barge facility, and alteration of nearshore habitats in conjunction with shoreline restoration and stabilization activities.

The Reservoir adjacent to the proposed SMR site (CRM 15.0 - 19.0) supports a fair to good fish assemblage and a poor mussel and snail community (see Section 3.6.1.2). A review of the 2011 mollusk and habitat survey, as well as surveys near the site in 1982 (Jenkinson), 1991 (Ahlstedt), and 1994 (TWRA and TDEC) found that habitat conditions to support mussels and snails is generally inadequate, despite reservoir release improvements to Melton Hill Dam and Watts Bar Dam that began in 1991. Although this reach of the Clinch River historically supported several federally listed aquatic mollusks, a lack of recent records for live endangered species in combination with a poor mussel and snail community indicates that developmental activities in or adjacent this reach of the Reservoir would not affect rare or listed aquatic animal species (See Section 3.8.2).

Construction of the intake and discharge structures, the supplemental onsite barge facility, and the shoreline restoration and stabilization activities have the greatest potential to impact aquatic habitat in the Reservoir. As described in Table 2-5, footprints of the intake, discharge and supplemental onsite barge facility are relatively small in comparison to the availability of similar habitats within the Reservoir. Construction of the intake and barge facilities is likely to impact 1.46 acres of instream benthic habitat in the Reservoir, while shoreline stabilization and the discharge structure are likely to impact 6,300 linear feet of shoreline along the Reservoir (Table 3-11). During construction, aquatic and benthic habitats within the construction zones would be disturbed or lost due to underwater excavation or dredging. However, these areas would be relatively small when compared to the extent of available aquatic habitat present in the Reservoir in the vicinity of the CRN Site. No habitats in the Reservoir are known to be unique or to provide essential habitat supporting rare aquatic species or important species. During construction, fish and other mobile aquatic species are likely to avoid the area, thereby minimizing impacts. Immobile benthic organisms would be directly impacted but would be expected to recolonize areas disturbed by construction.

Temporary and localized increases to turbidity in the immediate vicinity of intake and discharge structures may occur due to construction activities. Sedimentation could cause adverse effects on aquatic organisms adjacent to and downstream from construction activities if allowed to escape the immediate area. Additionally, as described in Section 3.3.2.2.1.1, the burial of diffusers and construction of intake, discharge, and onsite barge landing structures may disturb contaminated sediments in the Reservoir. Such disturbances may also affect aquatic biota. To mitigate and control activities involving the potential disturbance of contaminated sediments in the reservoir, TVA is party to the Watts Bar Interagency Agreement, along with the USACE, DOE, TDEC, and the EPA. Activities related to development of the Nuclear Technology Park which could result in the disturbance, re-suspension, removal, and/or disposal of contaminated sediments in the reservoir would be coordinated with these agencies through the agreement. Deposition would be minimized through the use of BMPs. While construction of intake and discharge structures are likely to have negative impacts on aquatic communities, the magnitude of impact would be minor with the application of Section 404 and 401 permits which would include the use of BMPs and with respect to the small area affected by construction activities as compared to the abundance of similar habitats within the Reservoir.

As a part of the construction of Alternative B, bank restoration and stabilization activities are expected to occur at several locations along the north bank of the Reservoir. In total, bank restoration and stabilization would be conducted at up to 9,050 feet of shoreline (Table 2-5). These measures include using riprap to stabilize and protect shoreline. Riprap would protrude into the river at a maximum of +/- 10 feet and would be installed from 2 feet below normal pool level to the top of the eroding bank. These activities can result in negative impacts to aquatic communities during the construction phase through disturbance to nearshore benthic habitats and increased sedimentation. There are no designated critical habitat areas in this nearshore zone. Additionally, given the abundance of similar available habitats in the reservoir, there is suitable area for mobile aquatic organisms to move from the disturbed area. Rapid recolonization of benthic habitats is also expected to occur within areas disturbed by construction. BMPs would be used to reduce runoff and sedimentation related to the construction of bank stabilization structures.

Throughout the duration of construction activities, BMPs would be used to minimize disturbance to the aquatic ecosystem in the Reservoir. This includes during the construction of intake and discharge structures, construction (i.e., pile driving) of barge facilities, and bank stabilization and culvert activities related to road improvements. Accordingly, construction activities on the CRN Site and in associated offsite areas along the Reservoir would not notably affect aquatic communities and the ecological impacts would be minor to moderate.

3.6.2.2.2.2 Operation

Plant operations on Area 1 would include the uptake of cooling water at the CWIS at CRM 17.9 through the dual-flow traveling screens at a velocity of less than 0.5 feet per second. Specific operational impacts to aquatic organisms related to operation of a CWIS are through entrainment and impingement of aquatic organisms at the intake. The term “entrainment” refers to the uptake of organisms such as eggs and ichthyoplankton in the intake water into the plant, whereas “impingement” refers to the entrapment of aquatic organisms (predominantly juvenile and adult fish) on the outer debris screens of the intake structure. Water intake at the CRN Site would be designed to be fully compliant with the rules in 316(b) of the CWA.

Entrainment typically affects those organisms that are small enough to pass through traveling screens located at the water intake structure. The most commonly entrained organisms include eggs, larval, and juvenile fish. Entrainment can vary drastically based on time of year, plant operation, and other factors. Mortality of entrained organisms is considered 100 percent. Preliminary entrainment studies in 2011-2012 indicated that percent entrainment ranged from 0.1 percent for one reactor with an intake flow of 5 cfs to 7.1 percent for four reactions and an average intake flow of 60 cfs (TVA 2012).

Impingement typically affects fish and shellfish, and the severity is variable and species dependent. Impingement mortality is the result of physical abrasion, asphyxiation, descaling, drowning or other physical harm. As a specific reactor technology has not been selected, the specific intake design and flow has not yet been finalized. Nonetheless, subject to technology selection TVA would design the CWIS such that the intake meets Best Technology Available criteria for both impingement and entrainment and is in compliance with all applicable Section 316(b) requirements. Therefore, impacts on aquatic resources from cooling water use would be minor.

During plant operations, blowdown from the cooling towers would be discharged in the Reservoir through a discharge pipeline and diffuser (Section 3.3.2.2.1.3). Thermal discharge from the plant at the discharge structure located at CRM 15.0 would potentially impact the aquatic organisms in the Reservoir. Low flow in the Reservoir could result in overall poor mixing of water. Thermal models have been described in Section 3.3.2.2.1.3 that show the extent of warming and mixing predicted for a plant located in Area 1 of the CRN Site. Thermal modeling shows that the largest area of high-temperature water could occur during the winter. This high-temperature water area would likely cover about 45 percent of the Reservoir width at CRM 15.0, in the vicinity of the discharge at a depth of about 5 feet. There are several thermally sensitive fish species in the Reservoir including greenside darter (*Etheostoma blennioides*), logperch (*Percina caprodes*), spotted sucker (*Minytrema melanops*), and white sucker (*Catostomus commersoni*). However, modeling indicates that the area of thermal discharge does not encompass the whole river, and there would be room for fish to avoid areas of high temperature to minimize thermal stress. Further, there are no nursery or critical habitat areas for fish located within the area potentially affected by increased temperatures; therefore, impacts of thermal discharge on aquatic ecology in the Reservoir would be minor.

Other impacts related to discharge include the potential chemical discharge and physical impacts from scouring of the river. Chemical discharge includes anti-scaling compounds, corrosion inhibitors, and biocides used to eliminate algal growth. The discharge could also contain minerals, salts, and organic compounds. These chemicals have the potential to have adverse effects on fish, invertebrate, and planktonic communities in the Reservoir. However, TDEC would approve of the use and quantities of chemicals for treatment of uptake water based on their future Biocide/Corrosion Treatment Plan. Biocides would likely be included specifically for the treatment of nuisance zebra mussels. Physical impacts from discharge are related to increased water velocity and unanticipated maintenance (e.g., dredging) at the discharge structure. These impacts could result in increased erosion, suspension, and deposition of sediments in the reservoir. To minimize impacts to aquatic habitats, the diffuser ports that are part of the discharge system would direct effluent upwards into the water column so that no physical alteration or scouring occurs, thereby minimizing impacts to benthic habitats. Therefore, impacts would be minor.

3.6.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

3.6.2.3.1 Construction

Stream impacts during construction in the associated offsite areas, such as the BTA and the transmission line ROWs, would be similar to those described for Alternative B. However, no ponds would be impacted under Alternative C. Under Alternative C, impacts to aquatic communities within streams and ponds are similar but slightly less than those described for Alternative B, with a total impact to seven perennial streams (1,412 lineal feet) and five intermittent streams (2,507 linear feet). Slightly reduced impacts would occur under Alternative C in conjunction with lesser impacts to STR07, STR06, and STR06. The total lineal footage of perennial and intermittent streams impacted within the Project Area of Alternative C is 3,919 feet (see Table 3-11). The impacts to streams would be minimized through the use of BMPs as practicable.

Under Alternative C, while the primary construction activities would take place in Area 2, construction along the Reservoir would be similar to those activities described in Alternative B. Specifically, the CWIS, the discharge structure, and the new barge facility would be constructed in the same location as in Alternative B. Bank restoration and stabilization activities are also the same as those described for Alternative B. Consequently, the impacts to aquatic organisms in the Reservoir for Alternative C are similar to impacts listed for Alternative B and would be minor to moderate.

3.6.2.3.2 Operation

The impacts of operation under Alternative C on aquatic ecology in streams and ponds that are not directly impacted by construction would be similar to those described for Alternative B. As remaining onsite streams and their riparian zones would be protected by 50- to 100-feet SMZs, the impacts to aquatic ecology during operational phase would be minor.

Under Alternative C, operation of the CWIS and discharge would be similar to operation under Alternative B. There are no additional operational impacts to the Reservoir outside of those listed under Alternative B. As such, the impacts of operation on the Reservoir would be minor.

3.6.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

3.6.2.4.1 Construction

Under Alternative D, the impacts to streams and ponds would reflect the additive of impacts associated with the addition of Area 2 to the effects described for Alternative B. However, because no additional effects to aquatic resources would occur within Area 2, the impacts from Alternative D are the same as those for Alternative B. Unavoidable impacts to aquatic resources would be mitigated in conjunction with stream mitigation commitments as described for Alternative B. Because the effects of the impacts to aquatic ecosystems under Alternative D are relatively small, and because these impacts would be mitigated, the impacts to aquatic ecosystems on the CRN Site and associated offsite areas would be minor.

For Alternative D, the CWIS, the discharge structure, and the new barge facility would be constructed in the same location as in Alternative B and C. Bank restoration and stabilization activities are also the same as those described for Alternative B. Consequently, the impacts on aquatic organisms in the Reservoir for Alternative D are similar to those for Alternative B and would be minor to moderate.

3.6.2.4.2 Operation

The impacts of operation under Alternative D on aquatic ecology in streams and ponds would be the same as those under Alternative B and Alternative C. As streams and their riparian zones would be protected by 50- to 100-feet SMZs, the impacts to aquatic ecology during operational phase would be minor.

Impacts of plant operation on the aquatic resource in the Reservoir under Alternative D are expected to be similar to those impacts under Alternative B and C. The main operation impacts to aquatic organisms include entrainment and impingement of fishes at the CWIS and warm water discharge at the discharge structure. Due to the changes to thermal profile of the river and the potential for entrainment and impingement, impacts to aquatic resources under Alternative D are expected to be moderate.

3.6.2.5 Summary of Impacts to Aquatic Ecology

In summary, potentially impacted streams on the CRN Site and associated offsite areas are small and do not support specialized or unique aquatic communities. Additionally, surface water ponds on the CRN Site were created during the CRBRP to serve as stormwater retention ponds and are expected to contain relatively common and unspecialized aquatic communities of relatively low quality. Impacts to aquatic systems could be mitigated through the use of BMPs during construction and operation.

Throughout the duration of construction activities, BMPs would be used to minimize disturbance to the aquatic ecosystem in the Reservoir. This includes during the construction of intake and discharge structures, construction (i.e., pile driving) of barge facilities, and bank stabilization and culvert activities related to road improvements. Accordingly, construction activities on the CRN Site and in associated offsite areas along the Reservoir would not notably affect aquatic communities and the ecological impacts would be minor to moderate.

A summary of impacts on aquatic ecology can be found in Table 3-18.

Table 3-18. Summary of Impacts to Aquatic Ecology

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Potential loss of jurisdictional stream habitat related to construction. Construction of CWIS, discharge structure, and barge facilities within the Reservoir.	In terms of impacts to aquatic habitats, impacts of Alternative C are greater than Alternative B and Alternative D. Loss of benthic habitat, sedimentation in the direct footprint of construction activities. Benthic habitat loss is expected to be temporary, and recolonization of much of the disturbed area would be expected to occur rapidly following the cessation of construction activities, therefore impacts would be minor.

Alternative	Project Phase	Impact	Severity
		Shoreline stabilization activities related to construction of the TN 95 Access Road would potentially result in the loss of nearshore aquatic habitat.	Shoreline restoration activities would result in the temporary loss of 2,000 feet of nearshore habitat for aquatic organisms in Reservoir. Further, construction activities would likely result in sedimentation in the water column. Impacts of stabilization on aquatic biota would be expected to be moderate. The severity of habitat loss would be mitigated through the use of BMPs. Following the cessation of construction, recolonization of nearshore areas by aquatic organisms would likely occur relatively quickly.
	Operation	Intake of water at the CWIS resulting in entrainment and impingement of aquatic species.	Intake design would be low velocity (less than 0.5 feet per second) to meet 316b standards for low impingement and entrainment. Though some level of impingement and entrainment is expected, impacts to aquatic organisms are expected to be minor.
		Thermal discharge during operation at the water discharge structure.	Thermal modeling shows that the largest area of high-temperature water would occur during the winter. This high-temperature water area would likely cover about 45 percent of the Reservoir width at a depth of about 5 feet. Fish and mobile aquatic organisms would be able to avoid these temporary increases in temperature, therefore impacts would be minor.
		Chemical discharge and physical scouring related to water discharges at the discharge structure.	Chemical inputs and physical scouring would likely have a minor adverse impact aquatic organisms in the Reservoir. Diffuser ports would be used to minimize the severity of physical scouring, reducing sedimentation and other negative impacts on aquatic habitats. Severity of impacts to aquatic organisms would be minor.

3.7 Terrestrial Ecology

3.7.1 Affected Environment

3.7.1.1 Plants

3.7.1.1.1 Plant Communities on the CRN Site and Vicinity

The CRN Site and associated offsite areas are located in the Southern Limestone/Dolomite Valleys and Rolling Hills and Southern Dissected Ridges and Knobs ecoregions, which are subdivisions of the Ridge and Valley. The Ridge and Valley, which occurs between the Blue Ridge Mountains on the east and the Cumberland Plateau on the west, is a relatively low-lying region made up of roughly parallel ridges and valleys that were formed through extreme folding and faulting events in past geologic time (Griffith et al. 1998). Over 95 percent of the CRN Site is found within the Southern Limestone/Dolomite Valleys and Rolling Hills, which is a heterogeneous region, composed predominantly of limestone and cherty dolomite. Landforms are mostly undulating valleys and rounded ridges with many caves and springs. Land cover in this ecoregion varies and includes forest, pasture, intensive agriculture, and areas of commercial, industrial, and residential development. The southern tip of the CRN Site, which comprises less than five percent of the site, is part of the Southern Dissected Ridges and Knobs ecoregion. This region contains more crenulated, broken, or hummocky ridges that support chestnut oak and pine forests in the higher elevations and stands of white oak, mixed mesophytic forest, and tulip poplar on the lower slopes (Griffith et al. 1998).

The CRN Site is situated in a rural area where forest and pasture/hayfields are dominant vegetation types (Figure 3-13). Based on the USGS land cover classification standards and the 2019 National Land Cover Database (NLCD), land cover in the CRN Site vicinity, which includes the CRN Site and the area within a six-mile radius, is categorized and shown in Figure 3-13 and Table 3-19. Forested land (deciduous, evergreen, or mixed forest) accounts for approximately 58 percent of the CRN Site vicinity. Wetlands (emergent herbaceous or woody wetlands) occupy approximately 2 percent of the CRN Site vicinity. Other vegetated undeveloped land (herbaceous or shrub/scrub) totals approximately 2 percent of the CRN Site vicinity. Land classified as cultivated crops and pasture/hay total approximately 21 percent of the CRN Site vicinity. Open water and barren land occupy approximately 3 percent of the CRN Site vicinity. The remaining approximately 14 percent of the CRN Site vicinity is classified as developed (high, medium, or low intensity, or open space).

Using the National Vegetation Classification System (Grossman et al. 1998), vegetation types within the CRN Site were classified as a combination of herbaceous vegetation and deciduous, evergreen, and mixed evergreen-deciduous forest. Based on interpretation of aerial photographs and the findings of past field surveys, TVA created a more refined map of dominant vegetation communities and other land cover types on the Project Area (Figure 3-14). Based on this map, over 75 percent of the CRN Site is covered by forest (including woody wetlands), approximately 22 percent is covered by herbaceous vegetation, and approximately one percent is covered by small ponds and emergent wetlands. The remaining two percent of the CRN Site is classified as roads and developed areas. Table 3-19 shows the percentage of the CRN Site and associated offsite areas covered by each type of vegetation community or land cover and the estimated acreage of each type.

Developed areas on the site have been heavily manipulated and have no appreciable vegetative cover. Previous environmental reviews state that much of the site was undergoing secondary succession due to previous disturbance associated with farming and logging and that plant communities present there were not unique because thousands of acres of comparable habitat occur on adjacent lands within the ORR (NRC 1977; NRC 1982). In addition, 240 forested acres on Area 1 of the CRN Site were cleared and heavily graded in preparation for construction of the prior CRBRP project.

The most recent field surveys of the CRN Site and associated offsite areas were conducted between September 2020 and June 2021. These efforts were focused on documenting plant communities and infestations of invasive plants and searching for possible threatened and endangered plant species on the CRN Site and associated offsite areas. Areas representative of each vegetation type present on the CRN Site were visited during the surveys. Characteristics of the vegetation communities on the CRN Site are described below, including examples of species generally representative of these community types.

Mixed evergreen-deciduous forest is defined as a forest stand where both evergreen and deciduous species contribute from 25 to 75 percent of total canopy cover. This is the most prevalent forest type on the CRN Site and accounts for approximately 41 percent of the vegetation cover on the site (TVA 2015; Table 3-19). It occurs as dry oak-hickory-pine stands along ridgelines and within disturbed tracts at other places on the landscape. The dry oak-hickory-pine forest is dominated by black oak (*Quercus velutina*), chestnut oak (*Q. montana*), northern red oak (*Q. rubra*), southern red oak (*Q. falcata*), and white oak (*Q. alba*). The dominant hickories include mockernut hickory (*Carya tomentosa*), pignut hickory (*C. glabra*), and shagbark hickory (*C. ovata*). Virginia pine (*Pinus virginiana*) is the dominant conifer along with scattered eastern red cedars (*Juniperus virginiana*). Black gum (*Nyssa sylvatica*), American hornbeam (*Carpinus caroliniana*), and sourwood (*Oxydendrum arboreum*) are common understory tress. Common herbaceous species include black snakeroot (*Sanicula odorata*), Christmas fern (*Polystichum acrostichoides*), little brown jug (*Hexastylis arifolia*), ebony spleenwort (*Asplenium platyneuron*), pennywort *(Obolaria virginica)*, running ground cedar (*Diphasiastrum digitatum*), spotted wintergreen (*Chimaphila maculata*), and wood sorrel (*Oxalis corniculata*) in the herb layer (TVA 2015).

Disturbed mixed evergreen-deciduous forest is similar to that found on dry ridgetops, but it generally occurs in more mesic situations. This relative abundance of soil moisture, mixed with historic disturbance, results in stands with a different assemblage of canopy species. Common hardwoods in these disturbed stands include sweetgum, yellow poplar (*Liriodendron tulipifera*), winged elm *(Ulmus alata),* sugarberry (*Celtis laevigata*), red maple, and sugar maple. The evergreen species loblolly pine (*P. taeda*) and white pine (*P. strobus*) are also frequent components of these sites.

Deciduous forest, the second most prevalent forest type, covers about 30 percent of the CRN Site and is characterized by trees with overlapping crowns and a canopy of more than 75 percent deciduous species (TVA 2015; Table 3-19). The deciduous forests on the CRN Site include three subtypes. The most extensive subtype of deciduous forest is mixed mesophytic forest, which has a rich herbaceous layer that includes species like bishop's cap (*Mitella diphylla*), blue cohosh (*Caulophyllum thalictroides*), bloodroot (*Sanguinaria canadensis*), dog-tooth violet (*Erythronium americanum*), doll's eyes (*Actaea pachypoda*), foam-flower (*Tiarella cordifolia*), Jack-in-the-pulpit (*Arisaema triphyllum*), maidenhair fern (*Adiantum pedatum*), Solomon's plume (*Maianthemum racemosum*), and Solomon's seal (*Polygonatum biflorum*). The forest canopy is dominated by yellow poplar with American beech (*Fagus grandifolia*), northern red oak, sugar maple, white oak, and yellow buckeye (*Aesculus flava*). The midstory is also diverse and includes American holly (*Ilex opaca*), Carolina buckthorn (*Rhamnus caroliniana*), flowering dogwood (*Cornus florida*), maple-leaf viburnum (*Viburnum acerifolium*), American cancer-root (*Conopholis americana*), muscadine (*Vitis rotundifolia*), poison ivy (*Toxicodendron radicans*), Virginia creeper (*Parthenocissus quinquefolia*), pawpaw (*Asimina triloba*), American hornbeam, and serviceberry (*Amelanchier* sp.) (TVA 2015, TVA 2021b).

The second subtype of deciduous forest, calcareous forest, occurs on portions of the CRN Site underlain by limestone. Woody plants present in the calcareous forest areas include bladdernut (*Staphylea trifolia*), eastern red cedar, eastern redbud (*Cercis canadensis*) along with the overstory tree species chinquapin oak (*Q. muehlenbergii*), which is characteristic in these limestone derived soils. Common herbaceous species include glade fern (*Diplazium pycnocarpon*), green violet (*Hybanthus concolor*), harbinger of spring (*Erigenia bulbosa*), Jacob's ladder (*Polemonium reptans*), twin-leaf (*Jeffersonia diphylla*), walking fern (*Asplenium rhizophyllum*), wild geranium (*Geranium maculatum*), and woodland phlox (*Phlox divaricata*). Most of the calcareous forest occurs within the Grassy Creek Habitat Protection Area and along a few mesic slopes adjacent to the river (TVA 2015).

The third subtype of deciduous forest present on the CRN Site is wetland forest. Wetland forest was found primarily near the edge of the Reservoir and within riparian areas of tributaries found on the site. These areas are dominated by American sycamore, black willow, buttonbush, silky dogwood, and tag alder (*Alnus serrulata*). In addition, persimmon (*Diospyros virginiana*) is common along the shoreline along with box elder, Chinese privet, false indigo (*Amorpha fruticosa*), multiflora rose (*Rosa multiflora*), and silver maple. Herbaceous species such as netted chain fern (*Woodwardia areolata*), jewelweed (*Impatiens capensis)*, lizard tail (*Saururus cernuus*), rose mallow (*Hibiscus* sp.), water willow (*Justicia americana*), and several species of grasses, rushes, and sedges are also present (TVA 2015).

The deciduous calcareous wetland forest just south of Bear Creek Road within the proposed offsite 161-kV transmission line ROW (see Figure 3-15 in Section 3.8 Threatened and Endangered Species) is fundamentally different from other wetland forests within the Project Area. This is likely because the geology and landscape position of this area differs from other forested wetlands onsite. Grass and sedge diversity is high here and includes fringed sedge (*Carex crinita*), sharpscale sedge (*C. oxylepis*), inflated narrow leaf sedge (*C. grisea*), squarrose sedge (*C. squarrosa*), lurid sedge (*C. lurida*), broom-like sedge (*C. bromoides*), nodding fescue (*Festuca subverticillata*), and slender spikerush (Eleocharis tenuis). Wetland forbs present include turtlehead (*Chelone* sp.), giant goldenrod, sweet flag iris (*Iris virginica*), groundnut (*Apios americana*), ironweed (*Vernonia gigantea*), and others. Notable species in this wetland include the state-listed pale green orchid (*Platanthera flava* var. *herbiola*) and rigid sedge (*Carex tetanica*).

Herbaceous vegetation has greater than 25 percent cover of grasses and forbs and occurs on about 22 percent of the CRN Site (Table 3-19). Approximately 240 acres on Area 1 of the site has been previously cleared and extensively graded for the prior CRBRP project and much of that land was revegetated with non-native species such as sericea lespedeza (*Lespedeza cuneata*) and tall fescue (*Lolium arundinaceum*). These cleared areas are in the process of undergoing succession and support a number of weedy species such as black-eyed Susan (*Rudbeckia hirta*), broom-sedge (*Andropogon virginicus*), tall goldenrod (*Solidago altissima*), poverty dropseed (*Sporobolus vaginiflorus*), Johnson grass (*Sorghum halepense*), Queen Anne's lace (*Daucus carota*), and various other common forbs. Young eastern redcedar is scattered throughout these heavily disturbed areas (TVA 2015; TVA 2021b).

Three areas of herbaceous vegetation resembling cedar glades, or barrens, were observed on the CRN Site and associated offsite areas (see Figure 3-15 in Section 3.8 Threatened and Endangered Species). These areas are characterized by shallow, drought prone soils and scattered eastern redcedar around canopy openings. Glade/barren habitat is notable for the region. These three separate habitat areas are: 1) disturbed glade on approximately 1.8 acres near the center of Area 1 within the existing 161-kV transmission line ROW; 2) approximately 5-acre glade on northeast portion of Area 1 near the proposed intake area; and 3) approximately 3.5-acre glade, known as the Raccoon Creek Barren, adjacent to the proposed offsite TN 95 Access improvements on the ORR near the Reservoir. The glade on Area 1 of the CRN Site that is adjacent to the existing 161-kV transmission line ROW is relatively disturbed compared to the other two areas. The most intact of the three sites is adjacent to the TN 95 Access on the ORR. It has sporadic tree cover with eastern redcedar, chinquapin oak, Shumard oak (*Q. shumardii*), and hophornbeam (*Ostrya virginiana*). No plant species that are considered rare and tracked by the state were observed, but many notable herbaceous species that are characteristic of cedar glades were present. These included grey headed coneflower (*Ratibida pinnata*), aromatic aster (*Symphyotrichum oblongifolium*), prickly pear (*Opuntia* sp.), glade St. Johnswort (*Hypericum dolabriforme*), spreading aster (*Symphyotrichum patens*), smooth aster (*S. laeve*), Indian grass (*Sorghastrum nutans*), Adam's needle (*Yucca filamentosa*), whorled milkweed (*Asclepias verticillata*), green comet milkweed (*A. viridiflora*), rough dropseed (*Sporobolus compositus*), false aloe (*Manfreda virginica*), and numerous others.

An herbaceous community is also maintained within the 500-kV transmission corridor extending to the Bethel Valley substation. The terrestrial habitats within this ROW are not known to include wetlands or occurrences of federally or state-listed species. The vegetation within the ROW is actively maintained by TVA as an herbaceous community with a composition flora and fauna that is similar to that of other transmission lines on the CRN Site.

Several small emergent wetlands occur on the CRN Site and associated offsite areas. See Section 3.4.2.1 (Wetlands) in this Draft PEIS for additional information on the structure and composition of vegetation in the wetlands.

Evergreen forest occurs on the CRN Site as remnants of planted loblolly and white pine plantations, and it comprises approximately three percent of the total land cover of the area.

3.7.1.1.2 Invasive Non-Native Plant Species

Executive Order (EO) 13112 directed TVA and other federal agencies to prevent the introduction of invasive species (both plants and animals), control their populations, restore invaded ecosystems, and take other related actions. EO 13751 amends EO 13112 and directs actions by federal agencies to continue coordinated federal prevention and control efforts related to invasive species. This order incorporates considerations of human and environmental health, climate change, technological innovation, and other emerging priorities into federal efforts to address invasive species.

Some invasive plants have been introduced accidentally, but most were brought to areas of the U.S. as ornamentals or for livestock forage. Because these robust plants arrived without their natural predators (insects and diseases) their populations spread quickly across the landscape displacing native species and degrading ecological communities and ecosystem processes (Miller 2010). According to Morse et al. (2004), invasive non-native species are the second leading threat to imperiled native species.

Large portions of the CRN Site were extensively altered during the CRBRP project, resulting in the introduction and spread of invasive non-native plants. No federal noxious weeds were observed during the most recent field surveys, but many non-native invasive plant species were observed throughout the study area. Common invasive plant species occurring on the CRN Site include autumn olive (*Elaeagnus umbellata*), Chinese privet, Japanese honeysuckle (*Lonicera japonica*), Japanese stilt grass (*Microstegium vimineum*), Johnson grass, mimosa (*Albizia julibrissin*), multiflora rose, Oriental bittersweet (*Celastrus orbiculatus*), sericea lespedeza, kudzu (*Pueraria montana* var. *lobata*), and tree-of-heaven (*Ailanthus altissima*) (TVA 2015; TVA 2021b). All of these species occur widely across the landscape and have the potential to adversely impact the native plant communities because of their potential to spread rapidly and displace native vegetation. All are considered a threat in Tennessee (Tennessee Invasive Plant Council 2021).

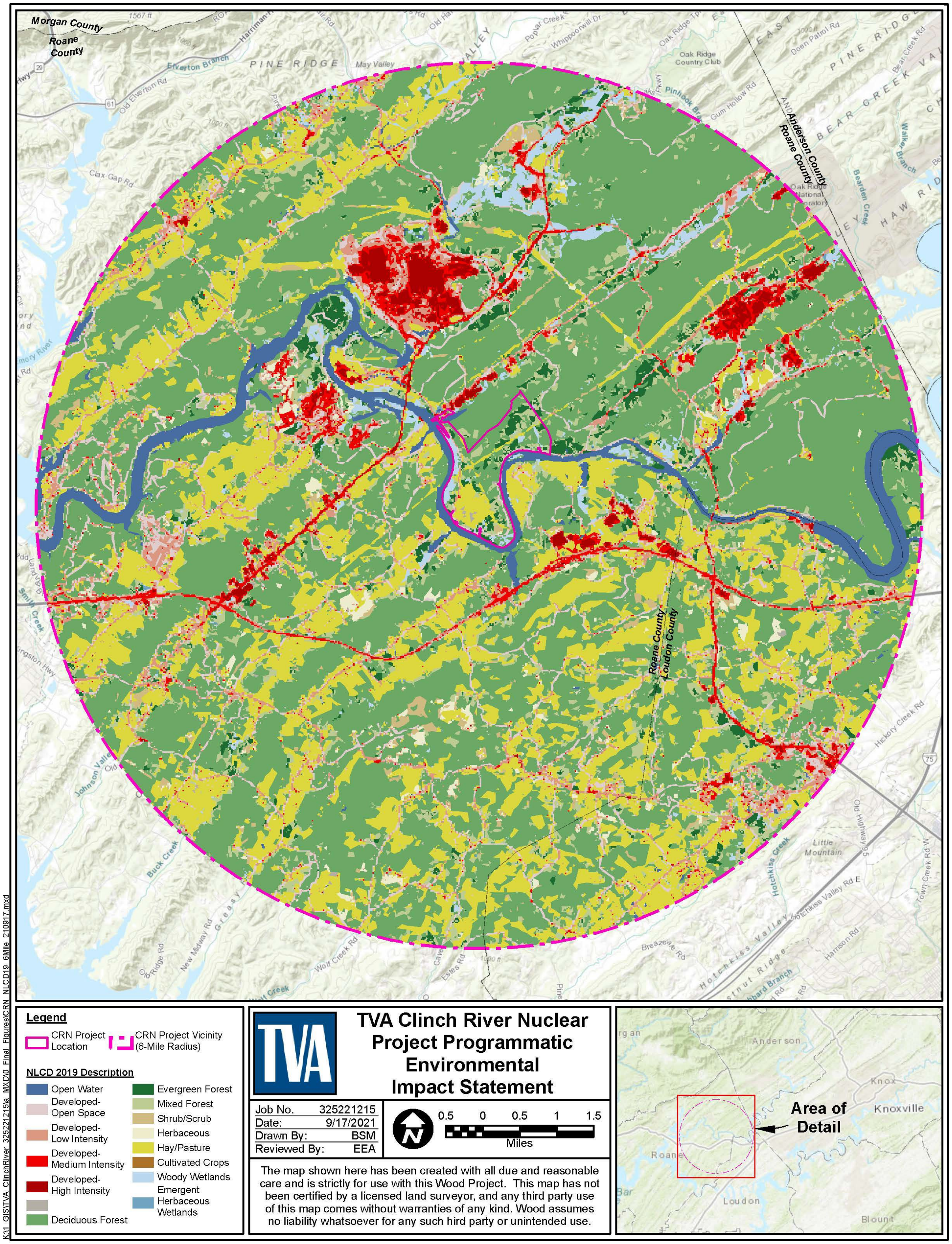


Figure 3-13. Land Cover within the 6-mile Vicinity of the CRN Site

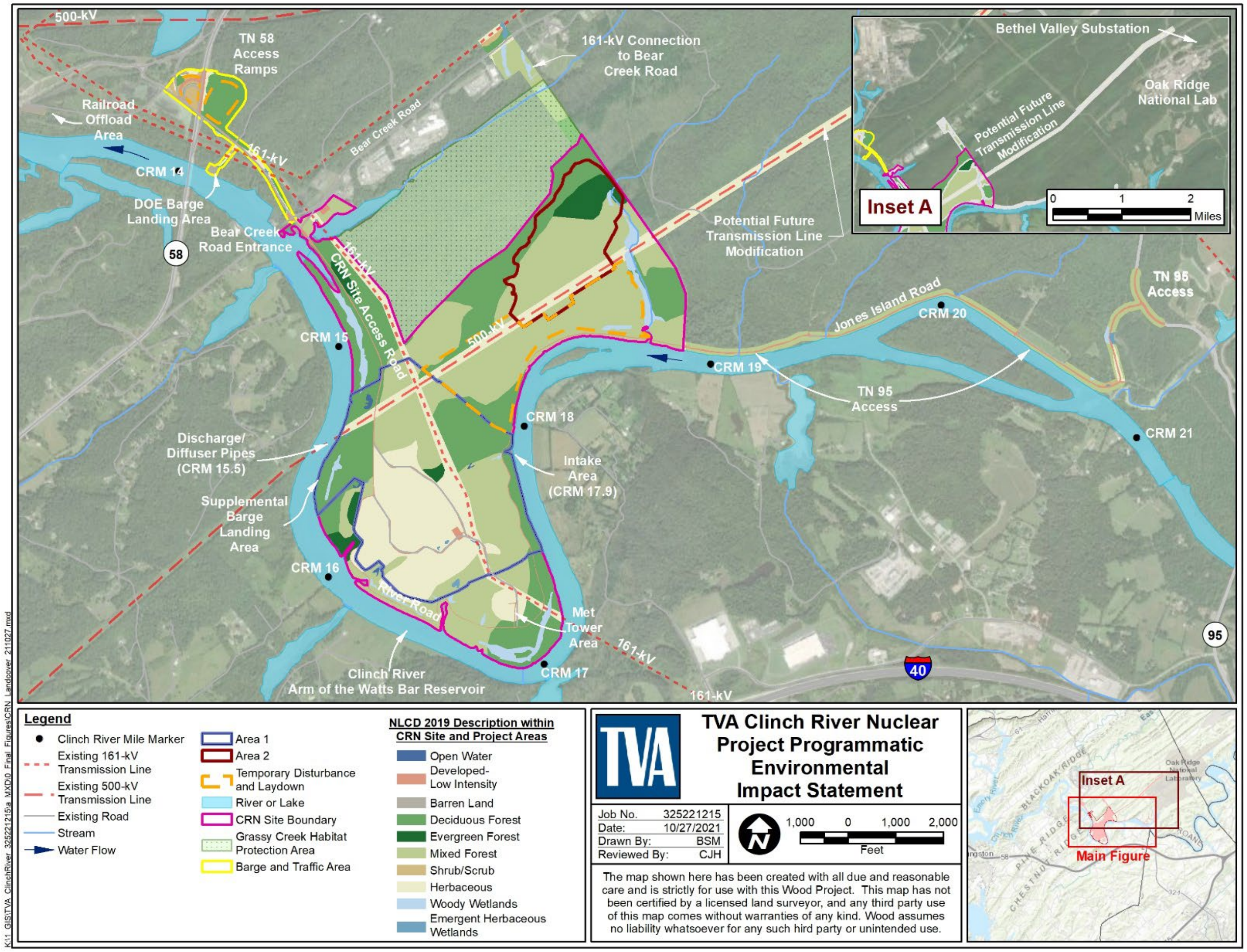


Figure 3-14. USGS Land Cover on the CRN Site and Associated Offsite Areas

Table 3-19. NCLD Land Cover Categories for the CRN Site and Vicinity

	CRN Site[1]		Barge and Traffic Area[1]		TN 95 Access[1]		Offsite 161-kV Transmission Corridor[1]		6-Mile Radius[2]	
NCLD Description	**CRN Site (ac)**	**Percent of Land Cover (%)**	**Barge/ Traffic Area (ac)**	**Percent of Land Cover (%)**	**Jones Island Road (ac)**	**Percent of Land Cover (%)**	**Offsite 161-kV Corridor**	**Percent of Land Cover (%)**	**Vicinity (ac)**	**Percent of Land Cover (%)**
Barren Land	0	0	1.1	3	0	0	0	0	90	<1
Cultivated Crops	0	0	0	0	0	0	0	0	0	0
Deciduous Forest	270.7	29	22.9	52	0	0	5.5	20	36,414	50
Developed, High Intensity	0	0	0	0	9.8	19	0	0	947	1
Developed, Medium Intensity	0	0	0	0	0	0	0	0	1,968	3
Developed, Low Intensity	14.2	2	7.5	17	0	0	0.4	1	3,316	5
Developed, Open Space	0	0	0	0	0	0	0	0	3,923	5
Emergent Herbaceous Wetlands	1.5	<1	0.9	2	0.8	2	0.7	3	43	<1
Evergreen Forest	32.0	3	0	0	0	0	0	0	1,476	2
Herbaceous	201.4	22	5.1	12	1.4	3	2.3	8	907	1
Mixed Forest	383.9	41	0.02	<1	38.2	74	14.8	53	4,086	6
Open Water	1.4	<1	0	0	0	0	0	0	2,159	3
Hay/Pasture	0	0	0	0	0	0	0	0	14,956	21
Shrub/Scrub	0	0	5.8	13	0.5	1	1.2	4	865	1
Woody Wetlands	29.3	3	0.4	1	0.7	1	2.9	10	1,232	2
Total	**934.4**	100	**43.7**	100	**51.4**	100	**27.8**	100	**72,382**	100

[1]Land cover for the CRN Site and associated offsite areas presents a more refined representation of vegetation/land cover types than the NLCD data presented for the 6-mile vicinity. Dominant vegetation communities and other land cover types on the CRN Site and associated offsite areas were drawn in GIS based on aerial photographs and information from TVA field surveys.
[2]Source: NLCD Land Cover (Dewitz 2019)

3.7.1.2 Wildlife

The CRN Site offers a wide array of wildlife habitats that support species common to the region. As described in Section 3.7.1.1, over half of Area 1, approximately 240 acres, has been previously cleared and extensively graded for the CRBRP and is now herbaceous fields with sporadic cedar trees, gravel roads, parking lots, and periodically mowed transmission line ROWs. The northern section of Area 1, as well as Area 2, are mostly forested. In addition, the proposed offsite 161-kV transmission line ROW would be sited across and down a ridge of forest habitat into forested bottomland. The proposed BTA is primarily located along existing roads (paved and gravel) with mowed or forested edges. However, a new section of road would be constructed in the BTA area through forest habitat. In addition, the areas that would be affected by the proposed TN 95 Access improvements consist of forest and mowed areas, as well as a barren known as the Raccoon Creek Barren. Extensive field surveys were performed across the CRN Site in 2011, 2013, and 2021 (TVA 2021c). Additional surveys were performed at the BTA in 2015 and along Jones Island Road in 2021 (TVA 2021c). Over 200 wildlife species have been observed on the CRN Site during these surveys.

Although some of the species observed on the CRN Site prefer specific habitat types, many are generalists and may occur in habitats throughout the site. Regionally abundant mammals that have been observed on the CRN Site include the white-tailed deer (*Odocoileus virginianus*), coyote (*Canis latrans*), red fox (*Vulpes vulpes*), eastern gray squirrel (*Sciurus carolinensis*), eastern chipmunk (*Tamias striatus*), eastern cottontail (*Sylvilagus floridanus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana*), and short-tailed shrew (*Blarina brevicauda*).

Breeding birds that have been observed during field surveys include the American crow (*Corvus brachyrhynchos*), blue jay (*Cyanocitta cristata*), Carolina chickadee (*Poecile carolinensis*), Carolina wren (*Thryothorus ludovicianus*), tufted titmouse (*Baeolophus bicolor*), pileated woodpecker (*Dryocopus pileatus*), red-bellied woodpecker (*Melanerpes carolinus*), hairy woodpecker (*Picoides villosus*), wild turkey (*Meleagris gallopavo*), barred owl (*Strix varia*), red shouldered hawk (*Buteo lineatus*), Cooper's hawk (*Accipiter cooperii*), ruby-throated hummingbird (*Archilochus colubris*), yellow-billed cuckoo (*Coccyzus americanus*), red-eyed vireo (*Vireo olivaceus*), yellow-throated vireo (*Vireo flavifrons*), white-eyed vireo (*Vireo griseus*), scarlet tanager (*Piranga olivacea*), chuck-wills-widow (*Caprimulgus carolinensis*), and whip-poor-will (*Caprimulgus vociferus*). Birds observed in riverine habitat and along the riparian zone include the belted kingfisher (*Megaceryle alcyon*), great blue heron (*Ardea herodias*), tree swallow (*Tachycineta bicolor*), osprey (*Pandion haliaetus*), black-crowned night heron (*Nycticorax nycticorax*), bald eagle (*Haliaeetus leucocephalus*), wood duck (*Aix sponsa*), Canada goose (*Branta canadensis*), and double-crested cormorant (*Phalacrocorax auritus*).

Amphibians observed on the CRN Site include the gray treefrog (*Hyla versicolor*), American toad (*Bufo americanus*), green frog (*Rana clamitans*), and eastern narrow-mouthed toad (*Gastrophryne carolinensis*). Reptiles observed include the black rat snake (*Elaphe obsoleta obsoleta*), corn snake (*Elaphe guttata guttata*), and aquatic turtles, including the common snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), river cooter (*Pseudemys concinna*), and Cumberland slider (*Trachemys scripta troostii*).

Three caves and one rock shelter exist on the HPA. One additional cave exists across the Reservoir immediately adjacent to the CRN Site. Review of the TVA Regional Natural Heritage database in July 2021 indicated that 11 additional cave records exist within five miles of the CRN Site. State- and federally listed species associated with these caves are discussed in Section 3.8 (Threatened and Endangered Species). Three wading bird colonies have been reported within 5 miles of the CRN Site, the closest of which is approximately 0.6 miles away. Thirteen osprey nests were observed on or adjacent to the CRN Site in January-May 2021 (TVA 2021c) (see Figure 3-15 in Section 3.8, Threatened and Endangered Species). Eight of these nests are on large transmission structures, four are on small utility poles, and one is on a nesting platform. These nests were active in spring/summer of 2021.

Review of the USFWS's Information for Planning and Consultation (IPaC) website in July 2021 resulted in seven migratory bird species of conservation concern identified as having the potential to occur near the CRN Site (bald eagle, cerulean warbler [*Setophaga cerulea*], prairie warbler [*S. discolor*], red-headed woodpecker [*Melanerpes erythrocephalus*], rusty blackbird [*Euphagus carolinus*], wood thrush [*Hylocichla mustelina*], and yellow-bellied sapsucker [*Sphyrapicus varius*]) (USFWS 2021). Suitable habitat exists for these species in the Project Area. Juvenile bald eagles have been observed flying along the Reservoir near the CRN Site. Prairie warbler, red-headed woodpecker, wood thrush, and yellow-bellied sapsucker have been observed on the CRN Site. While not observed onsite, suitable habitat exists for cerulean warbler within forested habitats and for rusty blackbird within forested wetlands.

3.7.1.3 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of terrestrial resources within their respective project areas. While the specific details regarding the scope of many of these actions are lacking it is expected that each would entail the alteration of land cover and associated terrestrial habitats. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. However, because each of these projects has the potential to alter terrestrial ecosystems, further consideration of reasonably foreseeable future actions and their effects on terrestrial resources are included in the following section as appropriate.

3.7.2 Environmental Consequences

3.7.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, the CRN Site would remain relatively unused, and vegetation and wildlife would be maintained and managed as they have been in recent years in accordance with the Watts Bar RLMP (TVA 2009, 2021k). TVA would continue routine maintenance and clearing associated with the transmission lines that traverse the CRN Site. Limited disturbance related to periodic mowing of developed areas and road margins would continue, but there would be no appreciable change to plant communities found in those areas. Forested areas within the site would continue to change over time, but any shift in forest composition would be related to natural ecological processes and not adoption of Alternative A. In addition, the TWRA permit for use of TVA land for controlled hunting could be continued. Thirteen active osprey nests were documented on or immediately adjacent to the CRN Site during field surveys in spring/summer 2021 (TVA 2021c). If the timing of routine maintenance actions within 660 feet of these nests cannot be modified to avoid nesting seasons, coordination with USDA Wildlife Services would be required for guidance to ensure compliance under the EO 13186 [Responsibilities of

Federal Agencies to Protect Migratory Birds]. With the use of avoidance and mitigation measures near osprey nests no notable impacts would occur to these terrestrial wildlife species. Therefore, there would be no impacts to terrestrial plants and wildlife under the No Action Alternative.

3.7.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.7.2.2.1 Plants

3.7.2.2.1.1 Construction

In conjunction with Alternative B, TVA would develop the CRN Nuclear Technology Park only at Area 1. Construction activities would start with site preparation work (clearing and grading) on the CRN Site and improvements to the offsite barge facility and haul road in the BTA. Activities such as land clearing, grading, excavation, and filling have the greatest potential to result in substantial effects on ecosystems. Subsequent construction-phase impacts would include installation of components that make up the facility's power block (reactor, turbine, cooling tower, transmission lines, transformers, switchyard, admin/control building, and associated parking).

As depicted in Table 3-20, up to approximately 550 acres of the CRN Site would be affected by construction activities under this alternative, including approximately 469 acres that would be permanently covered by the facility or otherwise developed and approximately 83 acres that would be used temporarily as laydown during construction. In addition to the areas on the CRN Site that would be affected by construction, additional areas that would be affected are located off the CRN Site within the BTA (43.7 acres), the TN 95 Access area (51.4 acres), and offsite transmission line ROW (27.8 acres). Impacts by land cover type within the BTA, TN 95 Access, and offsite transmission areas are provided in Table 3-20.

Adoption of Alternative B would have permanent, minor impacts on the vegetation of the region. However, much of Area 1 has been heavily disturbed by previous work on the CRN Site (NRC 1977; NRC 1982). The most disturbed areas within Area 1 are currently a patchwork of herbaceous vegetation and scattered trees. Because these areas have been previously cleared and graded and are dominated by non-native species, they do not resemble natural plant communities and possess little conservation value. Other portions of Area 1 support forest stands that range from early successional to mature. Some of these forest stands are dominated by planted pines that are not native to the region, while other stands are populated by larger hardwood trees and have many native plants in the herbaceous layer. Thus, forested stands that would be affected on Area 1 are a mix of habitats that range from lower quality sites to more intact, less disturbed plant communities.

The plant communities on the CRN Site and associated offsite areas most affected by construction-related activities under Alternative B would be, in order of decreasing acreage affected, mixed evergreen/deciduous forest, herbaceous (including all three native cedar glade areas), and deciduous forest. Table 3-20 shows the estimated acreage of each type of vegetation community or land use potentially disturbed by development on the CRN Site and associated offsite areas and the approximate percentage of each type that would be disturbed temporarily and permanently.

Construction activities would comply with federal and state regulations, permit requirements, established BMPs, and TVA procedures and guidelines. Land clearing would involve the cutting and removal of trees and other vegetation. Clearing operations would be conducted in accordance with TVA BMPs and in a manner that would prevent any unnecessary damage to the remaining natural vegetation, would protect wetlands and streams, and would prevent soil erosion. In areas such as transmission line ROWs that need to be kept cleared of vegetation, mechanical (mowing, hand trimming) and chemical clearing (herbicides) may be used. As described in Section 3.2, BMPs for erosion control and stormwater management would be employed during construction to minimize the potential for erosion, sediment deposition, and dust. These BMPs would substantially reduce the potential for such processes to directly disturb or indirectly impact nearby plant communities outside the footprint of development.

The terrestrial plant communities that would be permanently disturbed by the construction of facilities on the CRN Site under Alternative B comprise predominantly mixed evergreen-deciduous, deciduous, evergreen forest, and woody wetlands (273.6 acres) and herbaceous (180.6 acres) vegetation (Table 3-20). These acreages are a modest component of the expanse of such communities within the vicinity, as shown in Table 3-19.

Native cedar glade/barrens habitat occurs on about 1.8 acres in the center of Area 1, approximately 5 acres near the northeastern boundary of Area 1, and on approximately 3.5 acres on the offsite DOE ORR near the TN 95 Access within the Raccoon Creek Barren, that would be permanently impacted under Alternative B. These grasslands, particularly the grassland on the proposed offsite TN 95 Access area, are intact native habitats that are notable for the Ridge and Valley ecoregion. TVA would coordinate with DOE as appropriate to minimize and avoid impacts in these native cedar glade areas during design, construction, and operation of a future facility.

Some of the areas disturbed under Alternative B (approximately 83.2 acres or 15 percent of the total onsite disturbed area) would be for temporary use comprising construction-related facilities and material laydown areas (Table 3-20). Temporary use areas would be cleared and graded as appropriate to support construction activities. The areas cleared for temporary uses may be revegetated or otherwise restored after construction completion using native or non-invasive species to avoid the introduction or spread of invasive species.

Terrestrial vegetation communities and other land cover types on the offsite areas, including the BTA, TN 95 Access, and 161-kV transmission corridor, are described in Subsection 3.7.1.1 and in Table 3-19. Approximately 23 acres, 39 acres, and 23 acres of forest land in the BTA, TN 95 Access, and 161-kV transmission line ROW, respectively, would be permanently disturbed and/or converted by the planned improvements. These areas of mixed and deciduous forest are a negligible component of the expanse of these common plant communities within the vicinity of the CRN Site. It should be noted that offsite 161-kV transmission corridor impacts in Table 3-20 are for the entire proposed 280-foot corridor, as the final placement of the 120-foot ROW to be developed within this corridor is not yet known. Acreages of actual land cover impacts within the 120-foot ROW would be notably lower.

Much of Area 1 currently has a substantial component of invasive terrestrial plant species and adoption of Alternative B would not significantly affect the extent or abundance of these species at the county, regional, or state level. Implementation of Alternative B would result in conversion of most of Area 1 from natural vegetation to developed areas and regularly maintained habitats, such as mowed lawn. While developed areas would contain no vegetation and regularly mowed areas would be much less diverse than natural habitats, the conversion would likely result in fewer invasive plant populations on the landscape. All areas disturbed during the construction, operation, and management of the Technology Park in Area 1 would be revegetated with native and/or non-invasive plant species.

Table 3-20. Land Cover Types Potentially Disturbed by Development on the CRN Site and Associated Offsite Areas

Land Cover Types	Alternative B – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)	Alternative C – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)	Alternative D – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)
CRN Site						
Permanently Disturbed Areas						
Deciduous forest	102.9	19	50.8	15	116.5	19
Developed, low intensity	12.5	2	8.4	3	12.5	2
Emergent herbaceous wetlands	1.0	0	0.1	0	1.0	0
Evergreen forest	8.5	2	20.0	6	22.1	3
Herbaceous	180.6	33	32.6	10	180.6	29
Mixed forest	155.1	28	109.9	33	212.9	34
Open water	1.0	0	0	0	1.0	0
Woody wetlands	7.1	1	5.9	2	7.4	1
Total forest (including woody wetlands)	***273.6***	***50***	***186.6***	***57***	***358.9***	***57***
Subtotal Permanent	***468.6***	***85***	***227.7***	***69***	***553.9***	***88***
Temporarily Disturbed Areas (Laydown)						
Deciduous forest	10.8	2	15.2	5	10.7	2
Herbaceous	0	0	7.8	2	0	0
Mixed forest	71.3	13	77.1	23	67.2	11
Woody wetlands	1.2	0	1.2	0	1.2	0
Total forest (including woody wetlands)	***83.2***	***15***	***93.5***	***28***	***79.0***	***12***
Subtotal Temporary	***83.2***	***15***	***101.2***	***31***	***79.0***	***12***
Subtotal All Affected Areas	**551.8**	**100**	**328.9**	**100**	**633.0**	**100**

Land Cover Types	Alternative B – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)	Alternative C – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)	Alternative D – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)
Associated Offsite Areas						
Offsite Barge and Traffic Area						
Permanently Disturbed Areas						
Barren land	1.1	3	1.1	3	1.1	3
Deciduous forest	22.9	52	22.9	52	22.9	52
Developed, low intensity	7.5	17	7.5	17	7.5	17
Emergent herbaceous wetlands	0.9	2	0.9	2	0.9	2
Herbaceous	5.1	12	5.1	12	5.1	12
Mixed forest	0.02	0	0.02	0	0.02	0
Shrub/scrub	5.8	13	5.8	13	5.8	13
Woody wetlands	0.4	1	0.4	1	0.4	1
Total forest (including woody wetlands	***23.3***	***53***	***23.3***	***53***	***23.3***	***53***
Subtotal	**43.7**	**100**	**43.7**	**100**	**43.7**	**100**
TN 95 Access						
Permanently Disturbed Areas						
Developed, low intensity	9.8	19	9.8	19	9.8	19
Emergent herbaceous wetlands	0.8	1	0.8	1	0.8	1
Herbaceous	1.4	3	1.4	3	1.4	3
Mixed forest	38.2	74	38.2	74	38.2	74
Shrub/scrub	0.5	1	0.5	1	0.5	1
Woody wetlands	0.7	1	0.7	1	0.7	1
Total forest (including woody wetlands)	***38.9***	***76***	***38.9***	***76***	***38.9***	***76***
Subtotal	**51.4**	**100**	**51.4**	**100**	**51.4**	**100**

Land Cover Types	Alternative B – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)	Alternative C – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)	Alternative D – Approximate Acreage Affected	Approximate Percentage of Affected Areas (%)
161-kV Offsite Transmission Line						
Permanently Disturbed/Converted Areas						
Deciduous forest	5.5	20	5.5	20	5.5	20
Developed, low intensity	0.4	2	0.4	2	0.4	2
Emergent herbaceous wetlands	0.7	3	0.7	3	0.7	3
Herbaceous	2.3	8	2.3	8	2.3	8
Mixed forest	14.8	53	14.8	53	14.8	53
Shrub/scrub	1.2	4	1.2	4	1.2	4
Woody wetlands	2.9	10	2.9	10	2.9	10
Total forest (including woody wetlands)	***23.2***	***83***	***23.2***	***83***	***23.2***	***83***
Subtotal	**27.8**	**100**	**27.8**	**100**	**27.8**	**100**
Total (All Areas)	**674.7**		**451.8**		**755.9**	

[1]Offsite 161-kV Transmission Corridor land cover impacts noted here are for a 280-foot corridor, as final placement of the 120-foot ROW to be developed within this corridor is not yet known. Acreages of actual land cover impacts for the 120-foot ROW would be notably lower.

3.7.2.2.1.2 Operation

Impacts on vegetation related to operation of the proposed facilities may result from cooling-system operations and routine transmission line ROW maintenance. Operation of the cooling system can result in local deposition of dissolved solids (commonly referred to as salt deposition); increased local fogging, precipitation, or icing. As described in Chapter 2 of this Draft PEIS, the cooling systems at the CRN Site would use mechanical draft cooling towers for heat dissipation. TVA modeled salt drift deposition using the Electric Power Research Institute's SACTI (Seasonal and Annual Cooling Tower Impact) model for the ESPA. Results demonstrated that due to the relatively small size of the cooling towers (in comparison to cooling towers servicing a large power plant), and the temperature and climate of the area, there would be no hours of fogging or icing. Therefore, the potential impacts of fogging or icing on vegetation in the surrounding area would be negligible.

Potential impacts on vegetation from the operation and maintenance of the transmission system include maintenance of vegetation within transmission line ROW consistent with TVA's Transmission System Vegetation Management Final Programmatic EIS (TVA 2019c). Methods such as hand clearing, selective spraying, and conducting field surveys prior to vegetation management are used to protect wetlands and other sensitive biological resources as directed by TVA BMPs (TVA 2019c). Thus, potential impacts on terrestrial resources and native plant communities due to ROW maintenance would be negligible.

3.7.2.2.2 Wildlife

3.7.2.2.2.1 Construction

In conjunction with Alternative B, TVA would develop the CRN Nuclear Technology Park only at Area 1. Actions that would potentially affect wildlife habitats include site preparation within permanent and temporary use areas (Area 1 and laydown areas), development and improvement of barge access infrastructure and roadways, and expansion of transmission systems.

Construction activities would start with site preparation work (clearing and grading) on the CRN Site and improvements to the barge facility and haul road in the BTA. Activities such as land clearing, grading, excavation, and filling have the greatest potential to result in effects on terrestrial habitat. Subsequent construction-phase impacts would include installation of components that make up the facility's power block (reactor, turbine, cooling tower, transmission lines, transformers, switchyard, admin/control building, and associated parking).

Under Alternative B, habitat in Area 1 that could support common wildlife and migratory birds of conservation concern would be removed. These species include bald eagle, prairie warbler, cerulean warbler, wood thrush, yellow-bellied sapsucker, and rusty blackbird. Potential impacts to bald eagles are addressed in Section 3.8, Threatened and Endangered Species. Prairie warblers were present in Area 1 near sparsely growing cedar trees. They were also noted along the existing 500-kV transmission line, near Grassy Creek, and along the Reservoir. Cerulean warbler, wood thrush, and yellow-bellied sapsucker habitat exists in the forested areas in the northern portion of Area 1. Wood thrush and yellow-bellied sapsucker have been found in several forested areas across the CRN Site. Rusty blackbird habitat exists near retention ponds and intermittent streams along the perimeter of Area 1.

Thirteen active osprey nests were documented on or immediately adjacent to the CRN Site during field surveys in spring/summer 2021 (TVA 2021c). All but two are within 660 feet of the Alternative B Project Area. If the timing of proposed actions within 660 feet of these nests cannot be modified to avoid nesting seasons, then coordination with USDA Wildlife Services would be required for guidance to ensure compliance under the EO 13186 [Responsibilities of Federal Agencies to Protect Migratory Birds].

The terrestrial wildlife species identified on the CRN Site and associated offsite areas are characteristic of the region and the habitats described in Sections 3.7.1.1 and 3.7.1.2. Construction activities on the CRN Site and offsite areas would have both short-term and long-term effects on these wildlife species. The removal of upland plant communities would eliminate wildlife habitat permanently in the areas where permanent facilities are constructed and temporarily in the laydown area to be used only during the construction period and later revegetated.

As shown in Table 3-20, within the Alternative B footprint the areas and associated offsite areas to be directly affected by disturbance currently contain some terrestrial forest and herbaceous habitats. None of these habitats are unique in the region, and the permanent loss of approximately 273.6 acres of forest onsite (85.4 acres of forest offsite) and 180.6 acres of herbaceous vegetation onsite (8.8 acres offsite) to the building of facilities under Alternative B would not noticeably reduce the local abundance and diversity of wildlife in the surrounding vicinity. Removal of forest from the Project Area would not affect forest fragmentation any further than it already has been affected by previous work on the CRBRP project. Proposed clearing on the BTA would be small and would not permanently preclude species access and movement to suitable adjacent habitat.

A forested riparian zone would be likely be retained along most of the shoreline of the reservoir, and the clearing that would occur in the interior portions of the peninsula would not result in forest fragmentation or impede the movements of terrestrial wildlife. Because similar riparian habitat for wildlife is extensively available along reservoirs and other water bodies in the vicinity (see Figure 3-13), the loss of small segments at the intake and discharge structures would have a minor effect on populations of wildlife that utilize riparian habitats.

During construction, disturbance, displacement, and mortality of individual animals likely would occur as heavy equipment is used for clearing, grading, and excavation. Mobile animals, including birds, larger mammals, and some reptiles, can avoid such disturbances and move to safer areas. However, small, less-mobile animals, such as amphibians, turtles, and small mammals, or eggs or nestlings, are likely to be at greater risk of mortality. Although wildlife displaced by clearing activities can find refuge in undisturbed habitats in the vicinity, temporary reductions in population could occur as a result of increased predation and competition in these habitats. These effects from clearing, grading, excavation, and building of facilities also would occur on a smaller scale in offsite areas, including the BTA, TN 95 Access, and the 161-kV transmission ROW.

Birds can be affected by collisions with transmission towers or other tall structures, such as towers and construction cranes. However, the CRN Site is not within a major migratory flyway and is surrounded by higher terrain with tall trees. Therefore, avian collisions with structures during construction are predicted to have a negligible effect on avian mortality and populations.

Section 3.14 describes noise that can result from construction and operation of a Nuclear Technology Park and factors that influence noise effects, such as frequency, intensity, duration, location, and timing. As discussed in that section, noise is attenuated by natural factors such as vegetation, topography, and temperature, and it quickly decreases over relatively short distances. The majority of the noise occurring on the CRN Site would generate noise levels below 65 A-weighted decibels (dBA) at the site boundary. Some infrequent or night-time construction activities could generate temporary noise levels at or above 60 to 90 decibels (dB) at a distance of 100 feet from the equipment.

Noise can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense. It is also not unusual for wildlife to habituate to noise. Prediction of noise effects on wildlife is limited by the lack of information linking sound levels to effects on individual species. Some wildlife may experience effects similar to those noted for construction noise in Section 3.8.2.2.3.1, and the risk of such effects would be much higher within the site boundary, especially in close proximity to the cooling towers, than beyond. Based on the predicted lack of noise exceeding 80 to 85 dB in habitat areas on adjacent lands, the similarity of construction and highway noise levels, the rapid attenuation of noise expected to occur beyond the construction areas, and the habituation and limited sensitivity of many wildlife species to the noise levels likely to occur in habitat areas onsite, impacts of noise on wildlife are expected to be minor.

The loss of habitat at the CRN Site and associated offsite areas would result in mortality or temporary displacement of wildlife in those areas; however, these areas would be a small component of the accessible, undeveloped habitat in the vicinity to which animals can disperse with minimal effects on populations. In addition, noise avoidance and collisions with structures also would have a minor impact on wildlife populations in the vicinity.

BMPs would be followed to minimize impacts to streams, ponds, and wetlands. In an effort to minimize impacts, when feasible, tree removal across the Project Area would occur in winter when most species of migratory birds would not be nesting and/or would be away from the region. When considering the heavily disturbed nature of a large portion of Area 1, the potential avoidance of breeding/nesting seasons, the avoidance and minimization measures used near active osprey nests, and the amount of similar suitable habitat in areas immediately adjacent to or near the Project Area, impacts of the proposed actions to populations of common wildlife species and populations of migratory birds of conservation concern under Alternative B are expected to be minor.

Construction worker vehicles, delivery trucks, and other traffic needed to build the proposed new facilities on the CRN Site would increase traffic on the local roadway network, particularly Bear Creek Road and the Jones Island Access Road. The additional commuting workforce and truck traffic would likely increase traffic-related wildlife mortalities. Local wildlife populations could suffer declines if roadkill rates were to exceed the rates of reproduction and immigration. However, while roadkill is an obvious source of wildlife mortality and would likely increase during the construction period, traffic mortality rates rarely limit population size (Forman and Alexander 1998). Consequently, overall impact on local wildlife populations from increased vehicular traffic during the construction period is expected to be minor.

3.7.2.2.2.2 Operation

Impacts on terrestrial wildlife and habitats related to operation of the proposed facilities may result from cooling-system operations, routine vegetation management of transmission line ROW, and traffic. Operation of the cooling system can result in local deposition of dissolved solids (commonly referred to as salt deposition); increased local fogging, precipitation, or icing; increased local noise levels; risk of avian mortality caused by collision with tall structures; and shoreline alteration. As described below, these effects would all be minimal and localized.

As discussed in Section 3.7.2.2.1.2, the cooling systems on SMRs to be constructed at Area 1 are expected to use mechanical draft cooling towers for heat dissipation. Modeling for the ESPA predicted that salt drift impacts resulting from the cooling towers would be limited to non-forested early successional habitats and thus would be minor. In addition, due to the relatively small size of these cooling towers (in comparison to cooling towers servicing a 1,000 MW power plant), and the temperature and climate of the area, there would be no hours of fogging or icing (see Section 3.7.2.2.1.2). Therefore, the potential impacts of fogging or icing on wildlife habitats in the surrounding area would be negligible.

The maximum expected sound level produced by the operation of cooling towers, measured at 1,000 feet from the source would be less than 70 dBA. Noise can affect wildlife by inducing physiological changes, nest or habitat abandonment, or behavioral modifications, or it may disrupt communications required for breeding or defense. Some wildlife may experience effects similar to those noted for construction noise described above, and the risk of such effects would be much higher within the site boundary, especially in close proximity to the cooling towers, than beyond. However, because trees and other potential roosting or foraging habitat in proximity to the proposed cooling towers within Area 1 would be substantially removed and the area would be developed, noise impacts on wildlife would be minor. Based on the predicted lack of noise exceeding 70 dBA in habitat areas on lands adjacent to Area 1, the similarity to highway noise levels, the rapid attenuation of noise expected, and the habituation and limited sensitivity of many wildlife species to the noise levels likely to occur in habitat areas, impacts of cooling tower noise on wildlife populations are expected to be minor. Additionally, because mechanical draft colling towers are low in height relative to tall natural draft cooling towers, they pose no appreciable collision risk.

Potential impacts on terrestrial wildlife and habitats from the operation and maintenance of the offsite transmission system upgrades include vegetation maintenance, avian collision mortality and electrocution, and effects from electromagnetic fields. These effects would also be minimal and localized. Routine vegetation management of transmission line ROWs would have periodic effects on habitats within the ROW over the long term. Maintenance methods may vary by location but would be consistent with TVA's Transmission System Vegetation Management Final Programmatic EIS (TVA 2019c), resulting in minor and local impacts to wildlife.

Implementation of BMPs should facilitate avoidance and reduction of impacts to the extent practicable. If necessary, further environmental review would be conducted when more definitive information is available about the locations and areal extent of habitat disturbance in relation to terrestrial resources within the transmission line ROWs. In addition, the CRN Site is not within a major waterbird migratory flyway, and, based on previous experience with existing transmission lines, TVA staff do not expect avian species to collide with transmission lines often enough to effect local populations. Thus, offsite transmission line construction and upgrades near the Reservoir are not expected to result in additional mortality or injury to local avian populations.

Transmission lines generate coupled electric and magnetic fields, referred to together as electromagnetic fields (EMF). The strength of the magnetic field that surrounds the conductor decreases rapidly with distance. Studies have found that magnetic and electric fields from transmission lines do not cause adverse behavioral, health, or reproductive effects in wildlife or other animals (NRC 2013). Thus, EMF effects on terrestrial wildlife from operation of offsite transmission line ROW would be negligible.

Increases in traffic generated by the operation workforce would be less than those experienced during the construction period. As noted in Section 3.12, during operation, traffic would increase on the local roadway network around the CRN Site, particularly Bear Creek Road and the site access road during plant personnel shift changes. The additional workforce traffic would likely increase traffic-related wildlife mortalities, but the overall impact on local wildlife populations from increased vehicular traffic during the operation period would be less than during the construction phase and is expected to be minor.

3.7.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

3.7.2.3.1 Plants

Clearing of all or part of the vegetation in Area 2 on the CRN Site would have similar impacts to those of clearing Area 1, described under Alternative B. As summarized in Table 3-20, removal of up to 186.6 acres of forest vegetation on the CRN Site would be moderate, although all the forested habitats onsite are common throughout the region and represent a negligible percentage (0.4 percent) of forest cover in the vicinity. Temporary impacts and impacts to vegetation communities on associated offsite areas would be similar to those described for Alternative B.

Alternative C would not impact the cedar glade areas on Area 1 of the CRN Site, but impacts to the glade on the DOE ORR along the TN 95 Access could occur under this alternative. TVA would work to minimize and avoid impacts in this area during design, construction, and operation of a future facility and would revegetate all disturbed areas with native and non-invasive plant species.

Operational impacts to vegetation under Alternative C would be similar to those described under Alternative B. Overall, there would be moderate impacts to terrestrial vegetation under Alternative C.

3.7.2.3.2 Wildlife

Under Alternative C, a Nuclear Technology Park would be constructed on Area 2 of the CRN Site. Effects of Alternative C on terrestrial wildlife species would be similar to those discussed for Alternative B because wildlife species found in Area 2 are similar to those found in forested areas and open herbaceous areas of Area 1. As shown in Table 3-20, there would be 186.6 acres of forest and 32.6 acres of herbaceous habitats on the CRN Site converted to developed land under Alternative C as compared to 273.6 and 180.6 acres, respectively, under Alternative B. Impacts to habitats in associated offsite areas would be the same as those for Alternative B. Due to implementation of BMPs, including potential avoidance of breeding/nesting seasons, avoidance and minimization measures used near active osprey nests, and the amount of similarly suitable habitat in areas immediately adjacent to or in the vicinity of the Project Area, impacts to populations of common wildlife species and populations of migratory birds of conservation concern under Alternative C are expected to be moderate.

3.7.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

3.7.2.4.1 Plants

Clearing of all or part of the vegetation in both Area 1 and Area 2 under Alternative D would have greater impacts than clearing either of the areas alone (Alternatives B or C). The impacts of the permanent removal of up to 358.9 acres of forest on the CRN Site under this alternative would be moderate, although all the forested habitats onsite are common throughout the region and represent a negligible percentage (0.9 percent) of forest cover in the vicinity. Temporary impacts and impacts to vegetation communities on associated offsite areas would be similar to those described for Alternative B.

The cedar glade areas near the northeast boundary of Area 1 and along Jones Island Road on the DOE ORR could be impacted by adoption of Alternative D. These sites, particularly the glade on the ORR, are intact native habitats that are notable for the Ridge and Valley ecoregion. TVA would work to minimize and avoid impacts in these areas during design, construction, and operation of a future facility and would revegetate all disturbed areas with native and noninvasive plant species.

Operational impacts to vegetation under Alternative D would be similar to those described under Alternative B. Overall, there would be moderate impacts to terrestrial vegetation under Alternative D.

3.7.2.4.2 Wildlife

Under Alternative D, impacts would be greater than those under Alternatives B or C because the Nuclear Technology Park would be constructed on a greater area of the CRN Site (Areas 1 and 2). As shown in Table 3-20, there would be 358.9 acres of forest and 29 acres of herbaceous habitats on the CRN Site converted to developed land under Alternative D as compared to 273.6 acres of forest and 180.6 acres of herbaceous habitats under Alternative B and 186.6 acres of forest and 32.6 acres of herbaceous habitats under Alternative C. BMPs, including potential avoidance of breeding/nesting seasons, avoidance and minimization measures used near active osprey nests would be implemented to avoid and minimize impacts to upland plant and animal communities to the extent possible. Due to the amount of similarly suitable habitat in areas immediately adjacent to or in the vicinity of the Project Area and the implementation of BMPs, impacts to populations of common wildlife species and populations of migratory birds of conservation concern under Alternative D are expected to be moderate.

3.7.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.1.3, several reasonably foreseeable future actions were identified in proximity to the CRN Site. Depending on the local environmental setting and the design characteristics of these other proposed actions, direct alteration of terrestrial ecological resources may occur. Furthermore, each of these projects entails land disturbance activities that have the potential to change land cover, and impact both vegetation and faunal populations. None of the identified actions by others geographically intersect with the same terrestrial resources affected by the proposed project. However, it is expected that many of the proposed projects are located adjacent to existing developed facilities (ORNL, Kairos Hermes project, Oak Ridge airport, Roane Regional Business and Technology Park, TDOT roadway improvements) and are located within predominantly disturbed, developed, or artificially vegetated herbaceous habitats. As such, these actions would likely have minimal cumulative impacts on terrestrial ecological resources in the area.

3.7.2.6 Summary of Impacts to Terrestrial Ecology

The environmental effects to upland plant and animal communities from construction activities on the CRN Site and associated offsite areas would be moderate. However, affected communities in the areas to be developed are generally not high quality or unique habitats and there is an expanse of quality, undeveloped habitats in the vicinity. There is potential for impacts to three native cedar glade habitats, and TVA would work to minimize and avoid impacts in these areas during design, construction, and operation of a future facility.

The potential impacts of operating activities at the CRN Site and the associated cooling system (mechanical draft cooling towers) on terrestrial resources would be minor. The potential impacts of transmission line operation, including those from EMFs and routine ROW maintenance, on habitats are considered minor and would be consistent with TVA's Transmission System Vegetation Management Final Programmatic EIS (TVA 2019c). Impacts from operation of the proposed new facilities on terrestrial resources would be minor.

As summarized in Table 3-21, TVA has determined that impacts to terrestrial ecology related to development of the CRN Site and associated offsite areas are minor to moderate.

Table 3-21. Summary of Impacts to Terrestrial Resources

Alternative	Project Phase	Impact	Severity
Alternative B	Construction	Loss of mostly low-quality forest (approximately 274 acres) and herbaceous (approximately 181 acres) habitats associated with construction on the CRN Site, displacement of common wildlife.	Moderate due to construction phase losses to existing low quality habitats within Project Area and abundance of other similar habitats in surrounding landscape.
		Loss of approximately 85 acres of forest and 9 acres of herbaceous habitat associated with construction of facilities in offsite areas. Temporary impacts to approximately 83 acres of forest habitat in laydown area.	Moderate impacts to common wildlife populations. BMPs such as winter tree removal would reduce impacts to roosting and nesting wildlife.
		Impacts to active osprey nests would be avoided with seasonal restrictions.	Other suitable habitat readily available in vicinity for migratory birds of conservation concern.
		Permanent impacts to three small areas of native cedar glade including approximately 1.8 acres in the center of Area 1, approximately 5 acres near the northeastern boundary of Area 1, and approximately 3.5 acres near the offsite TN 95 Access.	TVA would work to minimize and avoid impacts in the native cedar glade areas during design, construction, and operation of a future facility.
Alternatives B, C, and D	Operation	Operation of the cooling system and towers can result in local deposition of dissolved solids, increased local fogging, precipitation, or icing, noise, and wildlife collisions.	Due to the relatively small size of the cooling towers and the temperature and climate of the area, cooling system effects would be minor and localized. In addition, due to vegetation clearing around the proposed facility and a lack of migration corridors in the area, potential noise and collision impacts to wildlife would be minor.
		Potential impacts on vegetation and wildlife from the operation and maintenance of the transmission system include maintenance of vegetation within transmission ROW and potential EMFs.	Due to use of BMPs for vegetation maintenance in the transmission ROW, effects would be minor and localized.

Alternative	Project Phase	Impact	Severity
Alternative C	Construction	Impacts similar to those of Alternative B. Loss of mostly low-quality forest (approximately 186.6 acres) and herbaceous (approximately 32.6 acres) habitats associated with construction on the CRN Site, displacement of common wildlife species. Loss of habitats in associated offsite areas would be the same as for Alternatives B and D. Temporary impacts to approximately 93.5 acres of forest habitat in laydown area. Impacts to active osprey nests would be avoided with seasonal restrictions. Permanent impacts to one 3.5-acre native cedar glade near the offsite TN 95 Access. No impacts to native glade on Area 1 of the CRN Site.	Moderate due to construction phase losses to existing low quality habitats within Project Area and abundance of other similar habitats in surrounding landscape. Moderate impacts to common wildlife populations. BMPs such as winter tree removal would reduce impacts to roosting and nesting wildlife. TVA would work to minimize and avoid impacts in the native cedar glade area during design, construction, and operation of a future facility.
Alternative D	Construction	Impacts similar to those of Alternatives B and C. Loss of mostly low-quality forest (approximately 358.9 acres) and herbaceous (approximately 180.6 acres) habitats associated with construction on the CRN Site, displacement of common wildlife species. Loss of habitats in associated offsite areas would be the same as for Alternatives B and C. Temporary impacts to approximately 79 acres of forest habitat in laydown area. Impacts to active osprey nests would be avoided with seasonal restrictions. Permanent impacts to three native cedar glade areas would be the same as described for Alternative B.	Moderate due to construction phase losses to existing low quality habitats within Project Area and abundance of other similar habitats in surrounding landscape. Moderate impacts to common wildlife populations. BMPs such as winter tree removal would reduce impacts to roosting and nesting wildlife. TVA would work to minimize and avoid impacts in the native cedar glade areas during design, construction, and operation of a future facility.

3.8 Threatened and Endangered Species

3.8.1 Affected Environment

TVA reviewed the TVA Natural Heritage Database (TVA 2021f) to produce records of state and federally listed or protected aquatic and terrestrial plant and animal species and other sensitive species tracked by the state of Tennessee that have been documented within the ten-digit HUC, within Roane County, and/or within certain radii of the Project Area. According to the database, records of federally and state-listed and tracked species include 19 aquatic animal species (six fish, 11 mussels, and two snails), 22 plants, and 14 terrestrial animals (two amphibians, five birds, and seven mammals). Appendix G includes the complete list and descriptions of these species.

In addition to the review of TVA's Natural Heritage Database, TVA also conducted comprehensive field surveys for aquatic and terrestrial plant and animal species on the CRN Site and associated offsite areas in 2011, 2012, 2013, and 2015 for the ESPA process and in 2021 as part of the Draft PEIS.

3.8.1.1 Aquatic Animals

A review of the TVA Natural Heritage Database (TVA 2021f) indicated records of 19 state and/or federally listed aquatic animal species (six fish, 11 mussels, and two snails) within Roane County and/or within the ten-digit HUC (0601020704) Clinch River watershed of the CRN Site (Table 3-22). No federally designated critical habitat for aquatic species exists within 10 miles of the Project Area. Species descriptions can be found in Appendix G.

Table 3-22. Records of Federally and State-Listed Aquatic Animal Species Known from Roane County and/or within Ten-digit HUC (0601020704) Clinch River Watershed of the CRN Site (Clinch River Miles 14 - 19)[1]

Common Name	Scientific Name	Element Rank[2]	Federal Status[3]	State Status[3]	State Rank[4]
FISHES					
Blue sucker	*Cycleptus elongatus*	E		T	S2
Highfin carpsucker	*Carpiodes velifer*	E		D	S2S3
Snail darter	*Percina tanasi*	E	T	T	S2S3
Spotfin chub	*Erimonax monachus*	E	T	T	S2
Tangerine darter	*Percina aurantiaca*	E		D	S3
Tennessee dace	*Phoxinus tennesseensis*	E		D	S3
MUSSELS					
Alabama lampmussel	*Lampsilis virescens*	H	E	E	S1
Fanshell	*Cyprogenia stegaria*	H	E, XN	E	S1
Fine-rayed pigtoe	*Fusconaia cuneolus*	H	E, XN	E	S1
Orangefoot pimpleback	*Plethobasus cooperianus*	H	E, XN	E	S1
Pink mucket	*Lampsilis abrupta*	E	E	E	S2
Purple bean	*Villosa perpurpurea*	H	E	E	S1
Pyramid pigtoe	*Pleurobema rubrum*	E			S2S3

Common Name	Scientific Name	Element Rank[2]	Federal Status[3]	State Status[3]	State Rank[4]
Ring pink	*Obovaria retusa*	H	E, XN	E	S1
Sheepnose	*Plethobasus cyphyus*	E	E	E	S2S3
Spectaclecase	*Cumberlandia monodonta*	H	E	E	S2S3
Tennessee clubshell	*Pleurobema oviforme*	H			S2S3
SNAILS					
Ornate rocksnail	*Lithasia geniculata*	H			S3
Spiny riversnail	*Io fluvialis*	E			S2

[1] Source: TVA Natural Heritage Database queried on 07/19/2021 (TVA 2021f)
[2] Heritage Element Occurrence Rank; E = extant record ≤25 years old; H = historical record >25 years old
[3] Status Codes: E = Endangered; T = Threatened; E, XN = Experimental, non-essential population; D = Deemed In Need of Management
[4] State Ranks: S1 = Critically Imperiled; S2 = Imperiled; S3 = Vulnerable

Of these aquatic animal species, five are federally listed as endangered, two are federally listed as threatened, and four are listed as endangered, experimental non-essential populations (Table 3-22). Nine of the 19 aquatic species records are considered historical (records >25 years old). Therefore, because these species have not been detected in many decades (including no detection during the 2011 survey) and due to apparent continuation of unsuitable habitat conditions for mollusks, TVA has determined that nine of the mollusk and snail species (Alabama lampmussel, fanshell, fine-rayed pigtoe, orangefoot pimpleback, purple bean, ring pink, spectaclecase, Tennessee clubshell, and ornate rocksnail) either do not occur or occur at extremely low (undetectable) levels near the CRN Site. Therefore, these species will not be addressed further in this analysis.

As discussed in Appendix G, none of the threatened and endangered species listed in Table 3-22 are likely to occur within the Project Area due to unsuitable, impounded habitat conditions present in the Reservoir. In addition, the tangerine darter and the Tennessee dace potentially could occur in some sections of Grassy Creek or streams potentially affected by offsite transmission line upgrades; however, habitat conditions in these streams are likely not suitable and these species were not found in surveys of streams on the CRN Site or the BTA.

3.8.1.2 Plants

A review of the TVA Regional Natural Heritage database (TVA 2021f) and the USFWS IPaC report (USFWS 2021) indicated that no federally listed plants have been previously reported from within 5 miles of the CRN Site, but three federally listed plants have been previously reported within Roane County, Tennessee: American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*), white fringeless orchid (*Platanthera integrilabia*), and Virginia spiraea (*Spiraea virginiana*) (Table 3-23). These three federally listed plants have not been observed in TVA field surveys of the CRN Site (TVA 2021b), and their preferred habitats were not found to be present. Federally designated critical habitat for plants also does not occur on the CRN Site or associated offsite areas. Therefore, federally listed plant species do not occur on the Project Area.

The TVA Regional Natural Heritage database indicates that 19 species tracked by the state of Tennessee have been reported from within 5 miles of the CRN Site (Crabtree 2016). Of these species, two (spreading false-foxglove [*Aureolaria patula*] and pale green orchid) were observed during 2021 field surveys within the Project Area. One additional state endangered plant that has not been previously observed near the CRN Site (rigid sedge) was also documented during the 2021 field surveys. Spreading false-foxglove was observed within Area 1 of the CRN Site, in steep floodplain forest associated with bluffs along the Reservoir (Figure 3-15). Rigid sedge and pale green orchid were observed in a calcareous wetland within the proposed offsite transmission line ROW just south of Bear Creek Road (Figure 3-15). Species descriptions are included in Appendix G.

Table 3-23. Plant Species of Conservation Concern Previously Reported from within 5 Miles of the CRN Site and Federally Listed Plants Known from Roane County, Tennessee[1]

Common Name	Scientific Name	Federal Status[2]	State Status[2]	State Rank[3]
Earleaf foxglove	*Agalinis auriculata*		E	S2
American hart's-tongue fern[4]	*Asplenium scolopendrium* var. *americanum*	T	E	S1
Spreading false-foxglove[5]	*Aureolaria patula*		S	S3
River bulrush	*Bolboschoenus fluviatilis*		S	S1
Rigid sedge[5]	*Carex tetanica*		E	S1
Tall larkspur	*Delphinium exaltatum*		E	S2
Northern bush-honeysuckle	*Diervilla lonicera*		T	S2
Branching whitlow-wort	*Draba ramosissima*		S	S2
Waterweed	*Elodea nuttallii*		S	S2
Godfrey's thoroughwort	*Eupatorium godfreyanum*		S	S1
Naked-stem sunflower	*Helianthus occidentalis*		S	S2
Butternut	*Juglans cinerea*		T	S3
Short-head rush	*Juncus brachycephalus*		S	SH
Slender blazing-star	*Liatris cylindracea*		T	S2
Loesel's twayblade	*Liparis loeselii*		T	S1
Pale green orchid[5]	*Platanthera flava* var. *herbiola*		T	S2
White fringeless orchid[4]	*Platanthera integrilabia*	T	E	S2S3
Heller's catfoot	*Pseudognaphalium helleri*		S	S2
Prairie goldenrod	*Solidago ptarmicoides*		E	S1S2
Virginia spiraea[4]	*Spiraea virginiana*	T	E	S2
Shining ladies'-tresses	*Spiranthes lucida*		T	S1S2
Ozark bunchflower	*Veratrum woodii*		E	S1

[1] Source: TVA Natural Heritage Database (TVA 2021f) and USFWS IPaC (USFWS 2021), queried July 2021
[2] Status Codes: E = Listed Endangered; S = Listed Special Concern; T = Listed Threatened
[3] State Ranks: S1 = Critically Imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently Secure; SH = Possibly Extirpated (Historical); S#S# = Denotes a range of ranks because the exact rarity of the element is uncertain (e.g., S1S2)
[4] Federally listed species occurring within the county where work would occur, but not within 5 miles of the Project Area
[5] State-tracked plant species observed during 2021 field surveys of the CRN Site

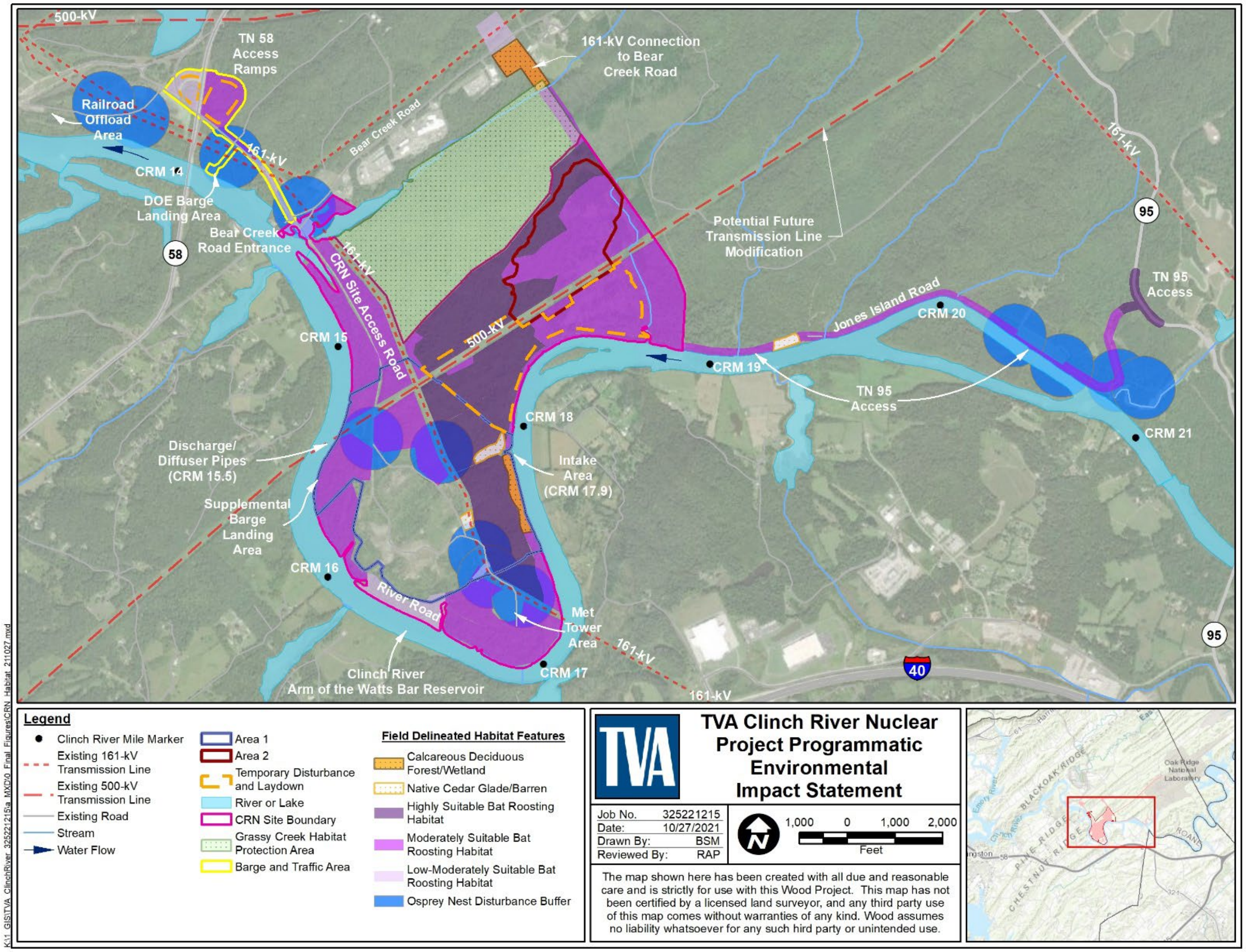


Figure 3-15. Sensitive Habitat Features for Species of Special Concern at the CRN Site and Associated Offsite Areas

3.8.1.3 Wildlife

Review of TVA's Regional Natural Heritage Database for terrestrial wildlife (TVA 2021f) indicated that there are records of 10 state-listed or tracked terrestrial wildlife species and two federally listed species within 5 miles of the CRN Site and associated offsite areas (Table 3-24.). One additional federally protected species (bald eagle) is known from Roane County. The USFWS also has determined that the CRN Site and associated offsite areas are in the range of the federally endangered Indiana bat (USFWS 2021). No records of this species are currently known from Roane County. No federally designated critical habitat exists within 5 miles of the Project Area. Species descriptions are included in Appendix G.

Table 3-24. Federally and State-listed Terrestrial Animal Species Documented Within Roane County, and Within 5 Miles of the CRN Site and Associated Offsite Areas[1]

Common Name	Scientific Name	Federal Status[2]	State Status[2]	State Rank[3]
Amphibians				
Four-toed salamander	*Hemidactylium scutatum*	-	D	S3
Hellbender	*Cryptobranchus alleganiensis*	PS[4]	E	S3
Birds				
Bachman's sparrow	*Aimophila aestivalis*	-	E	S1B
Bald eagle	*Haliaeetus leucocephalus*	DM	D	S3
Cerulean warbler	*Setophaga cerulea*	-	D	S3B
Sharp-shinned hawk	*Accipiter striatus*	PS		S3B,S4N
Swainson's warbler	*Limnothlypis swainsonii*	-	D	S3
Mammals				
Gray bat	*Myotis griscesens*	E	E	S2
Northern long-eared bat	*Myotis septentrionalis*	T	T	S1S2
Indiana bat	*Myotis sodalis*	E	E	S1
Little brown bat	*Myotis lucifugus*	-	T	S3
Meadow jumping mouse	*Zapus hudsonius*	PS	-	S4
Southeastern shrew	*Sorex longirostris*	-	-	S4
Tricolored bat	*Perimyotis subflavus*	-	T	S2S3

[1] Source: TVA Natural Heritage Database (TVA 2021f), queried 07/19/2021, USFWS 2021.
[2] Status abbreviations: D = Deemed in Need of Management; DM = Recovered, delisted, and being monitored, E = Endangered, T = Threatened; PS = Partial Status.
[3] State Rank Definitions: S1 - critically imperiled; S2 - imperiled; S3 - rare or uncommon; S4 - widespread, abundant and apparently secure, but with cause for long-term concern; S#B = Status of Breeding population; S#N = Status of non-breeding population.
[4] Species in this table with Partial Status are federally listed elsewhere in the U.S. but are not federally listed in Roane County, Tennessee.

3.8.1.4 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of habitats potentially supporting threatened or endangered species within their respective project footprints. However, the specific details regarding the scope of these actions are lacking. None of the identified actions by others geographically intersect with the same terrestrial resources affected by the proposed project. However, it is expected that while many of the proposed projects are located adjacent to existing developed facilities (ORNL, Kairos Hermes project, Oak Ridge airport, Roane Regional Business and Technology Park, TDOT roadway improvements) are located within predominantly disturbed, developed, or artificially vegetated herbaceous habitats, some may contribute to further habitat disturbance. Because each of these actions has the potential to affect forested habitats, further consideration of reasonably foreseeable future actions and their effects on habitat for listed bat species are included in the following section as appropriate.

3.8.2 Environmental Consequences

3.8.2.1 Alternative A – No Action Alternative

Under Alternative A, a Nuclear Technology Park would not be constructed, operated, or maintained at the CRN Site. Under this alternative, no development of the CRN Site would occur, and the site would continue to be managed under provisions of the Watts Bar RLMP. Therefore, under Alternative A, there are no impacts to threatened or endangered species resulting from TVA's action.

3.8.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

In conjunction with Alternative B, TVA would develop the CRN Nuclear Technology Park only at Area 1. Actions that would potentially affect threatened and endangered species include site preparation within temporary and permanent use areas (Area 1 and laydown areas), development and improvement of barge access infrastructure and roadways, including bank stabilization, expansion of transmission systems, and construction and operation of structures associated with the cooling system, including intake and discharge structures.

3.8.2.2.1 Aquatic Animals

3.8.2.2.1.1 Construction

Construction phase site preparation would entail general land disturbance and subsequent impacts to aquatic habitats and organisms within waterbodies on and near the CRN Site, including the Reservoir, Grassy Creek, and small unnamed streams and ponds on the CRN Site and associated offsite areas (Figure 3-9). These activities would affect only small instream areas of the reservoir, and TVA would use BMPs to prevent erosion and sediment transport. In addition, these activities would require a Department of the Army permit from the USACE, and TVA would need to conduct activities in accordance with the requirements of the permit.

The Reservoir adjacent the CRN Site (CRM 14.0 - 19.0) supports a fair to good fish assemblage and a poor mussel and snail community. While suitable habitat for state- and federally threatened and endangered fishes may exist within the Reservoir adjacent the CRN Site, high quality spawning habitat is not present, the area of instream impact would be small, and these species would be capable of swimming away from the construction footprint while work is ongoing. Therefore, no direct impacts to these fish species are anticipated.

A review of the 2011 mollusk and habitat survey, as well as the surveys near the site in 1982 (Jenkinson), 1991 (Ahlstedt), and 1994 (TWRA and TDEC) indicated that habitat conditions to support mussels and snails are generally inadequate, despite reservoir release improvements to Melton Hill Dam and Watts Bar Dam that began in 1991. Although this reach of the Clinch River historically supported several federally listed aquatic mollusks, a lack of recent records for live endangered species in combination with a depauperate mussel and snail community indicates that construction activities in or adjacent to this reach of the Clinch River under Alternative B would not affect rare or listed aquatic mussel or snail species. Additionally, no suitable habitats for threatened or endangered mussels and snails occur within the aquatic features (small streams and wetlands; see Figure 3-9) identified within the Project Area associated with the construction of a Nuclear Technology Park.

Ground disturbance would be minimized and appropriate BMPs (TVA 2017) would be followed to reduce sedimentation and other impacts, and all proposed project activities would be conducted in a manner to ensure that waste materials are contained and the introduction of pollution materials to the receiving waters would be minimized. TVA also will follow a SWPPP that sets controls to manage runoff during clearing and construction activities, and TVA would subsequently restore temporarily disturbed areas in accordance with the SWPPP and other associated permits.

For installation of offsite transmission line ROW, TVA would implement BMPs during construction and vegetation removal to minimize erosion and transport of sediments in the streams along the ROW. Therefore, there would be little potential for adverse effects on state-listed species that may inhabit streams along the ROW, such as the Tennessee dace or tangerine darter. Because these fish species are motile, most individuals can be expected to evade disturbance activity. It is assumed that the anticipated transmission line upgrades would not involve any physical disturbance of rivers, streams, ponds, or other aquatic features. Although riparian zone shrubs and trees may be cut for transmission line installation, impacts to aquatic species are not anticipated due to restoration of the riparian zone and lack of in-stream work. Considering also that the upgrade work would be brief and temporary, it is unlikely that aquatic species of conservation concern would be adversely affected by the upgrades.

Therefore, no impacts are expected to aquatic or riparian threatened and endangered species with the implementation of BMPs in accordance with site-specific erosion control plans. Activities would be designed to minimize impacts to the Reservoir and other surface waters and meet the terms and conditions of applicable USACE, NPDES, and TDEC permits.

3.8.2.2.1.2 Operation and Maintenance

Operational activities that could have a potential to affect aquatic species and habitats include the operation of the intake, discharge, and the barge facility, and maintenance of the offsite transmission line ROW. Potential effects from intake operation include water withdrawal and consumption, as well as entrainment and impingement of aquatic biota. Potential effects of the discharge operation on the aquatic habitats in the reservoir include thermal discharges, for cold shock, and physical changes resulting from scouring and chemical discharges. Impacts involved with operating a nuclear power plant are similar to the impacts associated with any large thermoelectric power generation facility, and TVA would be required to obtain all permits and certifications designed to protect aquatic life. In addition, because it is unlikely that threatened and endangered aquatic species are present in the Reservoir in the area of the CRN Site, impacts from cooling water intake and thermal discharge are not anticipated for these species.

Potential impacts on aquatic threatened and endangered species from the operation and maintenance of the transmission system include maintenance of vegetation within transmission line ROW consistent with TVA's Transmission System Vegetation Management Final Programmatic EIS (TVA 2019c). TVA would use BMPs specifically directed toward avoiding or minimizing adverse impacts on streamside management zones (SMZs) and the waterbodies to minimize erosion and transport of sediments in the streams along the transmission line ROW. TVA guidance for environmental protection and BMPs limit the broadcast application of fertilizers and herbicides within the SMZs, including the spraying of herbicides other than those labeled for aquatic use (TVA 2019c).

As discussed in Section 3.8.1.1 and in Appendix G, it is unlikely that threatened and endangered aquatic species are present in the Reservoir in the area of the CRN Site or in the streams and ponds on the site and in associated offsite areas. Because there is a lack of quality habitat for threatened and endangered species in the Project Area and TVA would obtain all required operational permits, operation of the CRN facilities including the water intake and discharge facilities situated on the Reservoir is not expected to affect populations of species of conservation concern. In addition, no impacts to listed aquatic species are expected from maintenance of proposed transmission line ROW because potential stream habitat would be protected by use of the BMPs discussed previously.

3.8.2.2.2 Plants

3.8.2.2.2.1 Construction

Alternative B would have no impact on federally listed plants or designated critical habitat because no suitable habitat for federally protected plant species occurs within the CRN Site or associated offsite areas. However, Alternative B does have the potential to impact two locations that contain known populations of state-listed plants. Development of Area 1 on the CRN Site has the potential to impact a calcareous forest that contains individuals of the state-listed spreading false-foxglove. This species was observed along the eastern edge of Area 1 within a calcareous forest situated between a steep slope and the Reservoir (Figure 3-15). Given the steepness of the adjacent terrain, it is not likely that development would occur at that location and directly impact spreading false-foxglove. If the population was directly impacted, impacts to the species would not be significant because spreading false-foxglove has been observed from at least 70 locations in Tennessee (TVA 2021f) and eliminating a single occurrence would not jeopardize the status of the species in the state.

Rigid sedge and pale green orchid occur just south of Bear Creek Road within an area of calcareous wetland potentially affected by the proposed offsite transmission line interconnection (Figure 3-15). No route has been designed, but a future transmission line alignment could impact one or both species. While the pale green orchid is known from about 20 locations within Tennessee, rigid sedge has only been documented from one other location in the state. Therefore, elimination or substantial degradation of this habitat would substantially impact rigid sedge in Tennessee. TVA would ensure that rigid sedge and pale green orchid are not significantly impacted under Alternative B by designing the proposed offsite transmission line to avoid the species and their habitat to the greatest extent possible. TVA transmission engineers would consult with the TVA botanist during design to ensure the location of the habitat is considered early in the process. TVA would consider additional avoidance measures to ensure impacts are not significant once a final transmission route is determined. With implementation of environmental commitments, adoption of Alternative B is not expected to impact populations of rigid sedge or pale green orchid. Furthermore, TVA is pursuing expansion of the Grassy Creek

HPA by approximately 14 acres to include the area where these species occur to provide additional protection.

3.8.2.2.2.2 Operation

Impacts on rare plants related to operation of the proposed facilities may result from cooling-system operations and routine transmission line vegetation maintenance. Operation of the cooling system can result in local deposition of dissolved solids (commonly referred to as salt deposition); increased local fogging, precipitation, or icing; and shoreline alteration. As described below, these effects would all be minimal and localized.

As discussed in Section 3.7.2.2.1.2, the cooling systems on SMRs to be constructed at Area 1 are expected to use mechanical draft cooling towers for heat dissipation. Modeling for the ESPA predicted that salt drift impacts resulting from the cooling towers would be limited to non-forested early successional habitats and thus would be minor. In addition, due to the relatively small size of these cooling towers (in comparison to cooling towers servicing a 1,000 MW power plant), and the temperature and climate of the area, there would be no hours of fogging or icing (see Section 3.7.2.2.1.2). Therefore, the potential impacts of fogging or icing on potential threatened and endangered species habitats in the surrounding area would be minor.

Potential impacts on threatened and endangered species from the operation and maintenance of the transmission system include maintenance of vegetation within transmission line ROW consistent with TVA's Transmission System Vegetation Management Final Programmatic EIS (TVA 2019c). Methods such as hand clearing, selective spraying, and conducting field surveys prior to vegetation management are used to protect sensitive plant communities as directed by TVA BMPs (TVA 2019c). Thus, potential impacts on native plant communities from routine transmission line ROW maintenance would be negligible.

3.8.2.2.3 Wildlife

3.8.2.2.3.1 Construction

Under Alternative B, approximately 359.0 acres of forest and 189.4 acres of herbaceous habitats would be permanently removed, as compared to 272.0 and 41.4 acres, respectively, under Alternative C and 444.3 and 189.4 acres, respectively, under Alternative D.

Fourteen species were addressed in this review based on records within 5 miles of the CRN Site and associated offsite areas. All of these species either have some potential to occur on portions of the Project Area or their occurrence was documented within the Project Area.

Suitable habitat for four-toed salamanders was identified along potentially affected streams on the CRN Site and the BTA. Field reviews were performed there during winter months when four-toed salamanders would be nesting. However, no four-toed salamander nests were observed. ORNL staff conduct ongoing periodic surveys along Jones Island Road near wet areas. While suitable habitat for this species was identified in these areas as well, no individuals have been documented on the CRN Site or associated offsite areas. Therefore, impacts to four-toed salamanders are expected to be minor.

Hellbenders have historically occurred in the Clinch River, but the most recent records of this species are over 30 years old. Shoreline impacts would occur at the barge terminal and may occur at the junction with Grassy Creek or along the TN 95 Access where road improvements are proposed. Areas of this riverine habitat directly impacted by proposed actions under Alternative B would be discrete, small, and scattered along the Project Area. With the use of BMPs in these areas, impacts to populations of this species are expected to be minor.

Bachman's sparrows, cerulean warblers, and Swainson's warblers were not observed on the Project Area during any of the field surveys that were conducted in 2011, 2013, 2015, and 2021. Additionally, there have been bird point count surveys conducted since 1995 at a survey station along Jones Island Road, and none of these species have been documented at this station. Although there is potentially suitable habitat for these species within the Project Area and there would be adverse impacts to these species if there was vegetation removal where active nests occur, surveys did not result in observations of these species. Therefore, impacts to populations of Bachman's sparrow, cerulean warbler, and Swainson's warbler are expected to be minor.

Sharp-shinned hawk was hawks have been observed on the CRN Site during winter boat surveys along the Reservoir, and they have been documented on the ORR, but they have not been observed onsite during the breeding season. Suitable habitat for this species does occur across the Project Area, and there would be adverse impacts to individuals if there was tree removal where active nests occur. However, due to lack of presence documented during the breeding season, impacts to populations of sharp-shinned hawk are expected to be minor.

No bald eagle nests have been documented within 1 mile of the Project Area. The closest nesting record of this species is approximately 7.8 miles away. Therefore, proposed actions are in compliance with the National Bald Eagle Management Guidelines (USFWS 2007), and impacts to the bald eagle are expected to be minor.

Meadow jumping mice and southeastern shrews have not been observed on the Project Area during any of the field surveys, including during small mammal trapping in 2013 and 2015. Only one record of meadow jumping mouse is known from the ORR, which is 3.4 miles from the CRN Site. In contrast, nine records of southeastern shrew are known within 5 miles of the site, including one historical record only 283 feet away from the proposed TN 95 Access road upgrades. Suitable habitat for both species occurs near water throughout the Project Area. Impacts could occur to individuals if nesting in areas of proposed vegetation removal at the time of proposed actions. However, impacts to jumping meadow mouse are unlikely because of its rarity in the area. The potential for impacts to individuals of the southeastern shrew is more likely, due to their documented presence nearby, though recent records do not exist within areas of potential impact. Because suitable habitat for these species is concentrated near bodies of water, site design would minimize and avoid impacts to streams and wetlands where feasible. Therefore, impacts to suitable habitat would only occur at discrete locations on the Project Area. With these minimization and avoidance measures, impacts to meadow jumping mouse and southeastern shrew are expected to be minor.

Gray bats inhabit caves in the vicinity and forage across the CRN Site and associated offsite areas, as documented in mist nest and acoustic surveys. Gray bats were captured along upland forest roads as well as near lowland wetlands. They were detected at all acoustic survey locations during 2013 and 2015 acoustic surveys and at all but one in 2021. A transitional roosting cave was identified across the Reservoir from the CRN Site in March 2021, approximately 966 feet from the Area 1 boundary. One gray bat was identified using the site at that time as well. A high proportion of the gray bats captured on the CRN Site were pregnant, which indicates presence of nearby maternity caves. While no caves onsite provide suitable summer or winter roosting habitat for gray bats, suitable foraging habitat is present throughout the Project Area. Because detailed project designs have not been selected, specific impacts, if any, to gray bats roosting in the cave across the river cannot yet be determined. Consultation with the USFWS under Section 7 of the ESA would occur when specific designs have been selected and scope of the project has been refined. Additional survey efforts may be needed closer to the time of potential impacts to determine when bats are using this cave and how best to avoid potential impacts.

One northern long-eared bat was captured during a mist net survey on the CRN Site in 2011 and this species was detected during acoustic surveys in 2013 and 2015. Indiana bat was detected acoustically in 2011. Neither of these species was detected acoustically or captured during mist net surveys in 2021. No occupied roost trees have been documented onsite. No suitable winter roosting habitat exists onsite for either species; however, suitable summer roosting habitat and foraging habitat does occur in forested habitat throughout the CRN Site and associated offsite areas. Because detailed project designs have not been selected, a specific estimate of the amount of potentially suitable summer roosting habitat that would be removed under Alternative B cannot yet be determined. Depending on the duration between previous bat surveys and site-specific design selection, additional presence/absence surveys may be required. Where feasible, tree removal would occur in winter (October 15 – March 31) to avoid nesting and roosting wildlife and to minimize impacts. Consultation under Section 7 of the ESA would occur when specific designs have been selected and scope of the project has been refined. By implementing minimization measures such as winter tree removal and any additional conservation measures that may result from the Section 7 consultation, impacts to Indiana bat and northern long-eared bat under Alternative B are expected to be minor.

While not yet federally protected as of August 2021, tricolored bats and little brown bats are being considered for listing under the ESA. Both species were detected acoustically on the CRN Site in 2021 and tricolored bats were captured during mist net surveys in 2011 and 2021. These species have both experienced significant recent declines due to white-nose syndrome. The tricolored bat captured in 2021 was a post-lactating female, indicating there is a maternity site in the vicinity of the CRN Site. Suitable summer roosting habitat for these species also occurs in forested habitat throughout the CRN Site and associated offsite areas. No winter hibernacula for either species occurs within the Project Area and therefore no winter hibernacula would be impacted by proposed actions. By implementing minimization measures such as winter tree removal, protective buffers around caves, and other conservation measures, adverse effects to little brown bat and tricolored bat are not anticipated under Alternative B.

Potential impacts to federally listed tree-roosting bats alongside existing ROWs were addressed in TVA's programmatic consultation with the USFWS on routine actions and federally listed bats in accordance with ESA Section 7(a)(2) and completed in April 2018 (USFWS 2018). For those activities with potential to affect federally listed bats, TVA committed to implementing specific conservation measures. With the use of avoidance, minimization, and conservation measures, there would likely be no adverse effects to threatened and endangered species under this alternative.

3.8.2.2.3.2 Operation

Impacts on threatened and endangered wildlife species related to operation of the proposed facilities may result from routine maintenance of proposed new transmission line ROW, collision with cooling towers, and cooling tower noise. For new onsite and offsite transmission line ROW, any proposed danger tree (i.e., any tree on or off the ROW that could contact electric supply lines) removal would be reviewed to determine if impacts to suitable Indiana bat and northern long-eared bat roosting habitat may occur. As described above under construction impacts, for those activities with potential to affect gray bats, Indiana bats, and northern long-eared bats, TVA has committed to implementing specific conservation measures. These activities and associated conservation measures would be identified on site-specific TVA Bat Strategy Project Screening Forms and would be implemented as part of the site-specific proposed actions. There would be no risk of potential impacts for gray bats from danger tree removal along new transmission line ROW, because they do not roost in trees. With the application of minimization measures such as winter tree removal and other conservation measures and BMPs, substantial impacts to threatened and endangered bats are not anticipated from transmission line ROW maintenance activities under Alternative B.

Other potential operational effects on listed bat species include the potential for collisions with elevated structures and the potential exposure to operational noise from cooling towers. However, the low height (maximum of 65 feet) of the proposed mechanical draft cooling towers makes the risk of bat collisions unlikely. Additionally, because trees and other potential roosting or foraging habitat in proximity to the proposed cooling towers within Area 1 would be substantially removed and the area would be developed, noise impacts on sensitive bat species would be minor.

3.8.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C potential impacts to aquatic animals are the same as those previously described for Alternative B. Alternative C would have no impact on federally listed plants or designated critical habitat because no suitable habitat for federally protected plant species occurs within the CRN Site or associated offsite areas. In contrast to Alternative B, Alternative C would not impact spreading false-foxglove, but, similar to Alternative B, could potentially impact rigid sedge and pale green orchid. With implementation of the environmental commitment described under Alternative B, adoption of Alternative C is not expected to impact populations of rigid sedge or pale green orchid.

Effects of Alternative C on threatened and endangered terrestrial animal species would be generally similar to those discussed under Alternative B. However, as shown in Table 3-20 in Section 3.7, up to approximately 272.0 acres of forest and 41.4 acres of herbaceous vegetation that may offer some suitable summer roosting and/or foraging habitat to state and federally listed bats would be removed, as compared to 359.0 acres and 189.4 acres, respectively, under Alternative B and 444.3 and 189.4 acres, respectively, under Alternative D. As such, the effects of potential habitat alteration on listed bat species are incrementally less than those previously described for Alternative B. In addition, proposed actions at Area 2 would occur approximately 0.38 miles from a transitional roosting cave used by federally listed gray bats. Depending on the duration between previous bat surveys and site-specific design selection, additional presence/absence surveys may be required prior to construction activities. When feasible, tree removal would occur in winter (October 15 – March 31) to minimize impacts to tree-roosting bats. Consultation under Section 7 of the ESA would occur when specific designs have been selected and scope of the project has been refined. By implementing minimization measures such as winter tree removal and any additional conservation measures that may result from the Section 7 consultation, substantial impacts to state and federally listed bats are not anticipated. Therefore, in consideration of minimization measures and any additional conservation measures, potential impacts to listed bat species are generally similar to those previously described for Alternative B and minor.

3.8.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D potential impacts to threatened and endangered animals and sensitive plants are the same as those previously described for Alternative B.

Effects of Alternative D on threatened and endangered terrestrial animal species would be generally similar to those discussed under Alternative B. However, because Alternative D would result in impacts to approximately 444.3 acres of forest and 189.4 acres of herbaceous vegetation that may offer some suitable summer roosting and/or foraging habitat to state and federally listed bats, the potential effects of potential habitat alteration on listed bat species is incrementally greater than that previously described for Alternative B. In addition, proposed actions at Area 2 previously described under Alternative C would occur approximately 0.38 miles from a transitional roosting cave used by federally listed gray bats. Depending on the duration between previous bat surveys and site-specific design selection, additional presence/absence surveys may be required prior to construction activities. Where feasible, tree removal would occur in winter (October 15-March 31) to minimize impacts to roosting bats. Consultation under Section 7 of the ESA would occur when specific designs have been selected and scope of the project has been refined. By implementing minimization measures such as winter tree removal and any additional conservation measures that may result from the Section 7 consultation, substantial impacts to state and federally listed bats are not anticipated. Therefore, in consideration of minimization measures and any additional conservation measures, potential impacts to listed bat species are incrementally greater than to those previously described for Alternative B and minor.

3.8.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.8.1.4, several reasonably foreseeable future actions were identified in proximity to the CRN Site. Depending on the local environmental setting and the design characteristics of these other proposed actions, direct alteration of aquatic and terrestrial resources may occur. Furthermore, each of these projects entails land disturbance activities that have the potential to contribute to habitat loss due to land clearing. None of the identified actions by others geographically intersect with the same habitat affected by the proposed project. However, these other projects have the potential to increase demands on water and land use during both construction and operational phases. Example projects include continued development in the Roane Regional Business and Technology Park and the Heritage Center Industrial Site, the Kairos Hermes reactor project, proposed actions at ORNL, development of the Horizon Center, and the development of the municipal airport near the ETTP. Project activities at the CRN Site would be within the bounds of impacts analyzed in TVA's Bat Strategy Programmatic Section 7 ESA consultation. With the implementation of identified conservation measures and BMPs and the abundance of available habitat surrounding the project area, the proposed actions are not expected to significantly impact listed bat species. Other reasonably foreseeable future actions may also have the potential to result in the removal of forested lands that may contain suitable bat foraging habitat or potentially suitable bat roost trees. Because many of the identified foreseeable future projects are also expected to be federally funded, each of these projects would have similar requirements for avoidance and minimization of potential impacts to federally listed bat species. As such, these actions would likely have minimal cumulative impacts on threatened and endangered species in the area but could contribute to collectively increased demands on existing habitats.

3.8.2.6 Summary of Impacts to Threatened and Endangered Species

For most of the federally and state-listed terrestrial and aquatic animal species that may have suitable habitat in the Project Area, there are no confirmed records that indicate that these species have historically occurred within the Project Area and there were no sightings of these species during recent field surveys.

While there may be minor impacts to discrete locations of potential habitat for some state listed species, impacts are not expected to affect populations of the species. Forest and herbaceous vegetation that may offer some suitable summer roosting and/or foraging habitat to state and federally listed bats would be removed under the action alternatives. In addition, proposed actions would occur in the vicinity of a transitional roosting cave used by federally listed gray bats. Depending on the duration between previous bat surveys and site-specific design, additional presence/absence surveys may be required prior to construction activities. Where feasible, tree removal would occur in winter to minimize impacts to roosting bats. Consultation with the USFWS under Section 7 of the ESA would occur when specific designs have been selected and scope of the project has been refined. By implementing minimization measures such as winter tree removal and any additional conservation measures that may result from the Section 7 consultation, substantial impacts to state- and federally listed bats are not anticipated.

Direct impacts to a population of the state-listed spreading false-foxglove located on the edge of Area 1 under Alternatives B and D are not likely due to topographical limitations on development of the calcareous forest where it is located. Potential impacts to the state-listed rigid sedge and green orchid from proposed development of the offsite transmission line ROW would be the same for all action alternatives. TVA would ensure that rigid sedge and pale green orchid are not significantly impacted under all action alternatives by consulting with the TVA botanist during design of the proposed offsite transmission line to avoid the plants and their associated calcareous wetland habitat to the greatest extent possible. With implementation of this environmental commitment, adoption of Alternatives B, C, and D are not expected to impact populations of rigid sedge or pale green orchid.

As summarized in Table 3-25, TVA has determined that impacts to threatened and endangered species and their associated habitats related to the proposed actions under Alternatives B, C, and D are minor.

Table 3-25. Summary of Impacts to Threatened and Endangered Species

Alternative	Project Phase	Impact	Severity
Alternatives B, C, and D	Construction	Loss of potential summer roosting and foraging habitat for Indiana bat, northern long-eared bat, little brown bat, and tricolored bat and loss of potential summer foraging habitat for gray bat.	Consultation with the USFWS under Section 7 of the ESA would occur when specific designs have been selected and scope of the project has been refined. By implementing minimization measures such as winter tree removal and any additional conservation measures that may result from the Section 7 consultation, large impacts to gray bat, Indiana bat, northern long-eared bat, little brown bat, and tricolored bat are not expected. No impact to other threatened and endangered species.
		Possible loss of habitats potentially used by four-toed salamander, hellbender, Bachman's sparrow, bald eagle, cerulean warbler, sharp-shinned hawk, Swainson's	Impact minor. There are no confirmed records for most of these species within the Project Area during the breeding season. TVA to use BMPs and conduct

Alternative	Project Phase	Impact	Severity
		warbler, meadow jumping mouse, and southeastern shrew.	further avoidance and minimization measures during design, as appropriate.
		Potential impacts to Project Area jurisdictional streams and riparian zones and near-shore instream areas of the Reservoir.	No impacts expected to aquatic threatened and endangered species due to lack of species observed in Project Area, and because BMPs would be implemented in accordance with site-specific erosion control plans. Activities would be designed to minimize impacts to the Clinch River arm of the Watts Barr Reservoir and other surface waters and meet the terms and conditions of applicable USACE, NPDES, and TDEC permits.
Alternatives B and D	Construction	Potential direct impacts to state-listed spreading false-foxglove, rigid sedge, and pale green orchid from development of Area 1 and offsite transmission line ROW.	Location of spreading false-foxglove in Area 1 not likely to be affected by development due to steep topography. TVA would ensure that rigid sedge and pale green orchid are not significantly impacted under all action alternatives by consulting with the TVA botanist during design of the proposed actions to avoid the plants and their associated habitats to the greatest extent possible.
Alternative C	Construction	Potential direct impacts to state-listed rigid sedge and pale green orchid from development of offsite transmission line ROW.	Potential impacts to state-listed rigid sedge and pale green orchid would be the same as Alternatives B and D.
Alternatives B, C, D	Operation	Potential for alteration of hydrology, flow patterns, and water quality of Clinch River arm of Watts Bar Reservoir from stormwater and water intake and discharge facilities.	Because there is a lack of quality habitat for threatened and endangered species in the Project Area and TVA would obtain all required operational permits, operation of the CRN facilities including the water

Alternative	Project Phase	Impact	Severity
			intake and discharge facilities situated on the Clinch River arm of Watts Bar Reservoir is not expected to affect populations of species of conservation concern.
		Routine maintenance of transmission line ROW.	No impacts to listed species are expected from maintenance of proposed transmission line ROW because potential stream and other sensitive habitats would be protected by BMPs and conservation measures such as winter tree removal would be implemented.
		Potential collisions and noise associated with cooling towers.	Impacts would be minor to negligible due to low tower height (<65 feet) and distance from noise source to suitable bat roosting and foraging habitat after development of the CRN Site.

3.9 Managed and Natural Areas

3.9.1 Affected Environment

Managed and natural areas include TVA and non-TVA managed areas, ecologically significant sites and Nationwide Rivers Inventory (NRI) streams, State Natural Areas (SNA), and HPAs. Managed areas include lands held in public ownership that are managed by an entity (e.g., TVA, DOE, State of Tennessee) to protect and maintain certain ecological and/or recreational features. Ecologically significant sites are either tracts of privately owned land that are recognized by resource biologists as having significant environmental resources or identified tracts on TVA lands that are ecologically significant but not specifically managed by TVA's Natural Areas program. NRI streams are free-flowing segments of rivers recognized by the National Park Service (NPS) as possessing remarkable natural or cultural values. SNAs are designated and protected under the Natural Areas Preservation Act as intact ecosystems which serve as reference areas for how natural ecological processes function and are designated and protected under the Natural Areas Preservation Act (TDEC 2021a). HPAs are TVA managed natural areas that are managed to protect populations of species identified as threatened or endangered by the USFWS, state-listed species, and any unusual or exemplary biological communities/geological features (TVA 2021g).

There are no natural areas present within the CRN Site boundary. There are numerous managed and natural areas within the surrounding geographic area of interest (Anderson, Knox, Loudon, and Roane Counties). A review of the TVA Natural Heritage database and the TDEC State Natural Area Boundaries indicated that five managed/natural areas, two designated

SNAs, and four proposed SNAs are located within the 6-mile vicinity of the CRN site (TVA 2021f; Tennessee State Parks 2021).

The natural areas adjacent or in proximity to the CRN Site are:

- **Grassy Creek HPA.** The Grassy Creek HPA is a 271-acre natural area located on Grassy Creek, abutting the northern end of the proposed CRN Site boundary. The HPA provides habitat for the state-listed plant species shining ladies-tresses (*Spiranthes lucida*). The northern portion of the HPA borders Grassy Creek and the southern portion is a buffer area for the sensitive habitats (TVA 2021h). Appalachian bugbane (*Cimicifuga rubifolia*), formerly listed as a state-listed species, has been reported on this site and was confirmed to be present during field surveys in 2011.
- **Oak Ridge Reservation**. The ORR is located adjacent to the northern and eastern portion of the CRN Site. The DOE manages this 32,900-acre area, which is used for manufacturing, laboratory, managed forest, and ecosystem process research. An analysis was conducted by ORNL in 2009 to document all the ecologically significant areas on ORR lands including natural areas, aquatic natural areas, reference areas, aquatic reference areas, special management zones, conservation easement areas, cooperative management areas, habitat areas, and potential habitat areas which are described in Table 3-26 and illustrated in Figure 3-16 (Baranski 2009). Also located in the ORR, the New Zion Boggy Area comprises 376 acres in the western portion of the ORR and is adjacent to the east of the CRN Site. It features portions of the Haw Ridge uplands, including rock outcrops, Raccoon Creek Barrens, Raccoon Creek Embayment as well as wetlands. Several rare and uncommon plant species occur here.
- **Oak Ridge State WMA.** This WMA is located adjacent to the proposed CRN Site, is a 37,000-acre area managed by the TWRA for small and large game hunting, and is located at CRM 18.8 to 14.5 on the right descending shoreline of Clinch River arm of the Watts Bar Reservoir) primarily on USDOE ORR.
- **ORNL National Environmental Research Park (and Biosphere Reserve).** This area is adjacent to the proposed site and contains approximately 20,000 acres and is within the boundaries of the ORR. The park is used as an outdoor laboratory for studying present and future environmental consequences from energy related issues. It provides protected land for the use of education and research in environmental sciences. Managed by the ORNL for USDOE, it is located on the Clinch River at (CRMs 21.0 to 18.9) and on Melton Hill Reservoir at (CRMs 33.2 to 23.0) on the right descending shoreline.

Two officially designated SNAs located outside the ORR are within a 3-mile radius of the proposed CRN Site. These are:

- **Campbell Bend Barrens—Designated SNA.** This SNA is approximately (1.7 miles) northwest of and across the Reservoir from the CRN Site. This 35-acre area, managed by TDEC, consists of small barrens that are a rare community type in a region where much of the land base has been developed or converted to agriculture. Eastern red cedar, white pine, post oak, dwarf chinquapin oak (uncommon in Tennessee), and other hardwoods are scattered throughout the open grassland community. The dominant grasses include little and big bluestem and side-oats gramma. The barrens community within the nature area is approximately four to six acres.

- **Crowder Cemetery Barrens—Designated SNA.** This SNA is approximately (1.8 miles) west of and across the Reservoir from the CRN Site. This 15-acre area, managed by TDEC, has grasslands in a matrix of mixed oak-pine with eastern red cedar and other hardwoods that are scattered throughout the barrens. Grasses include little bluestem and side-oats gramma and rare plants include slender blazing star and prairie dock. Dwarf chinquapin oak, uncommon in Tennessee, also is found here.

In 2001, four areas within the boundaries of the ORR were proposed for future designation as a designated state natural area (DSNA) and protection under the Natural Areas Preservation Act. These four areas are considered ecological core areas and contain multiple smaller natural areas within their boundaries. The four proposed DSNAs are within 3.0 miles of the CRN Site.

- **Copper Ridge Unit—Proposed DSNA.** This proposed DSNA comprises 3,908 acres located in the southern portion of the ORR, 2.3 miles southeast of the CRN Site. Prominent features include Copper Ridge, extensive river bluffs on the perimeter of Melton Hill Reservoir, a variety of forest community types, several caves and sink holes, ravines, springs, seeps, and forested wetlands. This area has been nominated but not yet been designated as a SNA.
- **Black Oak Ridge Unit—Proposed DSNA.** This proposed DSNA comprises 2,929 acres in the western part of the ORR (1.7 mile) north east of the CRN Site. This natural area includes two sections: East Black Oak Ridge and West Black Oak Ridge separated by the Poplar Creek water gap and Blair Road. Prominent features are the East Fork Poplar Creek floodplain, Black Oak Ridge, McKinney Ridge hemlocks, Leatherwood bluff, mixed hardwood-native pine forest, and a large forested wetland. This area has been nominated but not yet been designated as a SNA.
- **Pine Ridge-Bear Creek Valley Unit—Proposed DSNA.** This proposed SNA comprises 4, 584 acres adjacent to the northern boundary of the DOE Reservation (2.5 mile) north east of the CRN Site. Topographic features include Pine Ridge and the western portion of East Fork Ridge. There are extensive unfragmented forest and a variety of wetland habitat types, including headwater wetlands, seeps, marshes, and forested wetlands and sandstone outcrops. This area has been nominated but not yet been designated as a SNA.
- **Walker Branch-Three Bend Unit—Proposed DSNA.** This proposed DSNA comprises 6,059 acres located (2.6 mile) east of the CRN Site in the eastern corner of the ORR, including the entire Three Bend Scenic and Wildlife Area. The area includes one of the world's largest populations of the rare wildflower species, tall larkspur. This area has been nominated but not yet been designated as a DSNA.

Table 3-26. Natural Areas and Sensitive Areas within the ORR

Label ID	Area Name	Acreage	Label ID	Area Name	Acreage
NA2	East Fork Ridge Mesic Forest	282.8	PH1	Black Oak Ridge Mixed Pine and Hardwood Forest	83.8
NA4	Rein-orchid Swamp	421.4	PH2	Water Tank Road Forest	171.7
NA6	West Haw Ridge	444.9	PH6	Chestnut Ridge Forest	350.0
NA13	Pine Ridge Wetlands	158.7	CMA1	Fingerless Orchid Wetlands	50.6
NA20	Poplar Creek Cliffs	471.3	CMA5	White Oak Lake	152.5
NA25	Clinch Floodplain Swamp	30.7	RA6	Pink Lady Slipper Community	6.1
NA29	Northwest Pine Ridge Fringeless Orchid Site	20.4	RA19	Sweet Flag Marsh	6.3
NA31	Environmental Sciences Division Lily Site	237.9	RA22	Grassy Creek Security Site	43.2
NA33	The ETTP Filtration Plant Wetland	6.5	RA23	Upper Poplar Creek Rookery	17.5
NA37	Duct Island Road Bluffs	12.2	RA28	Spring Pond	2.9
NA41	Leatherwood Bluffs	103.5	RA30	Lower Poplar Creek Rookery	6.5
NA42	New Zion Boggy Area	376.0	RA31	Copper Ridge Cave Area	377.8
NA45	McKinney Ridge Hemlocks	52.1	HA1	Holland Road Forest	434.0
NA48	Sleepy Salamander Forest	233.1	HA2	East Pine Ridge Forest	1233.2
NA49	K-25 Beaver Pond Complex	16.9	HA5	Melton Valley Drive Forest	24.3
NA50	Bear Creek Tributary 4	88.6	HA7	McNew Hollow and Ridge Forests	610.2
NA51	Dry River Bluffs and Caves	431.9	HA8	New Zion Road Barrens	158.0
NA52	Bear Creek Springs	124.5			
NA53	Flashlight Heaven Area	102.0			
NA55	Chestnut Ridge Springs Area	291.1			

Source: Baranski 2009

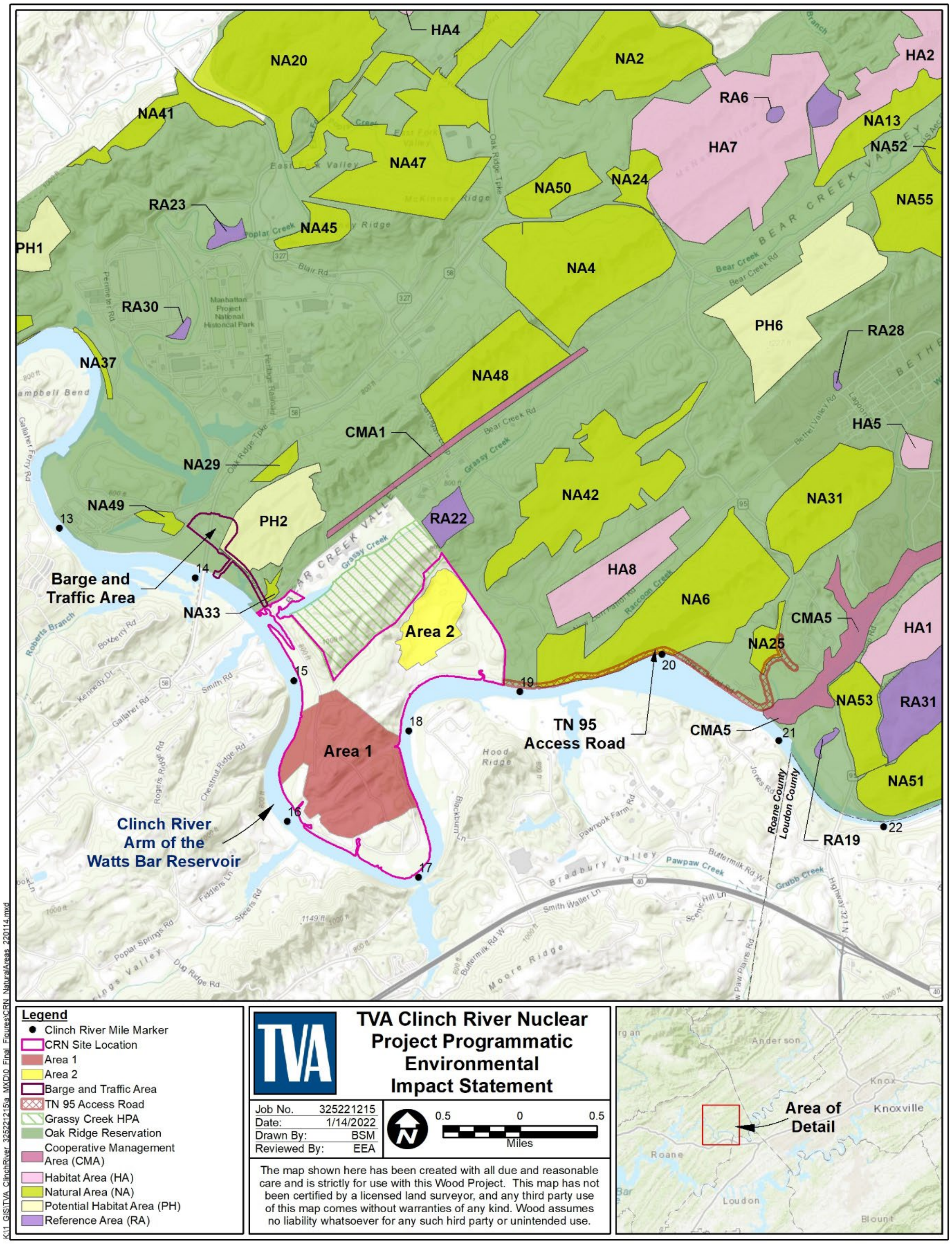


Figure 3-16. Managed and Natural Areas Within the ORR in the Vicinity of the CRN Site

3.9.1.1 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scopes of these other proposed actions are generally lacking. However, it is expected that they would not likely affect natural and managed areas. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on managed and natural areas are included in TVA's analysis.

3.9.2 Environmental Consequences

3.9.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, a Nuclear Technology Park would not be developed at the CRN Site; therefore, there would be no impact to managed or natural areas.

3.9.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

Under Alternative B a Nuclear Technology Park would be constructed and operated in Area 1 of the CRN Site. There are no managed or natural areas within Area 1; therefore, construction activities at this site would not directly impact natural or managed areas.

Several natural areas would be affected under Alternative B in conjunction with the proposed associated offsite areas:

- **Grassy Creek HPA.** The proposed 161-kV transmission line would intersect the eastern edge of the Grassy Creek HPA (Figures 2-1 through 2-3). Construction of the proposed 161-kV transmission line would include establishment of a maintained 120-foot ROW within a 280-foot corridor and would involve removal of trees and shrubs within the ROW. TVA would develop a mitigation plan to mitigate impacts associated with the loss of habitat in the Grassy Creek HPA. Under Alternative B, potential indirect effects on the Grassy Creek HPA include the development of a transmission line "edge" habitat that would potentially introduce associated plant and animal species that are characteristic of such habitats. Additionally, such edge habitats also represent the potential for increased introduction of invasive plant species into the interior of the HPA. However, TVA would manage the vegetation within the transmission line ROW in accordance with TVA's Transmission System Vegetation Management Final Programmatic EIS (TVA 2019c). Potential impacts to threatened, endangered, and sensitive species and their mitigative measures are discussed further in Section 3.8 (Threatened and Endangered species). As described in Section 3.8, TVA is pursuing expansion of the Grassy Creek HPA by approximately 14 acres to provide additional protection for these species. Based on the avoidance of sensitive species during transmission line design, and the commitment to additional mitigative measures, impacts to the Grassy Creek HPA are minor.
- **New Zion Boggy Area.** The TN 95 Access would cross several of the elements within the ORR boundary contained within the New Zion Boggy Area including the Haw Ridge uplands, Raccoon Creek Barrens, Raccoon Creek Embayment and Haw Ridge and the Clinch Floodplain Swamp. However, location of the TN 95 Access has been developed to coincide with the alignment of the existing Jones Island Road immediately adjacent to the Reservoir throughout much of its length. Widening of the existing Jones Island Road would be required. Potential encroachment on these natural area elements would be minimized when applicable; however, TVA would conduct extensive shoreline stabilization and restoration measures within this reach of the river and would therefore,

stabilize the eroding shorelines associated with these natural areas. Further avoidance and minimization measures would be undertaken in consultation with DOE during the detailed design phase. As such, impacts to these natural areas is moderate.

Managed and natural areas located within the adjacent 0.5-mile radius of the CRN Site may be indirectly impacted due to increases in noise, fugitive dust, and visual impacts associated with construction activities. However, the impacts would be intermittent and would only occur during construction periods and as such would be minor.

The construction and operation workforce and their families who relocate to the area of geographic interest would utilize natural areas in the vicinity of the CRN Site. The anticipated in-migrating construction and operation workforce would result in an 0.5 percentage population increase (Section 3.15.2) within the four-county geographic area of interest. Given the small increase in population, and diverse array of developed and dispersed recreation opportunities in the vicinity of the CRN Site, the impact associated with increased visitation to natural areas would be minor.

3.9.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

There would be no direct impacts associated with construction at Area 2 as no managed or natural areas are present. Potential impacts to managed and natural areas would be similar to those described under Alternative B.

Area 2 is located 0.38 miles northeast of Area 1 and is, therefore, closer to the Grassy Creek HPA. Accordingly, during construction indirect impacts from increases in noise, fugitive dust, and potential visual impairments associated with construction activities and operations would be slightly higher than Alternative B; however, these impacts would be intermittent. Other indirect impacts associated with the development of a transmission line “edge” habitat are similar to those described under Alternative B, but greater in proportion to the increase in edge habitat created. However, as stated for Alternative B, TVA would manage the vegetation within the transmission line ROW in accordance with TVA’s Transmission System Vegetation Management Final Programmatic EIS (TVA 2019c). Indirect impacts due to noise and visual intrusions during plant operation from plant facilities and systems are anticipated to be moderate.

3.9.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, a nuclear technology park would be constructed and operated in Areas 1 and 2. There would be no direct impacts associated with construction at Area 1 and 2 as there are no managed or natural areas present.

Indirect impacts would be similar to those described under Alternative C. Although activities associated with construction at Area 1 and Area 2 would be spread over a larger footprint, the maximum number of vehicles and staff would be the same under all alternatives.

Impacts associated with operation of the Nuclear Technology Park at Area 1 and 2 would be similar to those described for Alternative C. Therefore, impacts to managed and natural areas resulting from the actions undertaken by TVA under Alternative D would be minor to moderate.

3.9.2.5 Summary of Impacts to Managed and Natural Areas

Table 3-27 summarizes impacts to managed and natural areas from the development of a Nuclear Technology Park at the CRN Site. Overall, impacts would be minor. Users of these areas could be indirectly impacted during construction; however, the impacts would be minor and intermittent. Operational impacts could occur due to the creation of additional edge habitat, and noise and visual impairments.

Table 3-27. Summary of Impacts to Managed and Natural Areas

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Improvements to BTA and TN 95 Access in the ORR on existing road corridors.	Minor impacts that would be the same for all alternatives.
		Loss of habitat for sensitive species due to 161-kV transmission line (associated 120-foot ROW) through Grassy Creek HPA.	Minor impacts managed with TVA mitigation plan for sensitive species.
		Encroachment in several of the elements within the ORR boundary contained within the New Zion Boggy Area including the Haw Ridge uplands, Raccoon Creek Barrens, Raccoon Creek Embayment and Haw Ridge and the Clinch Floodplain Swamp.	Impacts minimized by avoidance. Extensive shoreline stabilization and restoration measures within this reach of the river and would stabilize the eroding shorelines. Further avoidance and minimization through consultation with DOE during the detailed design phase. Impacts are moderate.
		Increases in noise and fugitive dust, and visual impacts associated with construction activities.	Minor impacts based on area of disturbance and proximity to ORR and the Grassy Creek HPA. The magnitude of impact would be the same for Alternatives C and D, and incrementally less for Alternative B due to distance of Area 1 from the ORR and HPA.
	Operation	Potential increased indirect impacts to Grassy Creek HPA due to visual/noise intrusion and increased edge effect with Alternatives C and D.	Minor impacts for Alternative B and minor to moderate impacts for Alternatives C and D.

3.10 Recreation

3.10.1 Affected Environment

Developed recreation includes campgrounds, lodges, marinas, boat-launching ramps, parks, swimming pools and beaches, visitor buildings and other day use facilities, and golf courses. Dispersed recreation consists of passive informal activities such as hunting, hiking, nature observation, primitive camping, and bank fishing.

Parks and recreation facilities that are on, immediately adjacent to (within 0.5 miles), or within the vicinity (within a 6-mile radius) of the CRN Site are shown in Table 3-28 and illustrated on Figure 3-17.

Table 3-28. Parks and Recreation Facilities in the Vicinity of the CRN Site

Facility Name	Managing Entity	Distance from CRN Site
Black Oak Ridge Conservation Easement	TDEC, TWA, DOE	2.6 miles
Crosseyed Cricket Campground	Private Company	2.5 miles
ETTP Overlook	DOE	1 mile
Gallaher Recreation Area	City of Oak Ridge	0.1 mile
K-25 Gaseous Diffusion Plant (Manhattan Project Nation Historic Park)	DOE	1.25 miles
K-25 History Center (Manhattan Project National Historic Park)	DOE	1.6 miles
Melton Hill Dam	TVA	3.7 miles
Melton Hill Dam Recreation Area	TVA	3.9 miles
Soaring Eagle Campground and RV Park	Private	0.5 miles
Southern Appalachia Railway Museum	Private	0.8 miles
Wheat Community African Burial Ground	DOE	0.8 miles
X-10 Graphite Reactor (Manhattan Project National Historic Park)	DOE	3.1 miles
The Clinch River arm of the Watts Bar Reservoir	TVA	Adjacent

Source: Crosseyed Cricket 2021, Tennessee Landforms 2019, TVA 2021j, NPS 2021 and DOE 2020

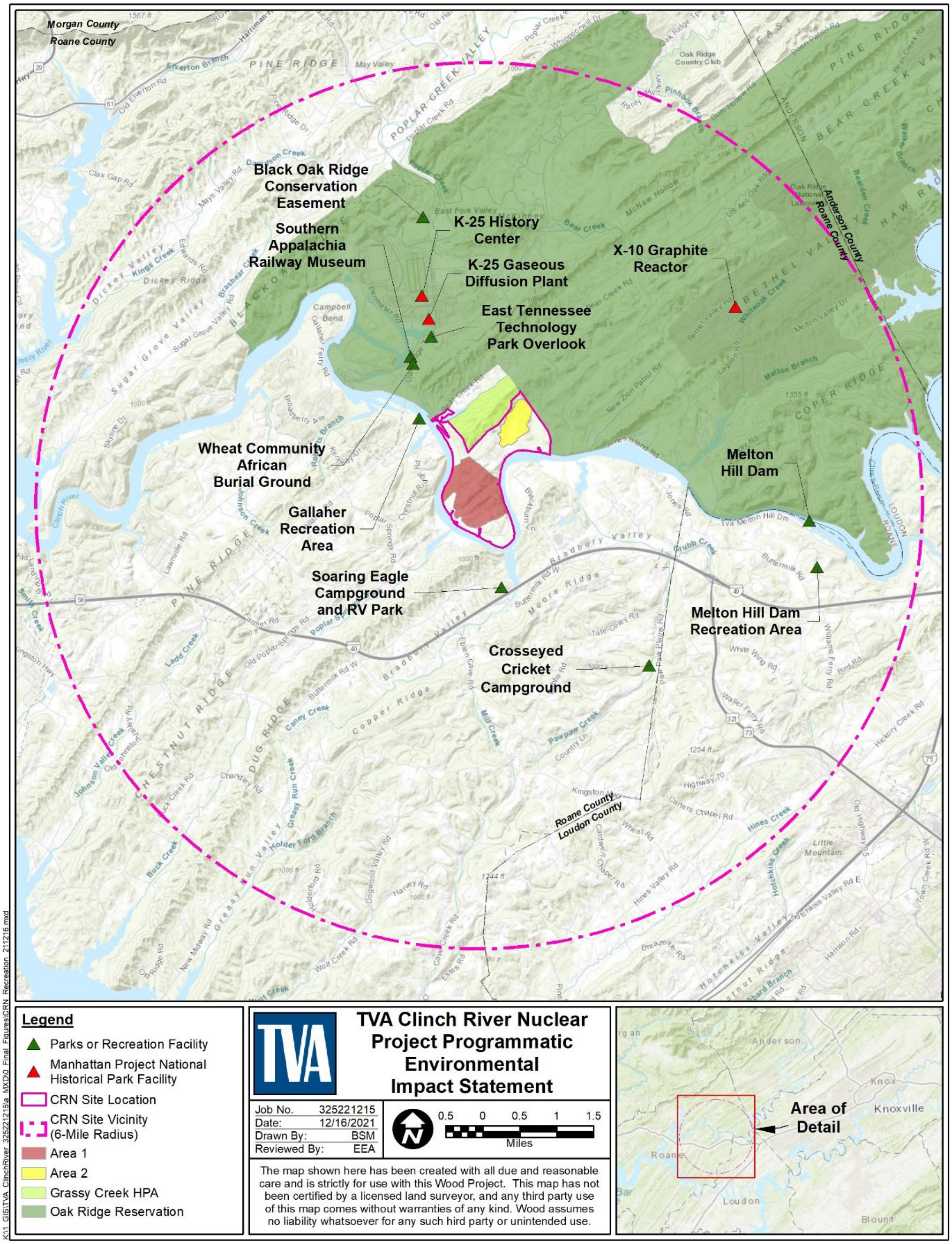


Figure 3-17. Parks and Recreation Facilities Within the Vicinity of the CRN Site

There are no parks and recreation facilities located on the CRN Site. Eleven parks and recreation facilities are located within the vicinity of the site, three are located adjacent to (within 0.5 miles) the CRN Site, which include the Gallaher Recreation Area, Soaring Eagle Campground, and the Reservoir. This section focuses on the recreation facilities adjacent to the CRN site, as there would be no direct impacts on parks or recreation facilities outside of this radius due to distance between the site and these facilities.

The Gallaher Recreation Area, located across the Reservoir from the CNR Site, spans over 45 acres and includes a boat ramp at CRM 14.5 and a beach area for swimming and fishing. The recreation area is managed by the City of Oak Ridge, and approximately 30-50 people visit the recreation area daily.

The Soaring Eagle Campground and RV Park includes 90 campsites for tents and RVs located 0.5 miles from the CRN site, on the opposite side of the Reservoir. The campground includes picnic pavilions, boat ramp and dock, a swimming pool, playground, bathhouses and laundry facilities. Approximately 13,000 patrons visit this area each year.

The Reservoir, which wraps around the western, southern, and eastern borders of the CRN Site, provides opportunities for various dispersed recreation activities including fishing, boating, and hiking (TVA 2021j). There are several boat ramps along the Reservoir, including privately owned boat ramps and public boat ramps associated with existing parks and recreation facilities. These boat ramps support activities such as power boating, canoeing, kayaking and dock fishing.

3.10.1.1 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. While the specific details regarding the scope of these actions are generally lacking, it is expected that these other proposed actions would not likely affect parks and recreation facilities. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on parks and recreation are included in TVA's analysis.

3.10.2 Environmental Consequences

3.10.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, the CRN Site would remain unused and managed in accordance with the Watts Bar RLMP (TVA 2009; TVA 2021k). Therefore, there would be no impacts to parks or recreation.

3.10.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

There are no parks or recreational facilities within the CRN Site boundaries or within the associated offsite areas (BTA, TN 95 Access, and 161-kV offsite transmission line). Therefore, there would be no direct impacts to parks or recreational facilities from construction or operation of the Nuclear Technology Park at Area 1. The three parks and recreation facilities that are adjacent to the CRN Site would not be directly impacted; however, construction-related impacts associated with construction activities could have some disruptive effect on dispersed recreation use and on developed recreation areas adjacent to the CRN Site.

Erosion and sedimentation from site stormwater runoff could impact recreators on the Reservoir, including those accessing the river from the Gallaher Recreation Area. However, erosion and sedimentation would be minimized with implementation of BMPs and, therefore, this impact would be minor. In addition, construction noise may indirectly impact fishing, boating, and hiking in the areas immediately adjacent to the Reservoir. However, due to the intermittent nature of these activities and the availability of additional areas for recreation upstream and downstream of the CRN Site, impacts would be minor.

Recreators at the Soaring Eagle Campground and RV Park may experience indirect impacts associated with increased traffic generated by the construction workforce and equipment transport. However, primary access to this campground is from I-40, and most construction traffic would access the CRN Site from TN 58 and Bear Creek Road, thereby not affecting traffic to the campground. As such, impacts would be minimal.

During operation of the Nuclear Technology Park at Area 1, users of parks and recreation facilities adjacent to the CRN Site may be indirectly impacted due to delays in traffic and operational noise. However due to the small size of the operational workforce traffic, noise impacts would be minor and mainly confined to normal working hours. As described in Section 3.13, development of the undisturbed CRN Site may reduce scenic integrity. However, while the major buildings of the facility would be visible to recreationists on the Reservoir, views would be somewhat screened by topography. As such, operation of the facility would result in minor impacts to recreational activities along the Reservoir.

Transient construction and temporary fuel outage workforces may utilize recreation facilities for short-term temporary housing. Within the vicinity of the CRN Site there are three campgrounds and RV sites that can provide temporary housing, in addition to other temporary housing as described in Section 3.15.1.2. Therefore, impacts associated with competition for transient housing would be minor. In-migrating operation workforces and their families would utilize parks and recreation areas within the vicinity of the CRN Site. As described in Section 3.9.2.2, the operation workforce would account for a small increase in the population. Therefore, impacts associated with increased visitation to recreation facilities would be minor.

3.10.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Impacts to parks and recreation areas would be similar to those described under Alternative B. Area 2 is located adjacent to the ORR, approximately 0.4 miles northeast of Area 1, and is further set back from the Reservoir. Therefore, the magnitude of potential impacts to parks and recreation facilities would be minor to moderate yet incrementally less than those described for Alternative B.

3.10.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Development of Areas 1 and 2 would create a greater visual impairment from the undisturbed landscape. However, the transformation of the undeveloped nature of the site to industrial development is not anticipated to destabilize users of parks and recreation areas, resulting in a moderate impact to recreationist along the Reservoir. Indirect impacts to parks and recreation facilities located adjacent to the CRN Site are bounded by the analysis in Alternative B, as the maximum number of vehicles and staff would be the same under all alternatives. Therefore, impacts to parks and recreation areas resulting from implementation of Alternative D would be minor to moderate.

3.10.2.5 Summary of Impacts to Recreation

Table 3-29 summarizes impacts to parks and recreation resources from the development of a Nuclear Technology Park at the CRN Site. Overall, impacts to parks and recreation would be minor to moderate. Recreators could be indirectly impacted during construction, but these impacts would be minor and minimized through the use of BMPs designed to reduce erosion, noise, and fugitive dust emissions. Operational impacts would be minor and would not impact the use or enjoyment of surrounding parks and recreational facilities.

Table 3-29. Summary of Impacts to Parks and Recreation Resources

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	No direct impacts to parks or recreational facilities. Indirect impacts associated with erosion and sedimentation due to land disturbances and temporary increase in noise, fugitive dust, and traffic during construction activities. Limited to users of parks and recreation facilities adjacent to CRN Site.	Minor impact. The magnitude of impact would be the same for Alternatives B and D, and incrementally less for Alternative C due to distance of Area 2 from the Reservoir.
	Operation	Introduction of industrial features into the existing natural landscape, reducing scenic integrity, traffic and noise increases from standard operation.	Impacts to parks and recreation would be minor based on the small operational workforce and somewhat screened views of the CRN Site. The magnitude of impact would be the same for Alternatives B and D, and incrementally less for Alternative C due to distance of Area 2 from the Reservoir.

3.11 Air Quality and Climate Change

3.11.1 Affected Environment

3.11.1.1 Air Quality

The discussion of air quality includes the six air pollutants for which the EPA has set NAAQS: ozone (O_3), particulate matter with a mean aerodynamic diameter of less than or equal to 10 µm and 2.5 µm (PM_{10} and $PM_{2.5}$, respectively), carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), and lead (Pb). These six pollutants are called criteria pollutants. This discussion also includes greenhouse gases (GHGs), primarily carbon dioxide (CO_2).

Areas with pollutant concentrations that are greater than the acceptable levels for criteria pollutants established by the NAAQS are nonattainment areas. Anderson, Blount, Knox, and Loudon Counties and a portion of Roane County were nonattainment areas for 1997 annual $PM_{2.5}$ and for 2006 24-hour $PM_{2.5}$ but have been re-designated as attainment areas effective August 29, 2017, and September 27, 2017, respectively (82 FR 40718; 82 FR 40953). Emissions from new major sources in attainment areas are evaluated by the State of Tennessee through the Prevention of Significant Deterioration (PSD) program.

Federal Class I areas are afforded additional protection for air quality under Section 169A of the CAA. The closest mandatory Class I Federal areas to the CRN Site are the Great Smoky Mountains National Park near Gatlinburg, Tennessee, approximately 31 miles east-southeast of the CRN Site (40 CFR 81.428) and the Joyce Kilmer-Slickrock Wilderness Area, in Monroe County, Tennessee, and Graham County, North Carolina, approximately 36 miles southeast of the CRN Site (40 CFR 81.428).

3.11.1.2 Climate Change and Greenhouse Gases

The CRN Site is located in a region of eastern Tennessee that is commonly referred to as “The Great Valley,” an area of ridges and valleys, which influences the climate of the site. Terrain elevations range from 700 feet AMSL to 1,500 feet AMSL. The climate of the CRN Site is humid and subtropical, with seasonal variations driven by the position of the jet stream. The jet stream is generally situated north of the CRN Site during warmer months, which allows maritime tropical air masses from the Gulf of Mexico, or, to a lesser extent, the Atlantic Ocean, to influence the region. During the winter months, the jet stream shifts toward the south, but with a west-to-east orientation, and conditions remain moderate. When the jet stream dips farther south into the southern states, the CRN Site experiences colder temperatures due to the intrusion of polar continental air masses. However, the region’s topography often blocks the coldest portions of the polar air masses, limiting temperature extremes at the CRN Site.

The winds at the CRN Site are influenced by the local topography of “The Great Valley”, as the topography channels winds into southwesterly or northeasterly directions. As a result, the prevailing wind direction at the nearby Oak Ridge National Weather Service (NWS) Station (located 12 miles to the northeast in the City of Oak Ridge) is from the northeast. Surface wind speeds are typically low due to the terrain as well, so that the mean annual wind speed at the Oak Ridge NWS Station is 2.9 mph.

The CRN Site typically experiences warm summers and mild winters. The annual average temperature at Oak Ridge was approximately 59°F. The highest normal daily maximum temperature at Oak Ridge was 88.4°F in July, while the lowest normal daily minimum temperature was 28.9°F in January. Average annual precipitation at the Oak Ridge NWS Station (located 25 miles to the east-northeast of the CRN Site) is approximately 51 inches. Droughts are relatively uncommon because precipitation is typically well distributed during the year. Annual average snowfall amounts are 11.1 inches at the Oak Ridge NWS Station and 6.5 inches at the Knoxville NWS Station. Snowfall usually occurs during November through March, with normal amounts per snowfall event that are typically between 0.1 and 4 inches at the Oak Ridge NWS Station. Thunderstorms are commonly reported at the surrounding NWS stations; approximately 40 to 55 days with thunderstorm activity are recorded annually at nearby NWS stations (Chattanooga, Bristol/Johnson City/Kingsport, Knoxville, and Nashville). The majority (approximately 60 to 75 percent) of thunderstorms occur between May and August.

3.11.1.2.1 Greenhouse Gases

GHGs are transparent to incoming short-wave radiation from the sun but are opaque to outgoing long-wave (infrared) radiation from Earth’s surface. The net effect over time is a trapping of absorbed radiation and corollary warming of Earth’s atmosphere, which together constitute the “greenhouse effect.” Since the onset of the Industrial Revolution in the mid-1700s, human activities have contributed to the production of GHGs, primarily through the combustion of fossil fuels (such as coal, oil, and natural gas) and deforestation. The principal GHGs that enter the atmosphere because of human activities include carbon dioxide CO_2, methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Some

GHGs, such as CO_2, CH_4, and N_2O, are also emitted to the atmosphere through natural processes.

Climate-related changes are under way in the U.S. and globally, and their scope and extent are projected to continue to grow during the next several decades. Potential climate-related changes include rising temperatures and sea levels; increased frequency and intensity of extreme weather (e.g., heavy downpours, floods, and droughts); earlier snowmelts; more frequent wildfires; and reduced snow cover, glaciers, permafrost, and sea ice. Climate-related changes are closely linked to increases in GHGs.

Though global climate change, in both its magnitude effects, is uncertain, projected trends are discussed in relationship to current conditions. The CRN Site is located in the southeast region of the U.S. During the preceding 100 years, the southeast has experienced alternating periods of generally warmer, or cooler temperatures. Warmer temperatures have occurred from the 1970s until present (with an average increase of 2°F). Further, there have been an increasing number of days that exceed 95°F, nights that exceed 75°F, and a decrease in the number of “extremely cold” days since the 1970s.

Regarding precipitation patterns, the southeast is located in a “transition zone” between the southwestern U.S., which is generally dryer and the Northern U.S., which is overall wetter. As such, precipitation trends in the southeast show less pronounced trends. Though precipitation patterns are more uncertain, reduced water availability is expected from increased evaporation due to higher air temperatures in the southeast.

Based on current understanding of the impacts of climate change, the greatest potential effects of climate change for the CRN Site and its surroundings are increased temperatures and reduced water availability. These projections are inherently uncertain, however. As part of a future licensing action of advanced nuclear reactors at the CRN Site, TVA would continuously monitor meteorological and environmental conditions throughout the life cycle of any reactors proposed for deployment, to ensure their operation would occur within authorized and licensed limits of operation.

3.11.1.2.2 Regulatory Requirements

Although there have been a series of recent administrative changes, no binding GHG emission reduction requirements are currently in force at the federal level for fossil-fired power plants. The national emissions reduction requirements established in the EPA’s Clean Power Plan (CPP) rule were repealed on July 8, 2019 (84 Federal Register 32250) and the targets in the Paris Climate Accord were withdrawn in November of 2020. The emission reduction requirements established by EPA in the Affordable Clean Energy (ACE) rule, which replaced the CPP rule, were vacated by the D.C. Circuit Court of Appeals on January 19, 2021. On January 20, 2021, President Biden issued EO 13990 (Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis) and on January 27, 2021, President Biden issued the EO 14008 (Tackling the Climate Crisis at Home and Abroad). Amongst other objectives, the EOs set an aspirational target to achieve a net-zero emission economy by 2050 and a carbon-free electricity sector by 2035. In addition, on January 20, 2021, President Biden announced that the U.S. would rejoin the Paris Climate Agreement, and the U.S. became a party to the Agreement on February 19, 2021. The Agreement is a binding international agreement to reduce GHG emissions and impacts due to climate change that was signed by 196 parties on December 12, 2015 and entered into force on November 4, 2016. The Agreement aims to limit global warming to well below 2°C, and preferably to 1.5°C, compared to pre-industrial levels. Prior to the U.S. withdrawal from the Agreement in November 2020, the

U.S. had proposed a 26 to 28 percent domestic reduction in GHG emissions by 2025 compared to 2005 levels. It is likely that the U.S. would retain or modify these goals upon rejoining the Agreement. On April 22, 2021, the U.S. submitted its nationally determined contribution (NDC) in line with Article 3 of the Paris Agreement. In the NDC, the U.S. is setting an economy-wide target of reducing GHG emissions by 50 to 52 percent below 2005 levels in 2030. Additionally, at the United Nations Climate Change Conference, COP 26, in November 2021, the United States and China, the world's top emitters of GHGs, agreed to boost cooperation on combating climate change over the next decade. *Both countries* said they will work together on increasing the use of renewable energy, developing regulatory frameworks, and deploying technologies such as carbon capture.

On December 8, 2021, President Biden signed EO 14057 detailing the administration's policy to take a whole of government approach to lead by example to achieve a carbon pollution-free electricity sector by 2035 and net-zero emissions economy-wide by no later than 2050. EO 14057 instructs virtually all elements of the federal government to demonstrate how innovation and environmental stewardship can protect our planet, safeguard federal investments, respond to the needs of American communities, and expand American technologies, industries, and jobs. EO 14057 highlights include:

Section 102. Government-wide Goals.

(i) 100 percent carbon pollution-free electricity, defined as electricity produced from resources that generate no carbon emissions, on a net annual basis by 2030, including 50 percent 24/7 carbon pollution-free electricity, defined as carbon-pollution free electricity purchased to match actual electricity consumption that is produced within TVA's regional grid; and

(iv) a 65 percent reduction in greenhouse gas emissions, defined as GHG emissions from operations/property that agencies owns or controls, by 2030 from 2008 levels.

Section 301. Federal Supply Chain Sustainability. Federal supply chains should support a government and economy that serves all Americans by creating and sustaining well-paying union jobs, protecting public health, advancing environmental justice, reducing greenhouse gas emissions, and building resilience to climate change. Consistent with applicable law, agencies shall pursue procurement strategies to reduce contractor emissions and embodied emissions in products acquired or used in federal projects.

While not binding on TVA specifically, EO 14057 creates binding requirements on federal agencies that TVA serves, including DOE's ORR.

3.11.1.2.3 TVA Carbon Trajectory and Strategic Intent

At its May 6, 2021, meeting, the TVA Board adopted the TVA Strategic Intent and Guiding Principles, which focus on energy supply and decarbonization initiatives (TVA 2021i). These guiding principles commit TVA to delivering safe, low-cost, reliable power while providing responsible stewardship by caring for the region's natural resources. The guiding principles are based on the 2019 IRP Recommendations and reiterate TVA's plan for 70 percent carbon reduction over 2005 levels by 2030, 80 percent carbon reduction by 2035, and aspirations for net-zero carbon emissions by 2050. Additional details regarding TVA's carbon trajectory can be found in the Fiscal Year 2020 Sustainability Report (TVA 2021e).

3.11.1.3 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of local and regional air quality and may contribute to GHG emissions. Specific foreseeable future actions that may contribute to local and regional air emissions include the potential development of the Kairos Hermes Reactor Project, the development of the new airport by the City of Oak Ridge (both at the ETTP), the proposed construction of new production facilities at the Y-12 complex, and potential development at the Horizon Center Industrial Park. Specific details regarding air emissions associated with these actions and their respective timing (construction duration, start of operation) are lacking. However, construction phase activities would increase particulates and other pollutants in conjunction with land disturbance and vehicular emissions. Such effects would generally be localized, temporary and not impactful to regional air quality. Operational phase activities would also increase emissions from vehicles and in conjunction with facility operations. Because each of these actions has the potential to contribute to impacts to regional air quality, further consideration of reasonably foreseeable future actions and their effects on the local air quality are included in the following section as appropriate.

3.11.2 Environmental Consequences

3.11.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not develop the CRN Nuclear Technology Park. Therefore, there would be no GHG emissions and no impacts to air quality from construction and operation of the advanced nuclear reactors.

3.11.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.11.2.2.1 Air Quality

3.11.2.2.1.1 Construction

Under Alternative B, advanced nuclear reactors would be manufactured in factories, with large, fabricated components shipped to the construction site. Therefore, less onsite construction would be required for installation than for a typical commercial reactor. Construction activities at the Area 1 could result in temporary impacts to local air quality from the following activities:

- land clearing and grading; and material processing, handling, and removal
- material replacement (e.g., subsurface preparation and concrete pouring and paving)
- driving piles and erecting structures
- machinery operation and maintenance
- truck deliveries of supplies and materials
- soil and rock transport and temporary stockpiling
- workforce commute

The equipment required to support the digging, grading and construction of this project is expected to be both gasoline and diesel powered. As such, this equipment would emit the air pollutants normally associated with mobile fossil fuel powered equipment. Equipment and vehicle emissions from these activities would contain CO, oxides of nitrogen (NO_X), VOCs, and sulfur oxides (SO_X) to a lesser extent. Per air quality regulations, all diesel equipment would use low-sulfur fuel and are expected to be equipped with all required pollution controls. The increase in emissions from the equipment would be temporary and would be within the normal daily variation of mobile emissions from a construction site. It is expected that fugitive dust particles (such as PM_{10} and $PM_{2.5}$) generated during demolition would be controlled using standard construction BMPs. A small amount of emissions would also be generated from the one-time burning of the trees and stumps to be cleared. Air emissions from construction are expected to be temporary and minor. The air quality impacts are also expected to be limited to the area within 5 miles of the CRN Site. As discussed above, Roane County, where the CRN Site is located, is in attainment for all criteria pollutants.

During construction activities, additional commuter vehicles, trucks, and other construction vehicles would pass daily through routes leading to the CRN Site, primarily TN 58, Bear Creek Road, and TN 95. This traffic would include the passenger cars and light-duty trucks of the construction workforce and truck traffic for delivery of construction materials and heavy equipment used to support development (e.g., excavators, bulldozers, heavy-haul trucks, cranes). Additionally, traffic delays and congestion may be expected to occur at key intersections surrounding the CRN Site during peak hours. Such increased traffic volumes and increased delays would result in result in locally increased emissions during construction. Mitigation measures that may be considered include staggering work shifts to avoid localized delays at key intersections, thereby reducing the effects of additional emissions from vehicle idling. The increases in emission levels are expected to be minimal and temporary and would have a minimal impact on air quality from criteria pollutants. Possible mitigation measures during onsite construction may include stabilizing construction roads and spoils piles, covering haul trucks, watering unpaved construction roads to control dust, and conducting routine inspections and maintenance on construction vehicles and equipment.

The overall impact caused by increased traffic volume and congestion would be localized and temporary and minor. TVA would identify specific mitigation measures that would be developed before building activities begin to reduce the impact of increased traffic on air quality.

3.11.2.2.1.2 Operation

Based on the CRN Site PPE (Appendix A), sources of air emissions would include stationary combustion sources (auxiliary boilers, emergency diesel generators, and/or standby power gas turbines), mechanical draft cooling towers, and mobile sources (worker vehicles, onsite heavy equipment and support vehicles, and delivery of materials and disposal of wastes). Emergency diesel generators, and/or standby power gas turbines would operate only for limited periods, including periodic maintenance testing.

The principal air emission sources associated with operating nuclear reactors at the CRN Site would be cooling towers, auxiliary boilers for heating and startup, engine-driven emergency equipment, and emergency power supply system diesel generators and/or gas turbines. Estimates of the annual auxiliary boiler, diesel generator, and gas turbine air emissions, which include NO_X, CO, SO_X, hydrocarbons in the form of VOCs, and PM_{10}, are shown in Table 3-30.

Table 3-30. Annual Estimated Emissions from Cooling Towers, Auxiliary Boilers, Diesel Generators, and Gas Turbines at the CRN Site

Emission Effluent	Cooling Towers (lb/yr)[1]	Auxiliary Boilers (lb/yr)[2]	Diesel Generators (lb/yr)[3]	Gas Turbines (lb/yr)[4]	Total (lb/yr)	Emissions (lb/yr)
Nitrogen Oxides	NA[5]	33,900	39,000	2,300	75,200	37.6
Carbon Monoxide	NA	5,900	3,100	600	9,600	4.8
Sulfur Oxides	NA	41,600	NA	25	41,625	20.8
Volatile Organic Compounds[6]	NA	500	700	15	1,215	0.6
Particulate Matter (PM_{10})	6,700	7,700	300	NA	14,700	7.4

[1]Based on 8,760 hours of operation at 0.76 lb/hr, using Reisman and Frisbie 2002
[2]Based on 36 days of operation, one auxiliary boiler
[3]Based on 4 hours operation per month
[4]Based on 4 hours of operation per month
[5]NA = not applicable
[6]As total hydrocarbon

Since no specific reactor technologies and associated supporting equipment have been selected, detailed emission data are not available at this time. Equipment associated with which are defined in the PPE (Appendix A), would contribute gaseous and particulate emissions to the air. The auxiliary boilers would be used for heating buildings associated with the new plant, primarily during the winter months, and for process steam during site startups. The diesel generators/gas turbines and engine-driven emergency equipment would be used intermittently and for brief durations.

For the purposes of the PPE, it is expected that one or more mechanical draft cooling towers would be used to provide reactor process water cooling primarily for the SMRs. However, the non-LWR reactors may not use water for cooling or require external cooling systems. The exact locations of the cooling towers would depend upon where the reactors are constructed. The proposed cooling towers remove excess heat by evaporating water. Upon exiting the tower, water vapor mixes with the surrounding air, and this process generally leads to condensation and formation of a visible plume, which would have aesthetic impacts. Other potential impacts include ground-level fogging/icing, plume shadowing, drift deposition from dissolved salts and chemicals found in the cooling water, and ground-level temperature and humidity increases. In addition, plumes from the cooling towers could interact with emissions from other sources. However, TVA performed a SACTI analysis that demonstrated that due to the relatively small size of the cooling towers (in comparison to cooling towers servicing a large power plant), and the temperature and climate of the area, there would be no hours of fogging or icing. Any mechanical draft cooling towers used onsite would be equipped with efficient drift eliminators to reduce PM emissions and the effects of drift around the CRN Site.

Predicted potential impacts of plumes from cooling towers would be limited primarily to the immediate onsite area and just beyond the site boundary. The area around the CRN Site is relatively sparsely populated and is therefore less sensitive to the potential impacts from cooling-tower operations. Therefore, atmospheric impacts of cooling-tower operation at the CRN Site would not be noticeable and no further mitigation is required.

Combustion sources that would be associated with new reactors at the CRN Site would operate for only limited periods. With the exception of particulates, these combustion sources emit criteria air pollutants (such as NO_X, SO_2, and CO) that are different from those produced by the cooling towers (i.e., small amounts of PM as drift). Interaction among pollutants emitted from these sources and the cooling-tower plumes would be for only limited periods and would not have a significant impact on air quality.

Small amounts of O_3 and even smaller amounts of NO_X are produced by transmission lines. The production of these gases was found to be insignificant for 745-kV transmission lines (the largest lines in operation) and for a prototype 1,200-kV transmission line (NRC 2013). Transmission line upgrades described in Section 2.4.2 may be necessary to support the added generation capacity. Given the sizes of the existing transmission line sizes and additions, air quality impacts from transmission lines would not be noticeable and mitigation would not be warranted.

Air emission sources associated with new reactors would be managed in accordance with federal, state, and local air quality control laws and regulations. New reactors at the CRN Site would comply with all regulatory requirements of the CAA, as well as the TDEC requirements to minimize impacts on state and regional air quality. As reactor designs are selected for placement in the Nuclear Technology Park, detailed air quality modeling would be conducted as required to demonstrate that project-related emissions would not result in exceedances of the NAAQS. Because the CRN Site is currently located in an attainment area for all criteria pollutants, the proposed project would not be subject to a Nonattainment New Source Review.

It is anticipated that up to 500 operational staff would be present once the park achieved 800 MW build-out. Nominal localized increases in emissions would occur due to the increased numbers of cars, trucks, and delivery vehicles that would travel to and from the CRN Site. Most of the increased traffic would be associated with employees driving to and from work and routine deliveries by truck to the site. Additionally, traffic delays and congestion may be expected to occur at key intersections surrounding the CRN Site during peak hours that may increase localized emissions, particularly during periods where there could be an overlap between construction and operational activities as it is likely portions of the CRN Site could be developed at different times. However, during operation alone, such increased traffic volumes and increased delays would be less than that for construction. Therefore, mitigation measures implemented for construction such as staggering of work shifts to avoid localized delays at key intersections and planned road improvement (see Section 3.12 Transportation) should be more than adequate to prevent congestion during operations. With the proposed mitigation, impacts on local and regional air quality from operation-related traffic would minor. Mitigation measures should also include instances when multiple plants are constructed following staggered schedules, so that traffic related to construction and operation overlap.

As described in Section 3.11.1.1, the closest mandatory Class I Federal area where visibility is an important value is the Great Smoky Mountains National Park near Gatlinburg, Tennessee (40 CFR 81.428), approximately 31 miles east-southeast of the CRN Site. Another Class I Federal area, the Joyce- Kilmer Slickrock Wilderness Area, in Graham County, North Carolina (40 CFR 81.428), is approximately 36 miles to the southeast. These Class I areas are located crosswind to the prevailing southwesterly and northeasterly winds around the CRN Site, so direct transport from the CRN Site to these Class I areas is unlikely. Given the minor air emissions from the CRN Site, there is little likelihood that activities at the CRN Site could adversely affect air quality, including visibility or acid deposition, in these Class I areas.

3.11.2.2.2 Climate Change and Greenhouse Gases

3.11.2.2.2.1 Construction

Construction activities, such as operation of construction vehicles, commuter vehicles, construction equipment, and marine engines, would result in GHG emissions, principally CO_2. The NRC ESP FEIS provides an estimate of the GHG footprint for a reference 1,000-MWe light water reactor. The GHG emission estimates include direct emissions from the nuclear facility and indirect emissions from workforce transportation and the uranium fuel cycle. The reference reactor assumes a 7-year construction period. Specifically, the GHG footprint includes estimated emissions of 39,000 MT CO_2 equivalent (CO_2e)[1] for construction. This value would not significantly differ for any reactor technology considered because TVA used an 80 percent capacity factor for a 1,000-MWe reference nuclear power plant and a 90 to 98 percent capacity factor for the 800-MWe CRN Site. The estimated GHG emissions translates to an emission rate of about 5,570 MT CO_2e annually, averaged over a 7-year period of construction. To put this into perspective, this emission rate corresponds to approximately 0.006 percent of the total estimated GHG emissions in Tennessee (100,000,000 MT of gross[2] CO_2e) in 2015. This also equates to about 0.00008 percent of the total U.S. annual emission rate of 6.6 billion MT CO_2e in 2015.

Workforce transportation would also result in GHG emissions, principally CO_2. Assuming a 7-year period for construction activities and a typical workforce size contained in the estimated GHG footprint, the total workforce GHG emission footprint for building the 1,000-MWe reference reactor would be on the order of 43,000 MT CO_2e. This total emission quantity translates to a rate of about 6,100 MT CO_2e annually, averaged over the 7-year period of construction. This amounts to approximately 0.006 percent of the total estimated GHG emissions in Tennessee (100,000,000 MT of gross[3] CO_2e) in 2015 and 0.00009 percent of the total U.S. annual emission rate of 6.6 billion MT CO_2e in 2015.

In general, air emissions from construction activities, including GHG emissions, would vary based on the level and duration of a specific activity, but the overall impact is expected to be temporary and limited in magnitude. TVA would develop and implement emission-specific strategies to ensure compliance with applicable air quality standards such as:

- Scheduling construction activities to minimize running, inactive vehicles
- Phasing activities and equipment use
- Ensuring the use of heavy equipment that is in good condition, is properly maintained, and is compliant with applicable federal regulations for off-road diesel engines
- Ensuring all machinery is maintained and operated in accordance with the manufacturer's specifications
- Minimizing idling time of vehicles delivering materials to the CRN Site

Based on the projected size of the construction workforce and the GHG footprint compared to the Tennessee and U.S. annual GHG emissions, the atmospheric impacts of GHGs from workforce transportation would not be noticeable and additional mitigation would not be

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[1] A measure to compare the emissions from various greenhouse gases (GHGs) on the basis of their global warming potential, defined as the ratio of heat trapped by one unit mass of the GHG to that of one unit mass of CO_2 over a specific time period.
[2] Total GHG emissions estimate is based on twice the reported emissions from large emitting facilities.
[3] Total GHG emissions estimate is based on twice the reported emissions from large emitting facilities.

warranted. Based on the limited increase in local vehicle traffic and TVA's plans to implement the mitigation measures above, the impact on the air quality from construction activities, including effects of GHG emissions, would be short term and minor.

3.11.2.2.2.2 Operation

The emission of some GHGs, primarily CO_2, along with CH_4 and N_2O, are to be expected in the Nuclear Technology Park. Based on the GHG emission estimates in the NRC ESP FEIS for the reference 1,000-MWe reactor, the total GHG footprint for operating a new nuclear power plant for 40 years is on the order of 317,000 MT of CO_2e. The value of 317,000 MT CO_2e includes the emissions from a nuclear power plant operating (181,000 MT CO_2e) and the associated emissions from the operation workforce (136,000 MT CO_2e). The CO_2e emission rate 317,000 MT corresponds to an emission rate of about 7,925 MT CO_2e annually, averaged over the 40-year period of operation. This amounts to approximately 0.008 percent of the total projected GHG emissions estimate in Tennessee of 100,000,000 MT of gross CO_2e in 2015. This also equates to about 0.0001 percent of the total U.S. annual emission rate of 6.6 billion MT CO_2e in 2015.

GHG emissions are also subject to PSD review as of January 2, 2011. A new major stationary source is subject to PSD permitting for GHGs if the source is major for a regulated NSR pollutant that is not GHGs and also has the potential to emit 75,000 tons per year CO_2e. Based on an estimate of 7,925 MT CO_2e emitted annually from operation of a new nuclear power plant at Area 1, the CRN project would not be classified as a major source for GHGs. TVA would obtain the required air emissions permits under Tennessee and Federal laws.

Based on its assessment of the GHG footprint of plant operation as compared to the annual GHG emissions for Tennessee and the U.S., the atmospheric impacts of GHGs from operation of advanced nuclear reactors would be minor, and additional mitigation would not be warranted.

3.11.2.2.2.3 Fuel Cycle and Fossil Fuel Consumption

The largest source of GHG emissions associated with nuclear power is from the nuclear fuel cycle, not operation of the nuclear power plant. The largest source of GHGs in the nuclear fuel cycle is production of necessary electric energy and process heat from combustion of fossil fuel in conventional power plants. This energy is used to provide power for components of the fuel cycle such as enrichment. Further consideration of the GHG emissions and other effects of the uranium fuel cycle are provided in Section 3.21.

3.11.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

The impacts on air quality and from GHG emissions for Alternative C would be similar to those for Alternative B.

3.11.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, the impacts on air quality and from GHG emissions would be greater in physical extent because activities would occur over different parts of Area 1 and also Area 2 but ultimately are similar to those discussed under Alternative B.

3.11.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.11.1.3, several reasonably foreseeable future actions were identified in proximity to the CRN Site. Depending on the local environmental setting and the design characteristics of these other proposed actions, direct increases or changes in air emissions would be expected. These identified foreseeable future actions by others would result in air emissions that would potentially affect the same region as that of the CRN Site and, as such, may have the potential to affect air quality during both construction and operational phases. Example projects include the Kairos Hermes reactor project, proposed actions at ORNL, development of the Horizon Center, and the development of the municipal airport at the ETTP. Construction activities would increase particulates and other pollutants in conjunction with land disturbance and vehicular emissions. Because increased traffic generation by the CRN project (and others) during construction is typically greater than that of operational phases, these reasonably foreseeable future projects have the potential to be more pronounced during the construction phase of the CRN Nuclear Technology Park. However, potential impacts to air quality from construction activities from each of these projects are expected to be minor, localized, and short term. Consequently, even for projects that have construction schedules that overlap with that of the CRN Site, no notable cumulative effects to air quality are expected. Operational phase activities would also increase emissions in conjunction with facility operations. Similar to the CRN Nuclear Technology Park, reasonably foreseeable future projects would be subject to operational phase air permits processed through TDEC, as applicable. Permitting reviews performed by TDEC are conducted to ensure that new permits do not result in regional air quality degradation. Therefore, the cumulative effects on regional air quality are minor.

3.11.2.6 Summary of Impacts on Air Quality and Climate Change

As summarized in Table 3-31, TVA has determined that impacts on local and regional air quality during construction are minor and temporary. During operation of advanced nuclear reactors, emissions from vehicles and mobile equipment, auxiliary systems and cooling towers have limited impacts on local and regional air quality. Regarding GHG emissions, atmospheric impacts of GHG emissions during construction are temporary and minor. Likewise, atmospheric impacts of GHG emissions during operation of advanced nuclear reactors are also relatively minor and not noticeable.

Table 3-31. Summary of Impacts on Air Quality and GHG Emissions

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Particulate and gaseous emissions from land clearing, earthmoving, other construction-related activities, and work force commute.	Temporary and localized impacts on air quality, the locations of which depend upon the exact location of the construction sites. Air quality impacts mitigated by dust control measures applied in accordance with air permit requirements.
		GHG emissions from vehicles and equipment supporting construction activity.	Atmospheric impacts of GHG emissions are temporary and minor. Emissions reduced by minimizing idling time and staggering workforce shifts.

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Operation	Particulate and gaseous emissions from mobile sources (worker vehicles, onsite heavy equipment, and support vehicles; material delivery and waste removal vehicles).	Minor impacts.
		Particulate and gaseous emissions from auxiliary boilers for heating and startup.	Minor impacts mitigated by limited building heating requirements (primarily during winter months) and limited startup operations.
		Emissions from engine-driven emergency equipment, diesel generators and gas turbines.	Minor impacts mitigated by limiting operations to periodic testing and emergency use.
		Particulate emissions and visible plumes from cooling towers.	Impacts are reduced by installation of efficient particulate drift eliminators. Potential minor impacts limited to the immediate onsite area and site boundary. The area around the CRN Site is sparsely populated and thus relatively less sensitive to impacts.
		Small amounts of O_3 and NOx produced by transmission lines.	Production of O_3 and NOx was found to be insignificant for 745-kV transmission lines and a prototype 1,200-kV line. Impacts are minor.
		GHG emissions from plant operation, vehicles, and equipment.	Atmospheric impacts of GHG emissions from operations are relatively minor and not noticeable.

3.12 Transportation

3.12.1 Affected Environment

The transportation network in the area around the CRN Site consists of a network of federal and state highways; three freight rail lines; one major navigable river; one commercial passenger airport, McGhee Tyson Airport; and the Knoxville Downtown Island Airport (see Figure 1-1).

3.12.1.1 Roads

The eight federal highways provide access to the geographic area of interest include I-40, I-75, US 11, US 27, US 70, US 129, US 321, and US 441. The closest interstate highway to the CRN Site is I-40, which runs east to west approximately 0.6 miles southeast of the CRN Site. Tennessee State Highways in the vicinity of the CRN Site include TN 58, TN 95, US 321/TN 73, TN 326, TN 327, and TN 1/US 70. TN 58 and TN 95 are the primary roadways near the CRN Site. TN 95 runs north to south approximately 2.6 miles east of the CRN Site and connects to the City of Oak Ridge business district approximately 10 miles to the northeast.TN 58 runs northeast to southwest approximately 0.9 miles northwest of the CRN Site and terminates at TN 95 approximately 3.2 miles north-northeast of the CRN Site (see Figure 1-1).

TN 58 is a five-lane northeast/southwest principal arterial north and west of the CRN Site that connects I-40 to TN 95 via an interchange. Posted speed limits along TN 58 vary between 45 and 55 mph. Bear Creek Road is a two-lane roadway that provides the only existing access to the CRN Site. Bear Creek Road is accessed shortly after crossing the Gallaher Bridge by a left turn from northbound TN 58 onto a loop ramp. From this location Bear Creek Road extends to the southeast under TN 58 to the entrance to the CRN Site. Bear Creek Road then makes a left turn to head northeast to an intersection with TN 95 (Figure 1-1). Posted speed limits along Bear Creek Road are primarily 45 mph.

TN 95 is a two-lane north/south principal arterial approximately 2.6 miles east of the CRN Site that connects I-40 to TN 58 (eventually to the City of Oak Ridge). TN 58 terminates at TN 95 north of the CRN Site via an interchange. TN 95 has a traffic volume of 6,057 vehicles per day with three percent heavy vehicles. Posted speed limits along TN 95 are primarily 55 mph. Several locations along TN 95 contain 35 mph advisory speed limit signs due to the horizontal (corners/bends) and vertical (hills/valleys) curvature of the roadway.

TN 327 is a two-lane north/south major collector that connects TN 58 to TN 61 carrying approximately 3,000 vehicles per day with two percent heavy vehicles. TN 61 connects the towns of Oliver Springs and Harriman, Tennessee to Oak Ridge and Clinton, Tennessee where it intersects I-75. Posted speed limits along TN 327 are primarily 35 mph.

In addition to the federal highways near the CRN Site, Jones Island Road is an existing private road that runs along the shoreline of the Reservoir on DOE property east of the CRN Site boundary. Access to Jones Island Road is provided at the gated entrance to the DOE property on TN 95. The road is a partially developed gravel roadway which can experience flooding in some areas during prolonged wet weather. Access and use of the road are restricted by DOE.

3.12.1.2 Traffic Conditions

3.12.1.2.1 Level of Service (LOS)

The traffic carrying ability of a roadway is described by level of service (LOS). LOS is a quality measure describing operational conditions within a traffic stream, generally in terms of such service measures as speed and travel time, freedom to maneuver, traffic interruptions, and comfort and convenience. Table 3-32 lists traffic conditions associated with LOS as described by the Florida Department of Transportation (FDOT 2020).

Table 3-32. Traffic Conditions Associated with Level of Service

Level of Service	Traffic Condition
A	free flow traffic conditions
B	free flow conditions although presence of other vehicles begins to be noticeable
C	increases in traffic density become noticeable but remain tolerable to the motorist
D	borders on unstable traffic flow; the ability to maneuver becomes restricted; delays are experienced
E	traffic operations are at capacity, travel speeds are reduced, ability to maneuver is not possible; travel delays are expected
F	designates traffic flow breakdown where the traffic demand exceeds the capacity of the roadway; traffic can be at a standstill

Vehicle volume on roads is provided by TDOT in the form of estimated annual average daily traffic (AADT) counts. The 2020/2021 AADT counts for the primary roadways that would serve the CRN Site, presented in Table 3-33, are measured in vehicles per day (veh/day). LOS on these roadways was calculated for the most recent daily traffic volumes and ranged from LOS A to LOS B.

Table 3-33. Average Annual Daily Traffic Counts of Affected Roadways

Roadway Segment	2020/2021 Average Daily Vehicle Use (veh/day)[1]	Functional Classification	Number of Lanes	Existing Level of Service[2]
Bear Creek Road (TN 58 to TN 95)	383	Local	2	B
TN 58 (Clinch River to TN 95)	11,121	Principal Arterial	4	B
TN 95 (TN 58 to Clinch River)	6,047	Principal Arterial	2	B
TN 95 (Clinch River to I- 40)	5,599	Principal Arterial	2	B
TN 327 (TN 61 to TN 58)	2,569	Major Collector	2	B
I-40 (at TN 95)	39,707	Interstate	4	A

[1] Source: TDOT 2021a. Value shown is average of all available AADT data for area roadway segments.
[2] Source: based on criteria in FDOT 2020.

Capacity analyses were performed for the 10 intersections most likely to be affected by construction and operation of the Nuclear Technology Park at the CRN Site for 2021 AM and PM peak hours. These intersections and results of the capacity analysis for each are described below and in Table 3-34. The existing LOS for each intersection is depicted in Figure 3-18.

TN 58 at Bear Creek Road Ramp

This unsignalized intersection currently operates at an LOS B in the AM peak hour and an LOS B during the PM peak hour. No significant queuing is present at this intersection.

TN 58 at TN 327

This signalized intersection currently operates at an LOS B in the AM and PM peak hours. No significant queuing is present at this intersection.

Bear Creek Road at TN 58 Southbound Ramp

This unsignalized intersection currently operates at an LOS A in the AM and PM peak hours. In the AM peak hour, the major turning movement is the southbound left-turn from Bear Creek Road ramp onto Bear Creek Road. This movement is stop-controlled; however, low volumes on Bear Creek Road allow this stop-controlled intersection to operate with minimal delay. In the afternoon, most of the vehicles turn right onto Bear Creek Road ramp from Bear Creek Road. This movement operates under yield control with minimal delay. The west leg (Bear Creek Road) of this intersection carries minimal traffic because it is restricted to personnel entering the DOE's ORR as indicated on a sign. No significant queuing is present at this intersection.

TN 95 at TN 58 Northbound and Southbound Off-Ramps

This is a freeway interchange with free-flowing ramps for all movements. The ramp merging and diverging movements operate at LOS A at all times.

TN 95 at Bear Creek Road One Way Ramp

This unsignalized intersection is a one-way ramp from Bear Creek Road to TN 95 and operates at LOS B in the AM peak hour and LOS F in the PM peak hour. This serves as an exit option from Bear Creek Road to TN 95 northbound for traffic generated from the ORNL and the Y-12 National Security Complex. The intersection is over capacity (LOS F) in the PM peak hour due to the large volume of right turning westbound vehicles. There is also some queuing during that period within the westbound right turn.

TN 95 at Bear Creek Road

This unsignalized intersection currently operates at an LOS B in the AM peak hour (eastbound approach) and a LOS C during the PM peak hour (westbound approach). In the PM peak hour, the major turning movement is the westbound left-turn from Bear Creek Road onto TN 95 for traffic generated from the ORNL and the Y-12 National Security Complex. In the afternoon, most of the vehicles leaving the facilities use the one-way ramp described above located approximately 1,000 feet north of this intersection. Traffic volumes on movements to and from Bear Creek Road are very low and traffic is minimal along TN 95. This intersection is over capacity (LOS F) in the PM peak hour and there is some queuing during that period of the westbound left turn.

TN 95 at Bethel Valley Road

This signalized intersection currently operates at an LOS B in the AM and PM peak hours. No significant queuing is present at this intersection.

TN 95 at Buttermilk Road

This unsignalized intersection currently operates at LOS B in the AM peak hour and LOS C in the PM peak hour.

TN 95 at I-40 Westbound and Eastbound Ramps

This signalized diamond interchange consists of two signalized intersections that operate in coordination. The westbound ramp intersection (northern intersection) operates at LOS C in the AM peak hour and LOS B in the PM peak hour. The eastbound ramp intersection (southern intersection) operates at LOS B in the AM and PM peak hours.

Table 3-34. CRN Site Area Intersections Existing Conditions

Intersection	Description	Turning Movement	LOS
TN 58			
TN 58 at Bear Creek Road Ramp	Unsignalized T - Intersection (One-Way Stop)	Eastbound Left (Ramp to Northbound TN 58)	B
Bear Creek Road at TN 58 Southbound Ramp	Unsignalized T- Intersection (One-Way Stop)	Southbound Left (Ramp to Eastbound Bear Creek)	A
TN 95			
TN 58 Northbound and Southbound Off-Ramps to TN 95 Southbound	Freeway to Freeway Interchange	Merge	A
TN 95 Northbound to TN 58 Northbound and Southbound On-Ramps	Freeway to Freeway Interchange	Diverge	A
Bear Creek Road One Way Ramp at TN 95 Northbound	Unsignalized T -Intersection (One Way Stop)	Westbound Right	F
Bear Creek Road at TN 95 Northbound and Southbound	Unsignalized Four Leg Intersection (Two-Way Stop)	Westbound Left	F
TN 95 at Bethel Valley Road	Signalized 3-Leg Intersection	Various	B
Buttermilk Road at TN 95 Northbound and Southbound	Unsignalized T - Intersection (One Way Stop)	Eastbound Left from Buttermilk Road onto TN 95 North	C
TN 95 at I-40 Westbound Ramps	Signalized Freeway Ramp	Various	B
TN 95 at I-40 Eastbound Ramps	Signalized Freeway Ramp	Various	B

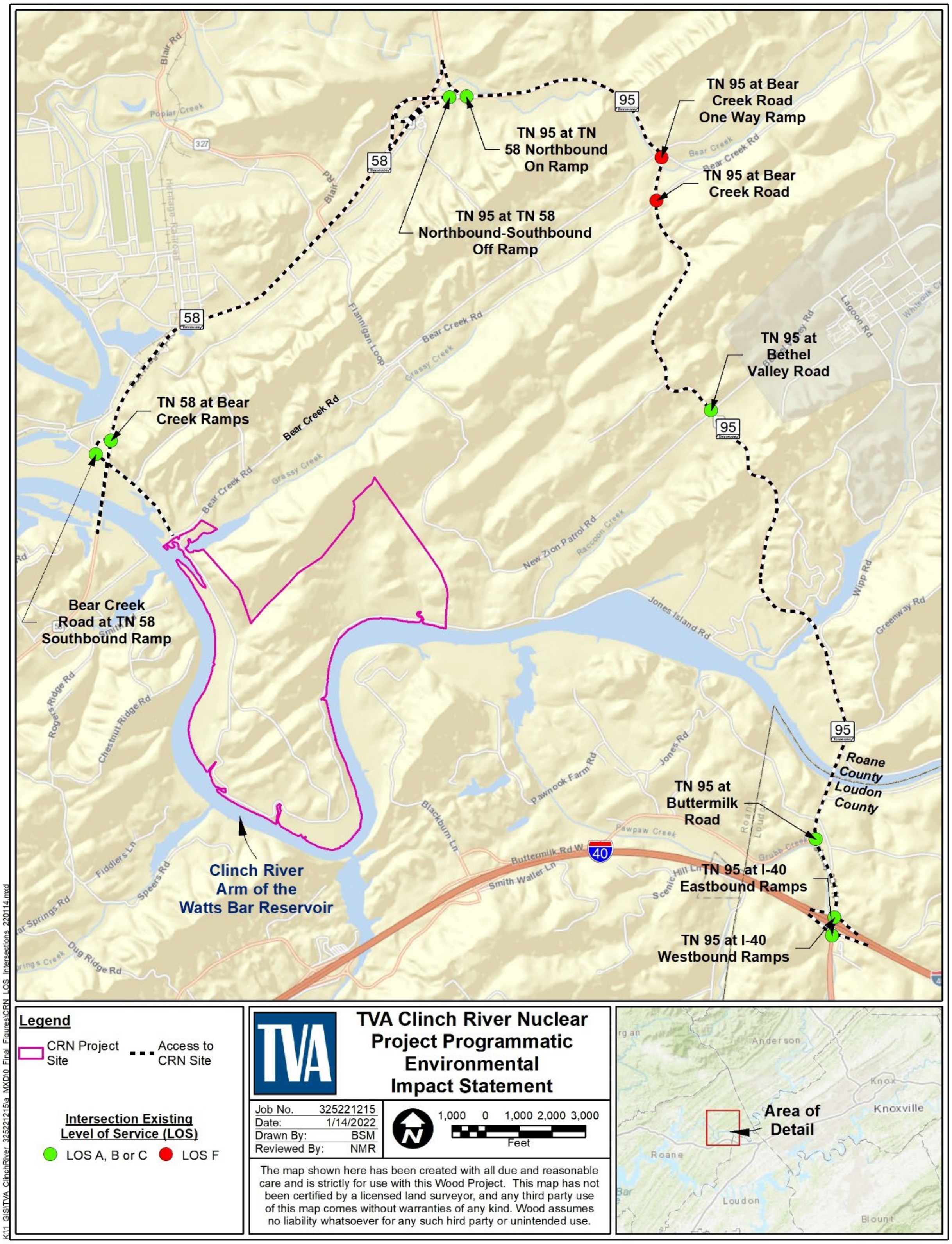

Figure 3-18. LOS at Existing Intersections Near the CRN Site

3.12.1.2.2 Traffic Crashes

The three primary roadways providing access to the CRN Site via Bear Creek Road are TN 58, TN 95, and TN 327. Crash data (from January 2019 through September 2021) were analyzed for segments of these three roadways to determine rates of traffic crashes for injury crashes, fatality crashes, and total crashes. Traffic crash data for the primary CRN Site roadways are presented in Table 3-35. Of the three roadways, TN 327 has the highest overall crash rate in annual crashes per million vehicle miles travelled (MVM) because the crashes occurred over a shorter and lower volume road. TN 95 has the lowest overall crash rate among the roadways near the CRN Site.

Table 3-35. Traffic Incident Rates in the Vicinity of the CRN Site (January 2019 to September 2021)

Incident Type	TN 58 (LM 17.60 to LM 20.18)	TN 95 (LM 0.00 to LM 6.70)	TN 327 (LM 0.00 to LM 2.20)
2021 Average Daily Traffic	11,121	6,047	2,569
Length (miles)	2.58	6.7	2.2
No. of Crashes (2019 to 2021)	29	36	14
No. of Injury Crashes (2019 to 2021)	6	11	3
No. of Fatality Crashes (2019 to 2021)	0	2	0
Overall Crash Rate per Year per 100 MVM	100.7	88.5	247.8
Injury Crash Rate per Year per 100 MVM	20.8	27.1	52.9
Fatality Crash Rate per Year per 100 MVM	0.0	4.9	0.0

LM = Log Mile, MVM = Million Vehicle Miles
Source: TDOT 2021b

3.12.1.3 Railroads

Figure 1-1 shows railways within the area surrounding the CRN Site. In Oak Ridge, Energy Solutions, LLC operates the 11.5-mile Heritage Railroad shortline serving the ETTP. This rail spur terminates at the rail offloading area to the northwest of the BTA, approximately 2.5 miles north-northwest of the CRN Site. A second shortline, operated by Knoxville and Holston River Railroad, extends 18 miles from Knoxville through Knox County. Both of these lines connect with rail lines operated by Norfolk Southern Railway Company. Norfolk Southern rail lines are located approximately 7.5 miles northwest and 9 miles southeast of the CRN Site. The line to the southeast runs through Knoxville, connecting Chattanooga with Johnson City and Kingsport, Tennessee.

3.12.1.4 Navigable Waterways

The CRN Site is immediately adjacent to the Reservoir between approximately CRMs 14.5 and 19. The Clinch River is a major tributary of the Tennessee River. The Tennessee River has a main navigable channel 652 miles long that begins at Knoxville and merges with the Ohio River in Paducah, Kentucky. This channel is controlled by a series of nine mainstream dams and locks that are part of TVA's integrated river control system consisting of a total of 49 dams and 15 navigation locks. Commercial navigation occurs on the Clinch River for 61 miles. The commercially navigable portion of the Clinch River extends from its mouth near Kingston, Tennessee upstream to Clinton, Tennessee. The navigable portion of the Clinch River includes a navigation lock at the Melton Hill Dam, 5 river miles north of the CRN Site.

3.12.1.5 Airports

The closest commercial airport to the CRN Site is the McGhee Tyson Airport in Alcoa, Tennessee. This airport is approximately 22.0 miles east-southeast of the CRN Site. Another smaller airport, the Knoxville Downtown Island Airport, is located in Knoxville. It is a reliever airport, designed to provide additional capacity for the McGhee Tyson Airport. Additionally, the Rockwood Municipal Airport is a public use airport in Roane County, located approximately 25 miles west of the CRN Site. As described in Section 3.1.3, the City of Oak Ridge, Tennessee is planning the development of a general aviation airport on the site of a large industrial complex, the ETTP, located approximately 3.5 miles north of the CRN Site. Although the final plans have not yet been completed, the airport conceptual layout includes a 5,000-foot runway which could be used by corporate jets, private airplanes, and Emergency Medical Service aircraft.

3.12.1.6 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions is expected to result in both construction phase and operational phase traffic generation that would increase traffic volumes on associated roadways. Specific foreseeable future actions that may contribute traffic to the roadways served by the CRN Project include the potential development of the Kairos Hermes Reactor Project, the development of the new airport by the City of Oak Ridge (both at the ETTP), the proposed construction of new production facilities at the Y-12 complex, and potential development at the Horizon Center Industrial Park. While the specific details regarding the scope of many of these actions is generally not available, each of these projects would potentially contribute both construction and operational phase traffic to the same regional roadway network surrounding the CRN Site. Because each of these actions has the potential to affect the same roadway network, further consideration of reasonably foreseeable future actions and their effects on the local transportation system are included in the following section as appropriate.

3.12.2 Environmental Consequences

3.12.2.1 Alternative A – No Action Alternative

Under the No Action alternative, TVA would not develop a Nuclear Technology Park at the CRN Site. As such under this alternative there would be no alteration of transportation facilities associated with the project. Therefore, there would be no impacts to transportation under Alternative A.

3.12.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

Existing transportation routes would be affected by the transportation of equipment, materials, supplies, and the construction workforce to the CRN Site. As stated above, the CRN Site can be accessed via roads, rail, and the Reservoir, and all transportation modes likely would be used during building activities. Large components and equipment could be transported by barge via the Tennessee and Clinch Rivers or by rail. TVA plans to refurbish the existing DOE barge facility in the BTA as described in Section 2.4.4.1 or may choose to construct an onsite barge landing area.

Under Alternative B, several roadway projects would be developed to accommodate workforce construction and operational traffic at the Nuclear Technology Park. These improvements are described in Section 2.4.1.2 and include the following as illustrated on Figure 3-19 and Figure 3-20:

- *Construction of New Ramps to Facilitate Access of Bear Creek Road and TN 58*. An additional northbound loop ramp between TN 58 and Bear Creek Road would be constructed to provide added capacity for the peak construction and operation traffic (Figure 3-19). This would allow traffic to/from the primary CRN Site entrance at Bear Creek Road to be distributed between two ramps rather than the existing configuration that includes one ramp.
- *Bear Creek Road Intersection with CRN Site Access*. The connection from the CRN Site access road onto Bear Creek Road would be improved to include a traffic signal with two receiving lanes onto Bear Creek Road (Figure 3-19). Bear Creek Road would also be realigned to a T-intersection, eliminating the existing curve at the CRN Site entrance, and would also be widened and upgraded to create a heavy haul road from the CRN Site entrance to the rail delivery area.
- *Improvements to the CRN Site Access Road*. These improvements would entail the upgrading of the existing roadway to a permanent heavy-haul road from the site entrance to the plant area (Figure 3-19). Eighty percent of construction and operation traffic at the CRN Site would use the upgraded highway interchange and primary access at Bear Creek Road to enter and exit the site.
- *New TN 95 Access*. In addition to improvements at the primary CRN Site entrance, a secondary entrance, the TN 95 Access, would be developed to accommodate approximately 20 percent of construction and operation traffic (Figure 3-20). The TN 95 Access would originate at the intersection of TN 95 and an existing gated entrance road to DOE property (See Section 2.4.1.2). The access road would then connect to Jones Island Road and River Road and traverse through DOE property along the shoreline of the Reservoir for a distance of approximately 2.3 miles to the CRN Site boundary. As shown in Figure 3-20, the intersection at Route 95 would be signalized and consist of left and right turning lanes.

Traffic capacity analysis modeling was used to determine the ability of roadways accessing the CRN Site to accommodate the influx of traffic associated with construction and operation at the Nuclear Technology Park. The capacity analysis was conducted using Synchro 10 software, which follows Transportation Research Board Highway Capacity Manual (HCM 2016) practices that are considered the national standard. The capacity analysis is based on a combination of peak construction employment, operation workforce, and baseline background traffic. The analysis considers 13 intersections shown in Figure 3-21, which include both existing and proposed intersections that are most likely to be affected by the CRN Nuclear Technology Park construction and operation traffic. Among the 13 intersections analyzed, ten are existing and three would be added as part of the project. The new intersections include the TN 58 northbound loop ramp at Bear Creek Road, a roundabout at the northbound ramp and Bear Creek Road, and a “T” intersection at Bear Creek Road and the CRN Site entrance.

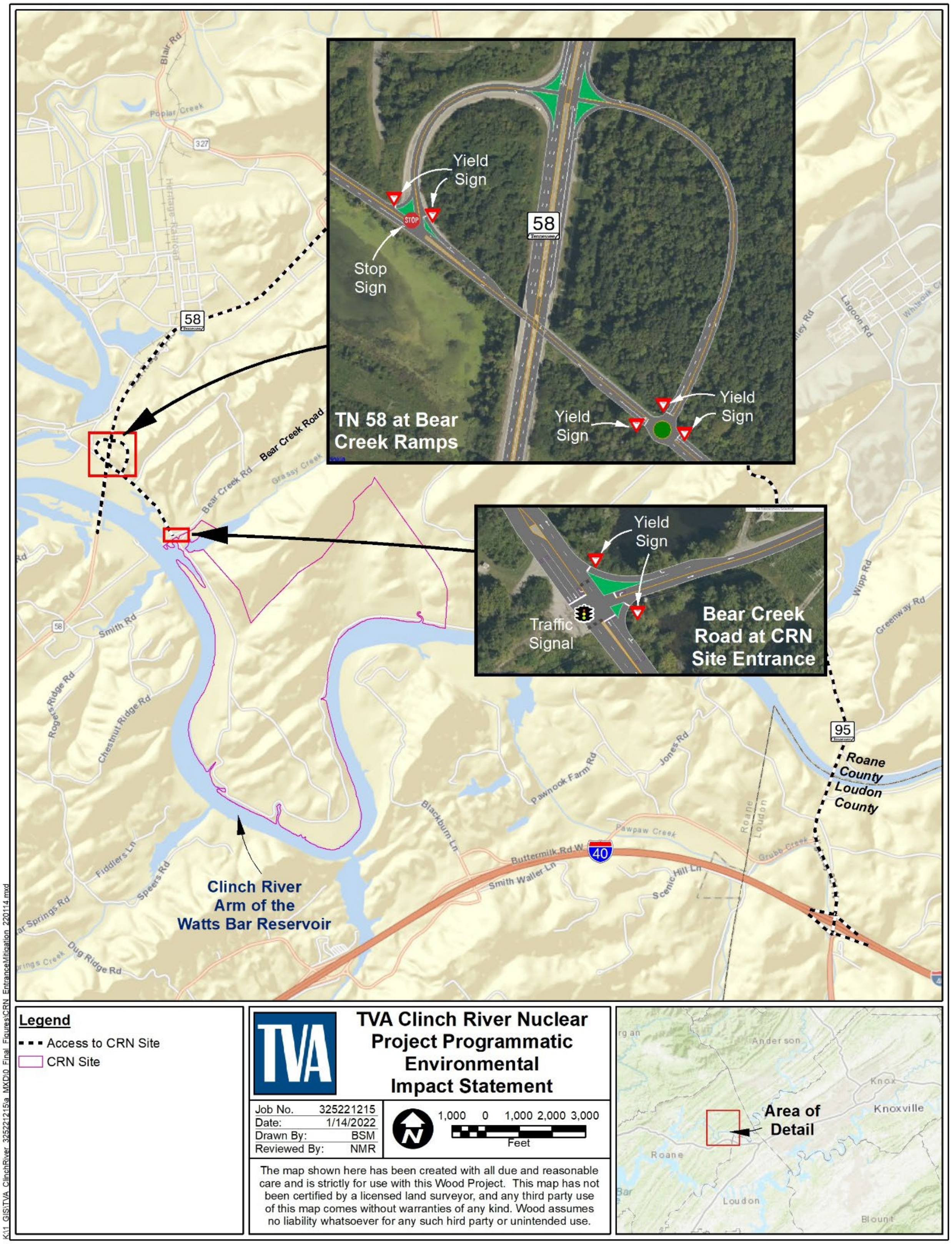

Figure 3-19. Proposed TN 58 and Bear Creek Road Improvements

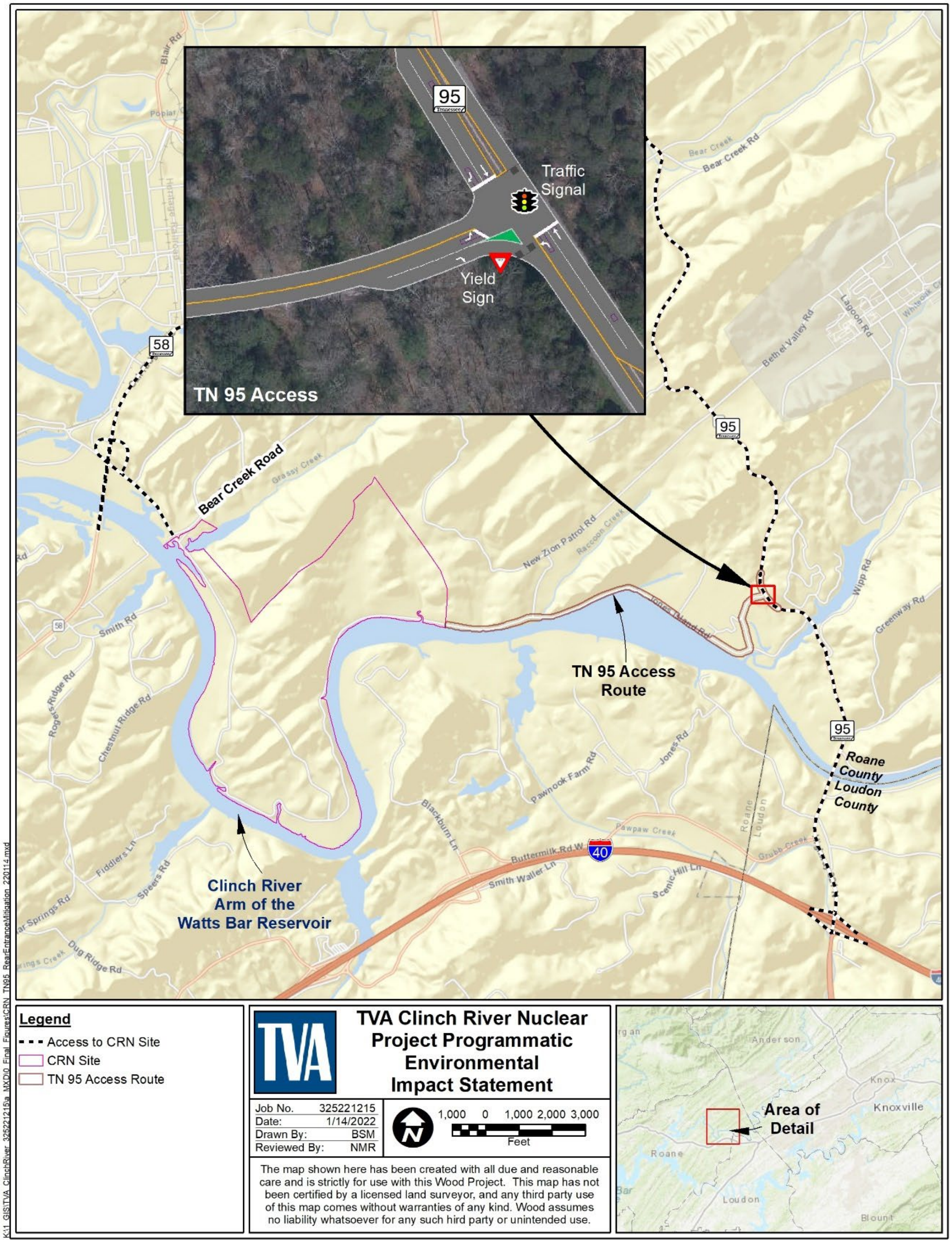

Figure 3-20. Proposed TN 95 Access Intersection

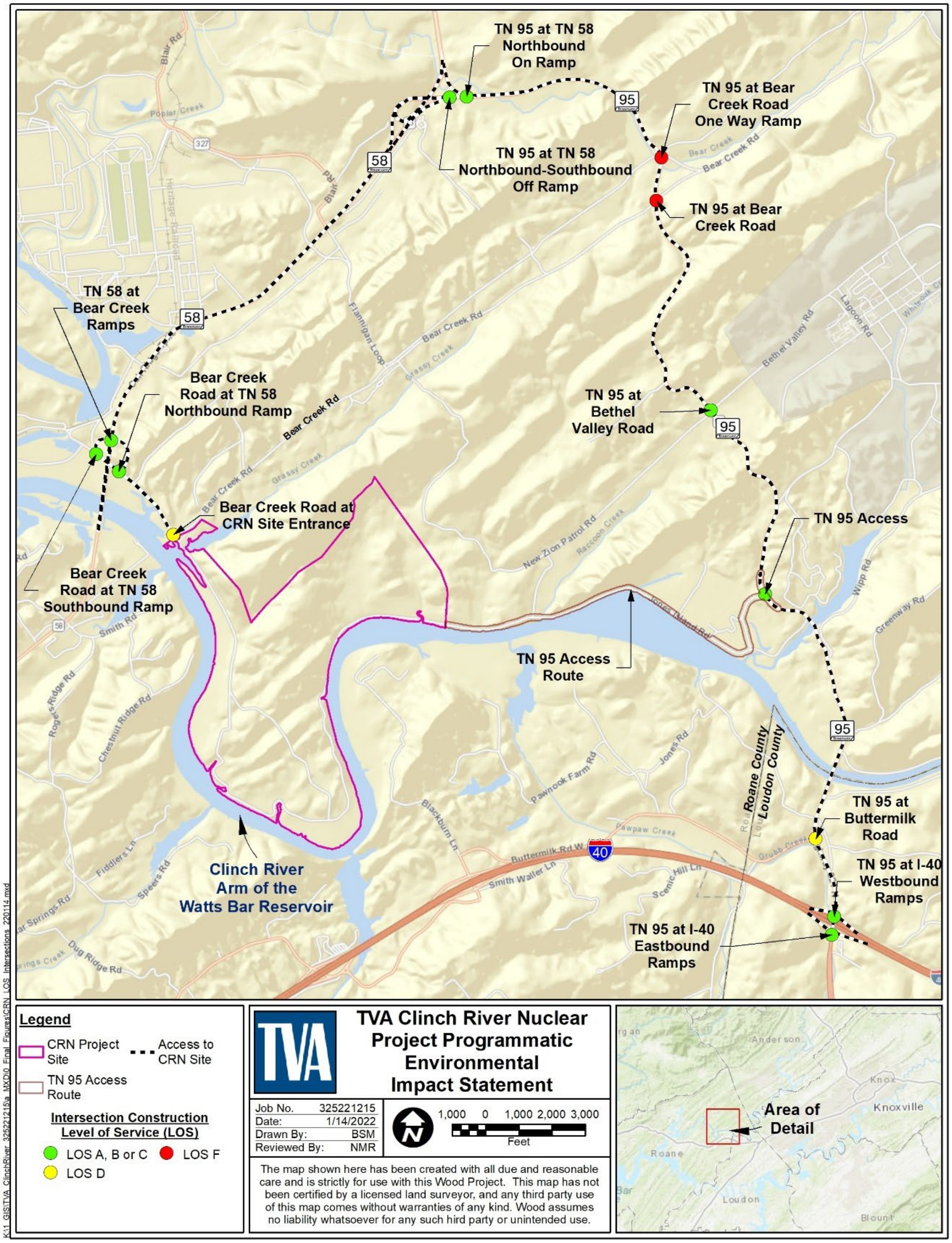

Figure 3-21. Construction Phase LOS at Key Intersections Near the CRN Site

Other assumptions used in the capacity analysis include the estimated daily workforce generated during CRN construction of 3,666 workers during the peak month of construction, which consists of 3,300 workers plus an additional 366 workers. It is also assumed that carpooling during construction would create an average of 1.3 persons per vehicle. In addition to workforce traffic, other construction-related trucking would include an estimated 30 trucks per hour during the ten-hour day shift workday. The day shift represents the worst-case scenario for construction traffic as 67 percent of the workforce would work this shift. Peak hourly traffic is estimated at 1,878 total workers arriving during the AM peak hour and departing during the PM peak hour in addition to the 30 trucks per hour of construction trucking. Based on these assumptions, 1,502 workers and 24 trucks per hour would use the Bear Creek entrance and 376 workers and 6 trucks per hour would use the TN 95 Access. These traffic levels were used to calculate the added traffic on the road network near the CRN Site and the associated impact on intersection capacity. Using the assumptions outlined above, the LOS at the intersections evaluated were determined for the peak construction traffic at the CRN Site. The analysis results are summarized in Table 3-36. The relative effects of Alternative B on the intersections evaluated is described below.

- *Bear Creek Road at TN 58*. Improvements at the connection of Bear Creek Road and TN 58 were proposed as a potential mitigative measure to offset potential impacts as part of the ESPA process. As discussed in Section 2.4.1.2 and above in this section, these improvements have been integrated into the proposed project plan and are therefore integrated into the impact assessment process (see Figure 3-19). As summarized in Table 3-36, the proposed action includes both intersection improvements and the construction of a new access ramp to provide an effective connection from Bear Creek Road to northbound TN 58. Each of these proposed improvements would either maintain or improve the existing LOS from A or B (indicative of a freeflow traffic condition). As such impacts associated with these improvements would be minor during construction and operation.
- *Bear Creek Road at CRN Site Entrance*. Improvements at the entrance of the CRN Site Access Road and the entrance to the CRN Site would be conducted to accommodate project staffing and deliveries of materials and equipment during construction. Improvements would facilitate traffic movements to/from Bear Creek Road north, but elevated traffic levels and delays would be evident during construction that would result in a LOS of D during the construction phase and a LOS of B during operation. Because 80 percent of the workforce is expected to use the primary entrance from Bear Creek Road, extensive delays and backups on Bear Creek Road entering the CRN Site would be evident, particularly during the peak hours associated with workforce shift changes. Impacts are therefore expected to be moderate during construction and minor during operation due to the reduced volume of workers and associated traffic.
- *TN 58 and TN 95 Interconnection*. Additional traffic associated with both construction and operational phases would utilize the existing interchange that serves the TN 58 and TN 95 interconnection. This interchange has an existing LOS of A and would continue to function in a free flow condition during both construction and operation. Impacts to this intersection are therefore minor.

Table 3-36. Project-Related Traffic Impacts at CRN Site Area Intersections

Intersection	Description	Turning Movement Evaluated	Existing LOS	Construction		Operation	
				Projected LOS	Impact	Projected LOS	Impact
TN 58							
TN 58 at Bear Creek Road Ramps	Unsignalized T-Intersection (One Way Stop)	Eastbound Left (Ramp to Northbound Rt 58)	B	A	Minor	A	Minor
Bear Creek Road at TN 58 Southbound Ramp	Unsignalized T Intersection (One Way Stop)	Southbound Left (Ramp to Eastbound Bear Creek)	A	A	Minor	A	Minor
Bear Creek Road at TN 58 Northbound Ramp	Roundabout	Southbound Left (Ramp to Eastbound Bear Creek)	NA (not developed under existing condition)	B	Minor	A	Minor
Access to CRN Site							
Bear Creek Road at CRN Site Entrance	Unsignalized T-Intersection (One-Way Stop)	Various	NA (access to CRN Site currently closed)	D	Moderate	B	Minor
TN 58 and TN 95 Interconnection							
TN 95 at TN 58 Northbound and Southbound Off-Ramps	Freeway to Freeway Interchange	Merge	A	A	Minor	A	Minor

Intersection	Description	Turning Movement Evaluated	Existing LOS	Construction: Projected LOS	Construction: Impact	Operation: Projected LOS	Operation: Impact
TN 95 at TN 58 Northbound On-Ramp	Freeway to Freeway Interchange	Diverge	A	A	Minor	A	Minor
TN 95 Access							
TN 95 at CRN Site TN 95 Access	Unsignalized T Intersection (One Way Stop)		NA (not developed under existing condition)	B	Minor	A	Minor
Local Road Access onto TN 95							
TN 95 at Bear Creek Road One Way Ramp	Unsignalized T Intersection (One Way Stop)	Westbound Right	F	F	Moderate	F	Minor
TN 95 at Bear Creek Road	Unsignalized Four Leg Intersection (Two Way Stop)	Westbound Left	F	F	Moderate	F	Minor
TN 95 at Bethel Valley Road	Signalized 3-Leg Intersection	Various	B	B	Minor	B	Minor
TN 95 at Buttermilk Road	Unsignalized T Intersection (One Way Stop)	Eastbound Left onto TN 95 North	C	D	Minor	C	Minor
I-40 Interchange							
TN 95 at I-40 Westbound Ramps	Signalized Freeway Ramp	Various	B	C	Minor	B	Minor
TN 95 at I-40 Eastbound Ramps	Signalized Freeway Ramp	Various	B	C	Minor	B	Minor

- *TN 95 Access*. The proposed TN 95 Access would allow for approximately 20 percent of both construction phase and operational phase traffic to exit the CRN Site onto local roadways. A signalized intersection and associated turning lanes would be installed at the proposed intersection to facilitate safe ingress/egress to/from the CRN Site (see Figure 3-20). Intersection LOS would be B during construction and A during operation. However, project related traffic on TN 95 would increase the volume of traffic on TN 95 that has the potential to increase delays on intersecting roadways as described below.
- *Local Road Access onto TN 95*. Several local roads that intersect with TN 95 would be affected by both construction phase and operational phase traffic. These include those at Bear Creek Road, Bethel Valley Road, and Buttermilk Road.
- Intersections associated with Bear Creek Road are currently rated as having an LOS of F (primarily due to high traffic volumes associated with ORR) that are associated with substantial delays for motorists accessing TN 95 from Bear Creek Road. These motorists would experience a reduced (worsened) condition during construction due to the increased traffic on TN 95. As such impacts of construction would exacerbate the existing LOS of F and result in additional delays. Impacts during construction at this location are therefore considered to be moderate. During operation, increased traffic on TN 95 is substantially less than that during construction, which would result in only a minor increase in delays. As such, impacts at this location during operation are minor.
- Increased project related traffic on TN 95 would also result in delays in access associated with Bethel Valley Road and Buttermilk Road. Impacts at these intersections during construction would typically be less than 10 seconds and are considered minor. Delays are less during operation and impacts are correspondingly reduced and minor.
- *I-40 Interchange*. Project related traffic using TN 95 is also expected to increase traffic on ramps associated with I-40. Although the LOS at TN 95 at the I-40 westbound and eastbound ramps would change from a LOS B to LOS C during construction, the increase in average vehicle delay at these signalized intersections is only five seconds and two seconds, respectively. Based on a lower level of CRN-related traffic during operation, the LOS of these ramps is expected to improve to LOS B. Therefore, impacts at this intersection are considered minor.

During construction, vehicular traffic volumes in the area would increase due to construction workers and delivery trucks driving to and from the CRN Site each day. Given the size of the increases in traffic volumes, construction activities at the CRN Site would increase the rate of degradation on some roads in the area, particularly TN 58 and Bear Creek Road in Roane County. These impacts could also result in localized roadway degradation and warrant increased maintenance that may also cause additional traffic congestion in some areas. Most road degradation would occur in Roane County. The physical impacts on roads would be noticeable where pavement is degraded, but it is not expected to occur on a widespread basis. TVA's payments to the state as a result of construction would increase to help compensate for road degradation. As such, these impacts are considered to be minor.

Additional increases in traffic and intersection delays may also occur during both the construction and operational phases for the CRN Project in conjunction with the reasonably foreseeable future actions described in Section 3.1.3. Depending on the timing of these projects and the intensity of traffic they generate, impact magnitude categories may increase relative to those included in Table 3-36.

3.12.2.2.1 Navigation Impacts

Transport of bulk materials or some components during construction may be expected to occur by barge that would use either the existing DOE offsite barge facility or the proposed supplemental onsite barge facility. However, barge traffic and access to the CRN Site would be spread out over time and appropriately conducted to minimize interference with existing navigation and boating operations on the Reservoir. Barge transport during the operational phase is expected to be infrequent. As such, impacts associated with navigation are minor.

3.12.2.2.2 Other Transportation Systems

Neither construction nor operational activities at the CRN Site would impact the operation of air or rail facilities in the vicinity of the CRN Site.

3.12.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

The impacts to transportation for Alternative C would be the same as those for Alternative B.

3.12.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

The impacts to transportation for Alternative D would be the same as those for Alternative B.

3.12.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.12.1.6, several reasonably foreseeable future actions were identified in proximity to the CRN Site. Depending on the local environmental setting and the design characteristics of these other proposed actions, direct increases or changes in traffic patterns would be expected. Several of the identified actions by others geographically intersect with the roadways affected by the proposed project and these other projects have the potential to increase demands on local roadways during both construction and operational phases. Example projects include the Kairos Hermes reactor project, proposed actions at ORNL, development of the Horizon Center, and the development of the municipal airport at the ETTP. As such, depending upon their specific timing, location and access to the primary arterial roadway system (e.g., TN 58, TN 95, I-40), these actions may result in notable increases in congestion and a reduced LOS at key intersections. Because increased traffic generation by the CRN project (and others) during construction is typically greater than that of operational phases, these reasonably foreseeable future projects have the potential to be more pronounced during the construction phase of the CRN Nuclear Technology Park. Regarding the potential development of the municipal airport at the ETTP, the NRC would require TVA to perform a design-specific assessment of the effects on the facility of the impact of a large commercial aircraft. TVA would ensure that each of the designs for the reactor technologies being considered for the CRN Site (SMRs and advanced non-LWRs) would follow the applicable requirements of 10 CFR 50.150 for Aircraft Impact Assessment (AIA). Additionally, 10 CFR 100.20(b) requires TVA to evaluate the nature and proximity of human-related hazards to establish site parameters for use in determining whether a plant design can accommodate commonly occurring hazards and whether the risk of other hazards is very low. The acceptability of a site depends on establishing that (1) an accident at a nearby facility will not result in radiological consequences that exceed the dose guideline in 10 CFR 50.34; (2) the accident poses no undue risk because it is sufficiently unlikely to occur; or (3) the nuclear power station can be designed so its safety will not be affected by the accident. As such the cumulative impacts of these projects is moderate during construction and potentially moderate during operation. Any site-specific impacts that are analyzed in the future that are expected to fall outside of the bounding analysis in this PEIS will be analyzed in subsequent NEPA analysis.

3.12.2.6 Summary of Impacts to Transportation

As summarized in Table 3-37, TVA has determined that impacts to transportation resulting from the alternatives would be minor with moderate impacts limited to localized intersections during construction.

Table 3-37. Summary of Impacts to Transportation

Alternative	Project Phase	Impact	Severity
B, C, D	Construction	Increased traffic due to workforce and associated construction activities. Improvements to key roadway intersections included in project design.	Impact generally minor with proposed improvements. Impacts moderate at Bear Creek Road and TN 95 due to increased traffic on TN 95. Impacts moderate at primary CRN Site access at Bear Creek Road intersection and on Bear Creek Road due to delays entering CRN Site during peak hours
		Transport of bulk materials or some components during construction would use either the existing DOE offsite barge facility or the proposed supplemental onsite barge facility.	Barge traffic and access to the CRN Site would be properly managed to reduce impacts on navigation. Impacts are minor. Moderate cumulative impacts.
B, C, D	Operation	Increased traffic due to workforce and associated operational activities, but substantially less than that during construction. Improvements to key roadway intersections included in project design.	Impact minor with proposed improvements at all locations. Increased traffic on TN 95, but notably less than that observed during construction. Therefore, impacts of delays at Bear Creek Road and TN 95 are minor. Impacts minor at primary CRN Site access at Bear Creek Road intersection and on Bear Creek Road. Moderate cumulative impacts.
		Barge operations infrequent.	Impacts minor.

3.13 Visual Resources

3.13.1 Affected Environment

This assessment provides a review and classification of the visual attributes of existing scenery, along with the anticipated attributes resulting from the proposed action. The classification criteria used in this analysis are adapted from a scenic management system developed by the U.S. Forest Service (USFS) and integrated with planning methods used by TVA (USFS 1995). Potential visual impacts to cultural and historic resources are not included in this analysis as they are assessed separately in Section 3.17.

The visual landscape of an area is formed by physical, biological, and man-made features that combine to influence both landscape identifiability and uniqueness. The scenic value of a particular landscape is evaluated based on several factors that include scenic attractiveness, scenic integrity, and visibility. Scenic attractiveness is a measure of scenic quality based on human perceptions of intrinsic beauty as expressed in the forms, colors, textures, and visual composition of each landscape. Scenic attractiveness is expressed as one of the following three categories: distinctive, common, or minimal. Scenic integrity is a measure of scenic importance based on the degree of visual unity and wholeness of the natural landscape character. The scenic integrity of a site is classified as high, moderate, low, or very low. The subjective perceptions of a landscape's aesthetic quality and sense of place are dependent on where and how it is viewed.

Views of the landscape are described in terms of what is seen in the foreground, middleground, and background distances. In the foreground, an area within 0.5 miles of the observer, details of objects are easily distinguished. In the middleground, from 0.5 miles to 4 miles from the observer, objects may be distinguishable, but their details are weak and tend to merge into larger patterns. In the distant part of the landscape, the background, details and colors of objects are not normally discernible unless they are especially large, standing alone, or have a substantial color contrast. In this assessment, the background is measured as 4 to 10 miles from the observer. Visual and aesthetic impacts associated with an action may occur as a result of the introduction of a feature that is not consistent with the existing viewshed. Consequently, the visual character of an existing site is an important factor in evaluating potential visual impacts.

For this analysis, the affected environment includes the areas within the CRN Site that encompass both permanent and temporary impact areas, as well as associated offsite improvement areas. The CRN Site is bounded on three sides (south, east, and west) by the Reservoir and bounded to the northeast by ORR. The topography in the vicinity of the CRN Site is characterized by parallel elongated ridges and valleys that run from northeast to southwest. The difference in height between the valleys and ridges is generally about 300 to 350 feet, and the ridges have steep profiles, often steeper than 45 degrees. The topography of the CRN Site was previously altered during construction related to the CRBRP, as shown in the grading and excavation photos in Figure 3-22. Approximately 240 acres of the CRN Site were extensively disturbed by the CRBRP, including the removal of approximately 3 million cubic yards of earth and rock. This excavation area was partially backfilled following project termination and has become sparsely revegetated over the intervening years, currently covered by open areas of herbaceous vegetation and scattered eastern red cedars. However, the excavation area remains a prominent feature in the landscape due to the notable topographic contrast. The remainder of the CRN Site topography includes both steep wooded hills and flat meadows, with elevations that range

Figure 3-22. CRBRP Grading and Excavation

from approximately 745 feet AMSL at the shoreline of the Reservoir to approximately 940 feet AMSL in the northern portion of the CRN Site. Vegetation covering the CRN Site outside of the previously disturbed areas is dense and consists of a mixture of mature hardwood forest, stands of evergreen trees, and shrubs.

Views of the CRN Site from surrounding areas beyond the river valley to the east, south, and west are characterized by the waters within the winding channel of the Reservoir; forested shorelines, bluffs, and ridges; and areas of old fields in the south-central portion of the CRN Site affected by the earlier CRBRP. Views of the CRN Site from the north are blocked by Chestnut Ridge. The areas across the river, to the east, south, and west of the CRN Site, are rural and sparsely populated. The principal aesthetic disturbances on the CRN Site when viewed from the areas across the river are the two TVA transmission lines that cross the CRN Site. The transmission lines are minor visual intrusions that can be seen from most locations in the foreground and middleground distances. Smaller structures currently present on the CRN Site, such as the construction trailers, are also minor intrusions on the landscape as they are relatively unobtrusive and small in comparison to the overall landscape. Views of the CRN Site from the adjacent portion of the Reservoir are dominated by the forested riparian zone, which is only interrupted in the two locations where the transmission line ROW corridors cross the river. The view of the CRN Site from higher surrounding areas also includes the Reservoir and agricultural fields associated with the floodplain in the foreground to middleground, and forested hills in the background.

In a visual impact assessment, sensitive receptors generally include any scenic vistas, scenic highways, residential viewers, and public facilities such as churches, cemeteries, schools, parks, and recreational areas that are located in the project’s viewshed. However, because the areas immediately surrounding the CRN Site are bounded by water features, forests, and ridge lines, direct views of the CRN Site are generally limited to onsite workers and visitors, recreators using the Reservoir, and residents living in close proximity across the Reservoir to the east, south, and west. The closest residences to the CRN Site are located on Blackburn Lane, approximately 850 feet east-northeast of Area 1 and 1,500 feet south of Area 2. The proposed project would also be in the foreground of visitors to the Hensley Cemetery, which is located on the CRN Site. However, the cemetery is on lower ground than Area 1, and is surrounded by trees and vegetation which provide visual screening that would be retained during site development. Overall, scenic visibility of the CRN Site from surrounding areas is considered moderate.

Land uses in the areas surrounding the CRN Site generally are rural, agricultural, or undeveloped. The ORR adjoining the CRN Site to the northeast is predominantly undeveloped. The ORR was acquired by the federal government in the 1940s and since then, the majority of the reservation has reverted from agricultural fields to forest. However, there are several notable industrial developments located in the immediate vicinity of the CRN Site, including:

- Clinch River Industrial Park, located north adjacent to the CRN Site and Grassy Creek HPA, on Bear Creek Road;
- ETTP/Heritage Center Industrial Park, approximately 1 mile to the north;
- ORNL, approximately 2.5 miles to the east; and
- Roane Regional Business and Technology Park, approximately 0.5 miles to the southeast.

Scenic views are common in the area surrounding the CRN Site and typically include contrasts between features such as forested ridges and relatively flat valleys, including agricultural fields and reservoirs. The aesthetic appeal of the scenery in the area derives predominantly from a natural landscape that provides ample opportunities for visual appreciation, with relatively limited visual interruptions due to industrial and other highly developed areas. The thickly forested slopes and valleys help to obscure and soften the appearance of the industrial areas.

Based on the above characteristics, the scenic attractiveness of the affected environment at the CRN Site is considered to be common, whereas the scenic integrity is considered to be moderate. The rating for scenic attractiveness is based on the ordinary or common visual quality of the landscape, with generally positive but typical attributes and a basic variety of forms, colors, and textures that are commonly seen in the surrounding landscape and are not considered to have distinctive visual quality. The scenic integrity of the site is moderate; while minor human alterations can be seen in the foreground, the deviations are subordinate to the overall landscape and largely natural in appearance. The scenic class of a landscape is determined by combining the levels of scenic attractiveness, scenic integrity, and visibility and can be excellent, good, fair, or poor. Based on the criteria used for this analysis, the overall scenic class for the affected environment at the CRN Site is considered to be good.

3.13.1.1 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of the visual attributes of the landscape surrounding their respective project areas. However, the specific details regarding the scope of these actions are generally lacking. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on visual resources are included in TVA’s analysis.

3.13.2 Environmental Consequences

The potential impacts to the visual environment from a given action are assessed by evaluating the potential for changes in the scenic value class ratings based upon landscape scenic attractiveness, integrity, and visibility. Sensitivity of viewing points available to the general public, their viewing distances, and visibility of the proposed action are also considered during the analysis. These measures help identify changes in visual character based on commonly held perceptions of landscape beauty and the aesthetic sense of place. The extent and magnitude of visual changes that could result from the proposed alternatives were evaluated based on the process and criteria outlined in the scenic management system as part of the environmental review required under NEPA.

3.13.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, a Nuclear Technology Park would not be constructed or operated at the CRN Site and landscape character and integrity would remain in its current state. Therefore, there would be no impact to visual resources.

3.13.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.13.2.2.1 Construction

Implementation of Alternative B would result in both permanent and temporary visual impacts associated with construction activities in Area 1, designated laydown areas, and associated onsite and offsite areas for development and improvement of infrastructure for barge access, roadways, and transmission systems (see Figure 2-1). During the construction period, there would be increased visual discord from existing conditions due to an increase in personnel and equipment coupled with disturbances from land clearing, grading, cut and fill activities, and facility construction. As these activities would generally be limited to the immediate vicinity of the project footprint, and because the areas immediately surrounding the CRN Site are bound by water features, forests, and ridge lines, most construction activities would not be visible to the general public. However, construction of advanced nuclear reactors would entail the use of large cranes, the largest of which is expected to be a heavy lift crane with a height of 638 feet. This would generally be visible over the tree line from local roadways near the CRN Site. Additional activities such as use of large earth-moving equipment; the transportation of large materials onto the CRN Site; transmission line modifications and switchyard construction; and intersection improvements at the BTA and TN 95 access, would likely be visible to members of the public on surrounding roadways and/or to residents located across the Reservoir to the east, south, and west. Additionally, nighttime lighting could be used during construction if work is to take place at night and for security purposes, which may be within the viewshed of residents in the surrounding area.

Project-related construction activities would also be visible to recreational users of the Reservoir and the Gallaher Recreation Area. Construction activities would be most noticeable to these groups during bank stabilization activities and while the intake and discharge structures are being built. Additionally, in conjunction with Alternative B, a portion of the existing 161-kV transmission line located on the CRN Site may be re-routed to the east, closer to the Reservoir. This would entail removing most of the vegetative buffer from the east side of the peninsula. The new transmission towers and cleared corridor would be visible from the Reservoir and a small group of residences across from the CRN Site. Given the presence of the existing transmission lines in the area and on Area 1, the effect of the project-related construction on nearby residents and recreational users would be noticeable but would not significantly alter the character of the landscape.

Overall, given that visibility of the CRN Site is limited by topography and that impacts of construction activities on visual resources would be localized, visual impacts to the general public would be minor. For nearby residents and recreational users of the Reservoir, which would have more direct views of the CRN Site, visual impacts of construction would be moderate.

3.13.2.2.2 Operation

Long-term visual impacts resulting from the development and operation of the CRN Nuclear Technology Park at Area 1 would include visible alterations to the existing landscape associated with one or more reactors, as well as supporting infrastructure including cooling towers and maintenance of cleared transmission line ROW corridors. Per the ESPA PPE (Appendix A), the minimum site grade in the power block area would be 821 feet AMSL, with the tallest power block structure up to 160 feet above grade and the mechanical draft cooling towers up to 65 feet above grade.

Renderings were completed for the ESPA ER, using baseline photographs from various observation points and plant design parameters from the PPE to estimate potential visual impacts associated with operation of the CRN Nuclear Technology Park at Area 1. The renderings depict the tallest facility structure visible from specific locations. Overall, the renderings show that the CRN facility would be well screened by the riparian trees from most locations. While the major buildings of the facility would be visible from some sensitive receptors in the foreground of the CRN Site, including recreationists on the Reservoir and a small number of residents living along the Reservoir, views from residences would be somewhat screened by trees. The surrounding hills would also help to soften the industrial aspects of the view because they are larger than the facility and make it seem smaller and less imposing. From a distance of approximately 2 miles, the CRN Nuclear Technology Park structures would not be visible from most viewpoints.

Apart from the facility structures themselves, a dominant visual feature resulting from the operation of the CRN Nuclear Technology Park would be the cooling tower plume. Plume height depends on weather conditions and wind; longer plumes generally occur with colder temperatures and when the atmosphere is more saturated. Based on SACTI modeling predictions, visible cooling tower plumes at the CRN Site would not go beyond 300 meters (984 feet) from the towers more than three percent of the time for any wind direction. So, while the facility buildings would generally not be visible from distances greater than 2 miles, cooling tower plumes, when present, may draw the observer’s attention to the facility from greater distances, inserting an industrial aspect to a mostly natural landscape. The plume impacts would be larger on a clear, cloudless day than on an overcast day. Therefore, the visual intrusion due to operation of the CRN Nuclear Technology Park would range from minor to moderate, depending on the location of the observer and the atmospheric conditions.

Additionally, views of the proposed project from the Hensley Cemetery, located on Area 1 of the CRN Site, are expected to be minimal because the cemetery is surrounded by vegetation and trees which provide visual screening. TVA intends to maintain the grounds and would avoid the cemetery during operation and maintenance activities. The cemetery would remain accessible to those individuals that have family members buried at Hensley Cemetery.

The meandering river channel and forested hills in the vicinity of the CRN Site contribute to the landscape’s ability to absorb negative visual change. Therefore, while the forms, colors, and textures of the landscape that make up the scenic attractiveness would be notably altered by the construction of the CRN Nuclear Technology Park and associated components, it would remain common or ordinary. Scenic integrity would be reduced from moderate to low, as visually disruptive human alterations such as the power block structures, cooling towers, vapor plume, and transmission systems would become prominent elements of the landscape. Based on the criteria used for this analysis, the scenic value class for the affected environment after the proposed modifications would be reduced from good to fair. While Alternative B would contribute to a decrease in visual integrity of the landscape at foreground and middleground distances, impacts would be minimal at background distances. The existing scenic class would not be reduced by two or more levels, which is the threshold of significance of impact to the visual environment.

Therefore, overall visual impacts resulting from the implementation of the Alternative B would be minor to moderate depending on location of the observer.

3.13.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C, a Nuclear Technology Park would be constructed on Area 2 of the CRN Site (see Figure 2-2). Impacts to visual resources would be similar to those discussed under Alternative B because construction activities, the offsite area improvements, and the reactor and cooling tower specifications and design parameters would be consistent with that described above. The site grade in the power block area (821 feet AMSL) and the maximum structure heights would be the same as those noted under Alternative B, resulting in a similar profile and visibility. Because Area 2 is located northeast of Area 1 and is set back further from the Reservoir, it would be less visible to sensitive receptors to the south and west of the CRN Site. However, for recreators and a small number of residences located southeast of the CRN Site, the clearing, grading, and development of the currently forested Area 2 would result in notable viewshed changes. Additionally, under Alternative C, the 161-kV transmission line would not be re-routed, so there would be no construction-related impacts associated with the establishment of a new transmission line along the eastern edge of the CRN Site, nor long-term intrusion associated with the maintenance of a cleared ROW corridor. Additional impact analyses for construction and operations at Area 2 would be further analyzed in future, supplementary NEPA analyses. Thus, while the impacts of Alternative C are anticipated to be somewhat less than that of Alternative B, the scenic value class of the affected environment would still be reduced from good to fair, resulting in minor to moderate impacts to visual resources depending upon the location of the observer.

3.13.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, impacts would be greater than those under Alternatives B and C because the Nuclear Technology Park would be spread over both Areas 1 and 2 (see Figure 2-3), creating visual discord over a larger portion of the CRN Site. Although the facilities would have the same bounding design parameters, impacts would be somewhat greater than those of Alternatives B and C due to the larger area of disturbance. However, the scenic value class of the affected environment would still be reduced to fair based on the ability of the landscape topography to absorb the negative change, resulting in minor to moderate impacts to visual resources depending upon the location of the observer.

3.13.2.5 Summary of Impacts to Visual Resources

As summarized in Table 3-38, visual resource impacts related to the construction and operation of a Nuclear Technology Park at the CRN Site would be minor to moderate.

Table 3-38. Summary of Impacts to Visual Resources

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Temporary visual discord onsite and in associated offsite areas due to land disturbances and an increase in personnel and equipment. Limited visibility to general public due to rural location and terrain.	Impacts to visual resources would be minor for the general public and moderate for a small number of adjacent residents and recreators. Based on visibility and area of disturbance, the magnitude of impact is as follows: Alternative D greater than Alternative B, which is greater than Alternative C.
	Operation	Introduction of industrial features, including a cooling tower plume, into the existing natural landscape, reducing scenic integrity. Visibility limited by forested, hilly terrain and low number of nearby visual receptors.	Impacts to visual resources would be minor to moderate based on atmospheric conditions and the location of the observer. Based on visibility and area of disturbance, the magnitude of impact is as follows: Alternative D, greater than Alternative B, which is greater than Alternative C.

3.14 Noise

3.14.1 Affected Environment

Noise is unwanted or unwelcome sound usually caused by human activity and added to the natural acoustic setting of a locale. It is further defined as sound that disrupts normal activities or diminishes the quality of the environment. Community response to noise is dependent on the intensity of the sound source, its duration, the proximity of noise-sensitive land uses, and the time of day the noise occurs.

Sound is measured in logarithmic units called decibels (dB). Given that the human ear cannot perceive all pitches or frequencies of sound, noise measurements are typically weighted to correspond to the limits of human hearing. This adjusted unit of measure is known as the dBA, which filters out sound in frequencies above and below human hearing. A noise level change of 3 dBA or less is barely perceptible to average human hearing. However, a 5 dBA change in noise level is clearly noticeable. The noise level associated with a 10 dBA change is perceived as being twice as loud; whereas the noise level associated with a 20 dBA change is considered to be four times as loud and would therefore represent a “dramatic change” in loudness.

To account for sound fluctuations, environmental noise is commonly described in terms of the equivalent sound level. The equivalent sound level is the constant noise level that conveys the same noise energy as the actual varying instantaneous sounds over a given period. Fluctuating levels of continuous, background, and/or intermittent noise heard over a specific period are averaged as if they had been a steady sound. The day-night sound level (L_{dn}), expressed in dBA, is the 24-hour average noise level with a 10-dBA correction penalty for the hours between 10 p.m. and 7 a.m. to account for the increased sensitivity of people to noises that occur at night. Typical background day-night noise levels for rural areas are anticipated to range between an L_{dn} of 35 and 50 dBA, whereas higher-density residential and urban areas background noise levels range from 43 dB to 72 dBA (EPA 1974). Common indoor and outdoor noise levels are listed in Table 3-39.

Table 3-39. Common Indoor and Outdoor Noise Levels

Common Outdoor Noises	Sound Pressure Levels (dB)	Common Indoor Noises
	110	Rock Band at 5 m (16.4 ft)
Jet Flyover at 300 m (984.3 ft)		
	100	
		Inside Subway Train (New York)
Gas Lawn Mower at 1 m (3.3 ft)		
	90	
		Food Blender at 1 m (3.3 ft)
Diesel Truck at 15 m (49.2 ft)		Garbage Disposal at 1 m (3.3 ft)
	80	
		Shouting at 1 m (3.3 ft)
Gas Lawn Mower at 30 m (98.4 ft)	70	Vacuum Cleaner at 3 m (9.8 ft)
Commercial Area		Normal Speech at 1 m (3.3 ft)
	60	
		Large Business Office
	50	Dishwasher Next Room
Quiet Urban Daytime		
	40	Small Theater, Large Conference Room
Quiet Urban Nighttime		Library
Quiet Suburban Nighttime		
	30	
		Bedroom at Night
Quiet Rural Nighttime		Concert Hall (Background)
	20	
		Broadcast and Recording Studio
	10	
		Threshold of Hearing
	0	

Source: Arizona DOT 2008

The perceived loudness or intensity between a noise source and a receptor may change because of distance, topography, vegetation, water bodies, and structures. The closer a receptor is to a noise source the louder the noise seems; for every doubling of distance from a source the intensity drops by about 6 dBA over land and about 5 dBA over water. Topography, vegetation, and structures can change noise intensity through reflection, absorption, or deflection. Reflection tends to increase the intensity, while absorption and deflection tend to decrease the intensity.

The City of Oak Ridge has established quantitative noise level limits based on adjacent property uses, as codified in Article XII of the City's Zoning Ordinance. Properties adjacent to the CRN Site consist of the Clinch River Industrial Park on the north side and the ORR on the east side. The Reservoir is adjacent to the remainder of the CRN Site, with the nearest residential areas located on the opposite bank. Oak Ridge's most stringent guidelines apply to properties with adjacent residential uses, setting a maximum noise limit of 80 dBA during the hours of 7:00 a.m. to 10:00 p.m. and a maximum of 75 dBA between 10:00 p.m. and 7:00 a.m. Additionally, during the hours of 7:00 a.m. to 10:00 p.m., the sound level should not exceed 65 dBA for more than 50 percent of a one-hour survey period or 70 dBA for more than 10 percent of a one-hour survey period. From 10:00 p.m. to 7:00 a.m., the sound level should not exceed 55 dBA for more than 50 percent of a one-hour survey period or 60 dBA for more than 10 percent of a one-hour survey period. These restrictions are specific to outdoor spaces, at the lot boundary (City of Oak Ridge 2020).

Neither Roane County nor the State of Tennessee have developed noise regulations that specify acceptable community noise levels. However, EPA noise guidelines recommend outdoor noise levels in public use areas do not exceed L_{dn} of 55 dBA, which is sufficient to protect the public from the effect of broadband environmental noise in typical outdoor and residential areas. These levels are not regulatory goals but are "intentionally conservative to protect the most sensitive portion of the American population" with "an additional margin of safety" (EPA 1974). The U.S. Department of Housing and Urban Development (HUD) considers an L_{dn} of 65 dBA or less to be compatible with residential areas (HUD 1985).

3.14.1.1 Noise Receptors
Sensitive noise receptors include residences or other developed sites where frequent human use occurs, such as churches, schools, cemeteries, and facilities for outdoor or community use (e.g., parks, libraries, and community centers). Based on site reconnaissance conducted during the preparation of the ESPA and updated via review of recent aerial photography and maps, locations with potential noise sensitivity within a 1-mile radius of the CRN Site boundary were identified. The sensitive receptors are shown in Figure 3-23 and include approximately 150 residences, one private school, eight cemeteries, and three facilities for outdoor/community use. The facilities include Gallaher Recreation Area to the west of the CRN Site, and the Bradbury Community Center and Soaring Eagle Campground to the south.

Apart from the Hensley Cemetery, which is located on the CRN Site, the closest sensitive noise receptors are residences located on Blackburn Lane, approximately 850 feet east-northeast of Area 1 and 1,500 feet south of Area 2. Other potential noise receptors include recreators on the Reservoir that boat in the waters adjacent to the CRN Site.

3.14.1.2 Ambient Noise Levels
In July and December of 2013, as part of the ESPA, a noise assessment was conducted to establish typical ambient noise levels at and in the area surrounding the CRN Site. Nine sampling locations were selected to provide a general representation of ambient sound levels within the local area that surrounds the CRN Site. Two sampling locations (Noise Sampling Locations 1 and 2 in Figure 3-23) were within the CRN Site boundary. Additional sampling locations were selected to represent the surrounding community, including Noise Sampling Locations 3 through 8 in Figure 3-23. An additional noise sampling location was established at the Melton Hill Dam Recreational Area approximately 4 miles east of the CRN Site (see Figure 3-17).

Based on data collected from these locations in 2013, typical onsite sound levels ranged between 46 and 48 dBA during the daytime and between 41 and 49 dBA during the nighttime. The L_{dn} ranged between 49 and 55 dBA. Offsite sound levels ranged between 42 and 63 dBA during the daytime and between 35 and 58 dBA during the nighttime. The offsite L_{dn} ranged between 51 and 64 dBA. Ambient noise within the CRN Site and the surrounding local community was observed to come from various sources including vehicle traffic, bioacoustical sources (i.e., general wildlife, livestock, birds, insects, and humans), the natural environment (i.e., wind through foliage and rain) and mechanical sources (i.e., construction/industrial equipment, farming equipment, and watercraft/boating).

There have been no large-scale development or land use changes in the areas surrounding the CRN Site or on the CRN Site itself that would result in significant changes to ambient noise levels reported in the 2013 noise assessment. Therefore, noise levels obtained during the 2013 survey continue to be representative of current ambient noise levels.

3.14.1.3 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail the alteration of ambient noise levels within their respective project areas. However, the specific details regarding the scope of these actions are lacking. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area, and noise emissions from each of these potential foreseeable future actions would attenuate to minimal levels over distance such that there would not be an aggregately greater effect with the construction or operation of the CRN Nuclear Technology Park. None of these actions are considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on noise are included in TVA's analysis.

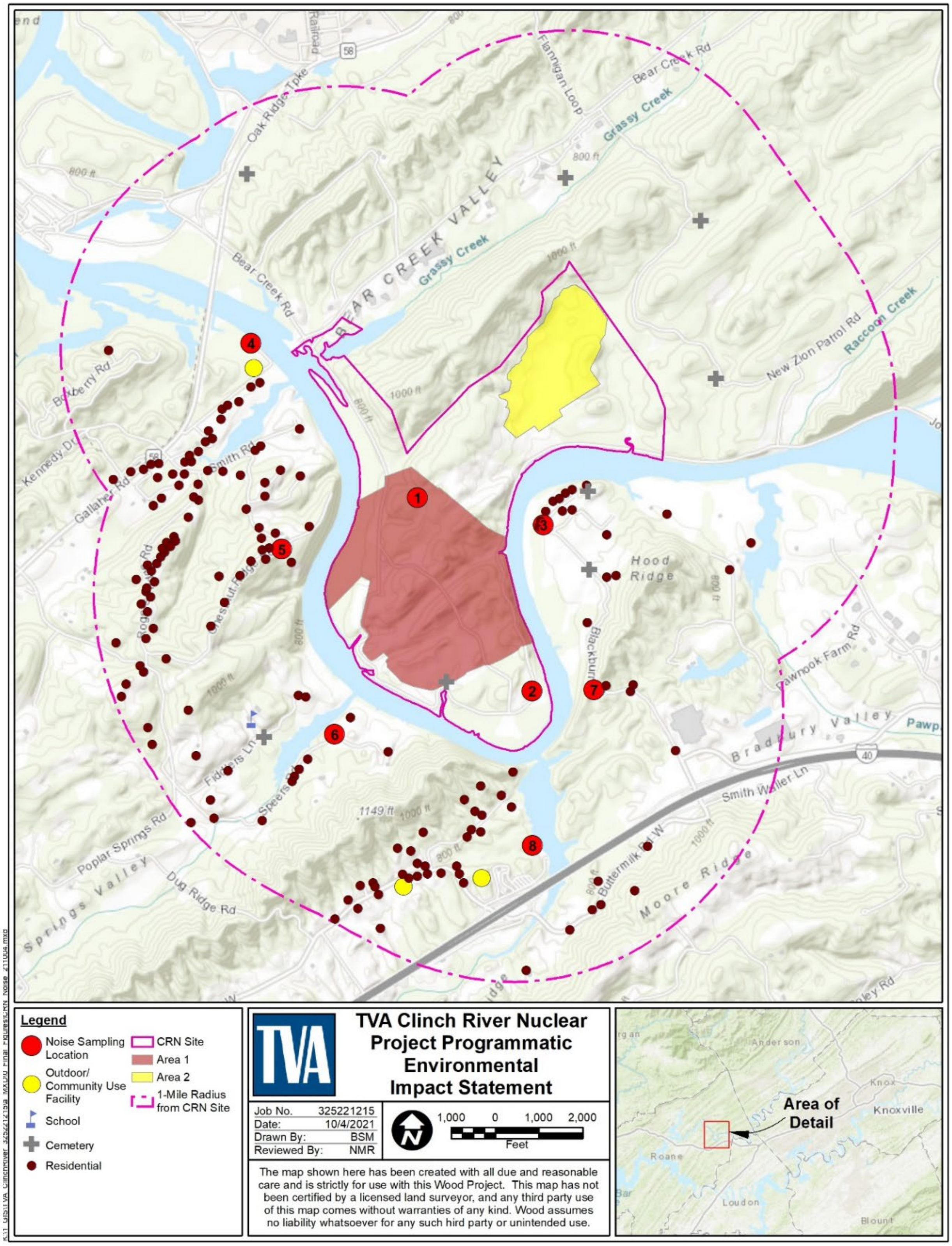

Figure 3-23. Noise Sampling Locations and Sensitive Receptors Within a 1-Mile Radius of the CRN Site

3.14.2 Environmental Consequences

3.14.2.1 Alternative A – No Action Alternative

Under Alternative A, TVA would not construct or operate a Nuclear Technology Park at the CRN Site. Therefore, there would be no impacts to noise receptors resulting from the proposed action under this alternative and ambient noise levels would remain similar to current conditions.

3.14.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.14.2.2.1 Construction

Under Alternative B, construction activities associated with the development of a Nuclear Technology Park at Area 1 are expected to generate noise through the operation of machinery and vehicles, including internal combustion engines (e.g., front end loaders, tractors, scrapers/graders, heavy trucks, cranes, concrete pumps, and generators), impact equipment (e.g., pneumatic equipment, jack hammers, and pile drivers), other equipment (e.g., vibrators, saws, and hydro excavation equipment), machine backup-alarms, and blasting. Maximum noise levels for the majority of construction equipment range from 76 to 84 dBA at a distance of 50 feet from the noise source; however, impact equipment, such as the use of pile drivers, can result in notably higher noise levels (up to 101 dBA at 50 feet). Therefore, the bounding parameter for maximum expected sound level due to construction activities, measured at 50 feet from the noise source, is 101 dBA (Table 2-4). Most construction activities would occur during normal daylight hours between 7:00 a.m. and 5:00 p.m. In cases where activities are required outside of normal working hours (e.g., for continuous concrete pours), noise levels would be limited to 65 dBA or less at the CRN Site border.

The closest sensitive receptors to Area 1 are residences located on Blackburn Lane, approximately 850 feet to the east-northeast at the closest point. Based on straight line noise attenuation, maximum noise levels from construction equipment operated within Area 1 would attenuate to 76.4 dBA at the closest residence. While this is notably higher than current offsite ambient noise levels, it illustrates an infrequent, worst case-scenario where the loudest potential activities (101 dBA at a distance of 50 feet) occur at the Area 1 boundary closest to the residence. In contrast, the maximum noise from most construction equipment (84 dBA or less at a distance of 50 feet) operated within Area 1 would attenuate to levels below 60 dBA at the nearest residence. While this may exceed the EPA’s recommended Ldn guidance of 55 dBA for residential areas, it is below the HUD’s recommendation of 65 dBA and conforms to the City of Oak Ridge’s daytime residential noise limits. Furthermore, construction equipment typically does not operate at maximum levels continuously; actual noise levels are generally expected to be lower than those described above and may be further reduced by vegetation, topography, and the use of modern, well-maintained equipment, mufflers, and hydraulic systems. TVA would require the construction contractor develop a blasting plan to include notifications to local officials, emergency departments, and neighboring businesses and residents.

Construction activities associated with Alternative B would also occur outside of Area 1, both within the CRN Site boundaries (i.e., onsite laydown and road upgrade areas) and within associated offsite areas (i.e., BTA, TN 95 Access, and offsite transmission line ROW) (see Figure 2-1). Portions of the onsite laydown area and road upgrades are slightly closer to the Blackburn Lane residences than is Area 1. However, the development of these areas would be relatively short-term, and once established, the laydown area would primarily be used to store construction equipment and materials. Noise associated with use of the laydown area and onsite roads during the construction phase would generally consist of equipment moving to and from the primary construction area (Area 1), resulting in noise levels significantly lower than the maximum levels discussed above. Additionally, construction in associated offsite areas would take place on federal property managed by the DOE or TVA, which is undeveloped or industrial in nature and not near residences or other sensitive receptors. Therefore, there would be no noise impacts resulting from offsite construction activities.

Persons recreating on the Reservoir would likely occasionally experience noise levels above those recommended by the EPA and HUD for residential and public use areas when boating in waters adjacent to Area 1 or the associated on and offsite construction areas. However, boaters would only be exposed to these noise levels intermittently, for a brief duration as they pass active construction areas. Other sensitive receptors (i.e., schools, cemeteries, and facilities for outdoor or community use) are located at distances at which noise levels during construction activities would be less than those described for the closest residences, and often comparable to ambient levels. Overall, construction noise would be expected to attenuate to levels below HUD's recommendation of 65 dBA for residential areas and below the City of Oak Ridge's daytime residential noise limits. During some construction activities, maximum noise levels could be higher; however, this would occur infrequently and would be short term and limited to daytime hours. For these reasons, noise impacts of construction activities under Alternative B would be minor.

There is also a potential for noise impacts associated with an increase in traffic related to workforce vehicles and construction/transport traffic. Roadway traffic noise is not usually a serious problem for people who live more than 500 feet from heavily traveled freeways or more than 100 to 200 feet from lightly traveled roads (FHWA 2011). Due to the nature of the decibel scale and the attenuating effects of noise with distance, a doubling of traffic volume would result in an approximately 3 dBA increase in noise level, which would not normally be a perceptible noise increase (FHWA 2011). Noise levels would vary over the course of the construction period based on the number of workers commuting to the CRN Site, with higher noise levels generated during the peak construction period. TVA estimates that up to 3,666 worker vehicles (3,300 construction workers and 366 operational workers, at peak overlap) and 90 construction/transport vehicles would access the CRN Site per day, with most of the increased traffic concentrated at shift changes. The composition of this traffic would include passenger cars and light-duty trucks driven by the workforce, as well as trucks for delivery of construction materials and heavy equipment used to support facility construction (e.g., excavators, bulldozers, heavy haul trucks, and cranes).

Approximately 80 percent of traffic during peak construction (3,005 vehicles) would access the site via TN 58 and Bear Creek Road, while the remaining 20 percent (751 vehicles) are expected to utilize TN 95 and Jones Island Road. Project-related traffic would result in considerable increases in traffic volume on Bear Creek Road, which has a current AADT of 651 (TDOT 2021a), and on Jones Island Road, which is a private, undivided road on DOE property that currently supports minimal traffic. Noise levels along these roadways would increase substantially compared to current levels, as traffic volumes are expected to be at least several times their current volumes during peak construction. However, properties adjacent to both Bear Creek Road and Jones Island Road are either undeveloped or industrial; there are no sensitive noise receptors within 500 feet of either roadway.

Therefore, there would be no noise impacts to sensitive receptors as a result of increased traffic on Bear Creek Road and Jones Island Road.

Peak construction-related traffic would increase volumes on TN 58 and TN 95 by approximately 20 percent or less. As the traffic volume would not result in a doubling of the current traffic volumes on these roadways, the increase over current noise levels is estimated to be less than 3 dBA and as such there would be no discernable increase in traffic noise along these roadways. As traffic noise impacts would be limited to roadways with no adjacent sensitive noise receptors, construction-related traffic would have no impact on noise levels at residences or other sensitive areas in the surrounding community.

3.14.2.2.2 Operation

Operation of a Nuclear Technology Park at Area 1 would require the use of various equipment that may generate noise. Tests of emergency warning sirens would be conducted periodically, with advance notification to the public. The primary source of continuous noise during operation would be the mechanical draft cooling towers, which operate at 70 dBA or less at a distance of 1,000 feet. The nearest offsite residence is approximately 1,900 feet southwest of the proposed cooling tower block location at Area 1, across the Reservoir. Based on straight line noise attenuation, it is estimated that noise levels from the cooling tower would attenuate to 64.4 dBA at the nearest residence. While this is higher than the EPA's recommended Ldn guidance of 55 dBA for residential areas, it is below the HUD's recommendation of 65 dBA. Additionally, cooling towers emit noise of a broadband nature, which is largely indistinguishable from and is less obtrusive than noise of a specific tonal nature (such as transformer or loudspeaker noise).

Residential cooling tower noise levels of 64.4 dBA or less would also fall below the City of Oak Ridge's daytime residential noise limits, and below the maximum nighttime noise limit of 70 dBA. However, as cooling towers would operate continuously, the maximum predicted noise levels would exceed the City's established limits of 55 dBA for more than 50 percent of a one-hour survey period or 60 dBA for more than 10 percent of a one-hour survey period during overnight hours. Because estimates of cooling tower noise attenuation are based on bounding criteria, operational noise may result in lower noise levels than those predicted and may be further attenuated by intervening vegetation and topography. When designs for specific reactor technology(s) and associated cooling technologies are developed, TVA would conduct further analysis and/or modeling to determine offsite noise impacts. As operational noise would generally attenuate to levels below the HUD's recommendation of 65 dBA for residential areas, and with implementation of noise abatement if deemed necessary to remain below local noise guidelines, impacts to sensitive noise receptors from operation of a Nuclear Technology Park at Area 1 would be minor.

Implementation of Alternative B would also involve operation of new transmission infrastructure, which may include new switchyards, a connection from the existing 161-kV line along Bear Creek Road to the southeast to 500-kV line, and relocation of the 161-kV line along the edge of Area 1. Under certain wet weather conditions, high-voltage transmission lines may produce an audible low-volume hissing or crackling noise from corona discharge (the electrical breakdown of air into charged particles). Under normal conditions, corona-generated noise is not audible, and during rain showers, the corona noise would likely not be readily distinguishable from background noise. During very moist, non-rainy conditions, such as heavy fog, the resulting corona noise may produce a very minor increase in background noise levels; however, this would be limited to the immediate vicinity of the transmission lines and would not be perceptible at the nearest sensitive noise receptors. Therefore, there would be no noise impacts from the operation of associated transmission infrastructure.

During operation, there would be an increase in traffic on local roadways resulting from workers commuting to the CRN Site. TVA estimates that up to 1,500 worker vehicles (500 operational workers and 1,000 additional workers during refueling) would access the CRN Site per day, during peak operation. Similar to the construction period, approximately 80 percent of traffic (1,200 vehicles) are expected to access the site via TN 58 and Bear Creek Road, while 20 percent (300 vehicles) would utilize TN 95 and Jones Island Road. Traffic noise impacts would be similar to impacts during the construction period because Bear Creek Road and Jones Island Road would experience the greatest increases in traffic volume, and therefore, traffic noise. TN 58 and TN 95 would not experience significant traffic increases in relation to current volumes, and as such, traffic noise along these roadways would not increase perceptibly. While the magnitude of traffic noise impacts would be somewhat less than the traffic noise associated with the construction period due to the smaller traffic volumes, operational impacts would be long term. However, as noticeable traffic noise increases would be limited to Bear Creek Road and Jones Island Road, which have no adjacent sensitive noise receptors, operational traffic would have no impact on noise levels at residences or other sensitive areas in the surrounding community.

3.14.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C, a Nuclear Technology Park would be constructed on Area 2 of the CRN Site. Noise impacts would be similar to those discussed under Alternative B because construction activities, offsite area improvements, assumptions regarding workforce traffic and the distribution of traffic accessing the site, and the reactor and cooling tower specifications and design parameters would be consistent with that described above. However, as the boundary of Area 2 is located at a slightly greater distance (approximately 1,500 feet) from the residences across the Reservoir, construction noise impacts would be incrementally less at the closest sensitive receptors. Maximum noise levels from construction equipment (101 dBA at a distance of 50 feet) operated within Area 2 would attenuate to 71.5 dBA at the closest residence, while the maximum noise from most construction equipment (84 dBA or less at a distance of 50 feet) would attenuate to levels below 55 dBA at the nearest residence. Therefore, similar to Alternative B, the majority of construction noise would attenuate to levels below federal recommendations for residential areas, while exceedances would be infrequent, short-term, and limited to daytime hours.

The location of the cooling tower block in Area 2 has not yet been determined; however, assuming that it would be set back from the existing transmission line ROW, it would be greater than 1,900 feet north of the closest residences, resulting in operational impacts incrementally less than those described under Alternative B. As operational noise would generally attenuate to levels below the HUD’s recommendation of 65 dBA for residential areas, and with implementation of noise abatement if deemed necessary to remain below local noise guidelines, impacts to sensitive noise receptors from operation of a Nuclear Technology Park at Area 2 would be minor.

3.14.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, a Nuclear Technology Park would be constructed on Areas 1 and 2 of the CRN Site. Noise impacts would be similar to those discussed under Alternative B because construction activities, offsite area improvements, assumptions regarding workforce traffic and the distribution of traffic accessing the site, and the reactor and cooling tower specifications and design parameters would be consistent with that described under Alternative B. During construction and operation, noise sources would be spread over a larger portion of the CRN Site, potentially impacting a larger number of residential receptors. However, the maximum potential noise levels would be bounded by those discussed under Alternative B, as the distance to the closest residential receptor would be the same. Therefore, impacts to sensitive noise receptors from operation of a Nuclear Technology Park at Areas 1 and 2 would be minor.

3.14.2.5 Summary of Impacts to Noise

As summarized in Table 3-40, noise impacts associated with the construction and operation of a Nuclear Technology Park at the CRN Site would be minor.

Table 3-40. Summary of Noise Impacts

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Generation of noise from operation of construction equipment and machinery.	Minor; construction noise at offsite residential receptors would typically attenuate to levels below HUD’s recommendation of 65 dBA for residential areas. Exceedances would be intermittent, short-term, and limited to daytime hours. Based on distance from receptors, noise levels from construction at Area 1 would be slightly higher than those associated with Area 2. Therefore, the magnitude of impact is as follows: Alternative D > Alternative B > Alternative C.
		Noise impacts resulting from an increase in construction-related traffic on surrounding roadways.	No impact; notable traffic noise increases expected along Bear Creek Road and Jones Island Road due to increases in traffic volume, which would be the same for all alternatives. However, there would be no traffic noise impacts due to lack of sensitive noise receptors.
	Operation	Generation of noise from facility operation, including use of mechanical draft cooling towers.	Minor; cooling tower noise, which would be the primary source of continuous operational noise, would be abated if necessary to remain below City of Oak Ridge residential noise guidelines. Therefore, impacts to sensitive noise receptors would be minor. Based on the distance from receptors, the magnitude of impact is as follows: Alternative D > Alternative B > Alternative C.

Alternative	Project Phase	Impact	Severity
		Corona noise from operation of transmission systems would contribute an increase in background noise levels during certain wet weather conditions.	Limited to the immediate vicinity of transmission lines; would not be perceptible at the nearest sensitive noise receptors. Noise impacts would be minimal and similar across all alternatives.
		Noise impacts resulting from an increase in operational traffic on surrounding roadways.	No impact; notable traffic noise increases expected along Bear Creek Road and Jones Island Road due to increases in traffic volume, which would be the same across all alternatives. However, there would be no traffic noise impacts due to lack of sensitive noise receptors.

3.15 Socioeconomics

3.15.1 Affected Environment

3.15.1.1 Land Use

The CRN Site is located within the city limits of Oak Ridge in eastern Roane County, Tennessee. The northwestern portion of Loudon County and part of the southwestern portion of Anderson County are also included within the CRN Site vicinity (6-mile radius from the center of the CRN Site).

Land use in the unincorporated areas outside of city limits is regulated by the respective counties, primarily through zoning and subdivision regulations. Control of land use in the cities is regulated by the individual municipalities, which have zoning authority for the lands within their boundaries. Counties and municipalities use comprehensive plans to guide land use.

In Roane County outside of the corporate city limits, land use is regulated by the county zoning resolution, which establishes zoning districts and development standards. The five municipalities in Roane County, including Harriman, Kingston, Oak Ridge, Oliver Springs, and Rockwood, have zoning ordinances. The Roane County Future Land Use Plan, adopted in 1998, covers the unincorporated areas of the county. The plan identifies the best direction for growth and recommends future land use patterns for the year 2020 based on land suitability and future land use demands.

In Anderson County outside of the corporate city limits, land use is regulated by the county zoning resolution, which establishes zoning districts and development-related requirements. The five municipalities in Anderson County, including Clinton, Oak Ridge (partially in Roane County), Rocky Top (formerly Lake City), Oliver Springs (partially in Roane and Morgan Counties), and Norris, have zoning ordinances. Anderson County does not have a current land use plan. The county is in the process of updating its 20-year-old growth plan. However, the Anderson County Growth Plan Map was updated in 2007. It identifies urban growth boundaries encompassing planned growth areas adjacent to the cities of Clinton, Rocky Top (formerly Lake City), Norris, and Oak Ridge.

In the unincorporated areas of Loudon County, the county zoning ordinance regulates land use and imposes development requirements. The five municipalities within Loudon County, including Philadelphia, Lenoir City, Greenback, Loudon, and Farragut, have zoning ordinances. The Loudon County Growth Management Plan – 20-Year Land Use Plan map identifies future land use for the county and municipalities, with nonresidential uses concentrated in the cities of Loudon and Lenoir City and along major highways.

Although the CRN Site is within the city limits of Oak Ridge, local zoning laws and regulations or regional land use plans do not apply to federal property. The City of Oak Ridge designates federally controlled lands within its city limits as “Federal Industry and Research” lands. These lands only become subject to local zoning regulations upon transfer from federal ownership.

The only federal or state public lands on or adjacent to the CRN Site are owned and managed by TVA and DOE. There are no national or state parks, national wildlife refuges, or Tribal lands on or adjacent to the CRN Site.

TVA establishes land use zones within its reservoir land management plans. The 2009 Watts Bar Reservoir Land Management Plan (RLMP) (TVA 2009) and the 2020 TVA Natural Resource Plan (TVA 2020) govern the zones of the Reservoir where the CRN Site is located. TVA develops RLMPs using the Single Use Parcel Allocation methodology which defines separate parcels of reservoir lands and allocates those parcels and affiliated land rights to a single land use allocation zone.

The reservoir land management planning process involves allocation of reservoir land to one of seven defined land use zones, six of which are comprised of property owned by TVA in fee. The term “land use zone” refers to a descriptive set of criteria given to distinct areas of land based on location, features, and characteristics. The definition of a land use zone provides a clear statement of how TVA would manage public land, and allocation of a parcel to a particular land use zone identifies that land for specific uses. Further, the implementation of an RLMP minimizes conflicting land uses and makes it easier to handle requests for use of public land.

Allocation changes that are needed for non-administrative purposes must be completed during the normal land planning cycle, either through a supplement or an amendment to a portion of reservoir lands in an RLMP, or through a revision of all reservoir lands in an RLMP. If land use allocation changes are needed on the Watts Bar Reservoir that do not meet the criteria for an ‘off-cycle’ allocation change, an amendment to the 2009 RLMP is warranted. This type of change was processed in July 2021 when TVA amended the 2009 Watts Bar RLMP which modified the land use allocation of eight parcels affecting 231.2 acres (TVA 2021k).

The CRN Project Area primarily includes Watts Bar RLMP parcels that are designated as Zone 2 – Project Operations. Per the Watts Bar RLMP, Zone 2 includes “TVA reservoir land currently used for TVA operations and public works projects. It includes… [l]and used for TVA power projects operations: generation facilities, switchyards and transmission facilities and rights-of-way.” TVA updated the land use designations for several parcels on the CRN Site from Zone 3 to Zone 2 to support future power generation activities in the July 2021 amendment.

The Clinch River Property also includes the Grassy Creek HPA parcel which is designated as Zone 3 – Sensitive Resource Management/Natural Area. The land immediately north of the HPA, Bear Creek Industrial Park, is reservoir land allocated to Zone 5-Industrial. The proposed new 161-kV transmission line that extends from the CRN Site offsite to Bear Creek Road would cross through a portion of the HPA and the Industrial Park; however, no zone change would be required.

The Oak Ridge Wildlife Management Area, where hunting is seasonally authorized when conditions allow, is adjacent to the CRN Site within ORR. Further, hunting access is also seasonally authorized when conditions allow on the CRN Site as part of the Oak Ridge Wildlife Management Area managed hunts, until site development activities begin on the CRN Site.

Potential future transmission line modifications may also be required along the 500-kV transmission line beyond the CRN Site boundary to the Bethel Valley substation. TVA has an easement for this land which lies outside of the jurisdiction of the Watts Bar RLMP and is managed by the DOE but consist of existing transmission land uses.

3.15.1.2 Demographics

The following subsections describe the demographic characteristics of the population within the geographic area of interest, defined as Anderson, Knox, Loudon, and Roane Counties in Tennessee. These counties are those most likely to incur economic, labor force, and infrastructure effects due to the proposed action. This subsection includes the demographic characteristics of permanent area residents, as well as transients who may temporarily live in or visit the area but have permanent residences elsewhere, and migrant workers who travel into the area for seasonal employment and then leave once their jobs are completed. Data used in this subsection were derived from the U.S. Census Bureau's (USCB) decennial censuses and American Community Survey (ACS) 5-year estimates, as well as the USDA's Census of Agriculture data on farms and farm workers. Data regarding future population projections were prepared by the UT's Boyd Center for Business and Economic Research.

3.15.1.2.1 Resident Population

Potentially affected populations near the CRN Site including those of the City of Oak Ridge and others within a 10-mile radius are listed in Table 3-41.

Table 3-41. Population of Municipalities within 10 miles of the CRN Site

Municipality	Population: 2019
Oak Ridge	29,037
Farragut	22,631
Lenoir City	9,162
Harriman	6,126
Loudon	5,747
Kingston	5,927
Oliver Springs	4,468

Source: USCB 2019

While Oak Ridge is the largest city within 10 miles of the CRN Site, the geographic area of interest is dominated by the City of Knoxville, in Knox County. As shown in Table 3-42, the geographic area of interest had a total population of 642,580 in 2019. More than 71 percent of that population resides in Knox County, with nearly 29 percent (186,173 people) within the Knoxville city limits. In comparison, Roane County, the location of the CRN Site, contains 8.3 percent of the area's resident population (USCB 2019).

Table 3-42. Recent Population and Growth Rates of Counties in the Geographic Area of Interest

County	2000	2010	2015	2019	Annual Growth Rate: 2010-2019 (%)
Anderson County, TN	71,330	74,257	75,430	76,061	0.27
Knox, County, TN	382,032	423,748	444,348	461,104	0.98
Loudon County, TN	39,086	47,102	50,229	52,340	1.24
Roane County, TN	51,910	54,156	53,162	53,075	-0.22
Total Geographic Area of Interest	544,358	599,263	623,169	642,580	0.80
State of Tennessee	5,689,283	6,234,968	6,499,615	6,709,356	0.85

Sources: USCB 2000; USCB 2010; USCB 2015; USCB 2019

Population data provided in Table 3-42 indicates that the population of the geographic area of interest grew at an average rate of 0.8 percent per year between 2010 and 2019. The average annual population growth rate between 2010 and 2019 ranged from -0.23 percent per year in Roane County to 1.24 percent per year in Loudon County.

Long-term population trends and projections for the geographic area of interest are provided in Table 3-43. Historic population data, from 1970 through 2015, were obtained from the USCB's decennial censuses and ACS 5-year estimates. The UT's Boyd Center for Business and Economic Research provides county-level population projections through the year 2070, which is assumed to encompass the majority of the proposed Nuclear Technology Park's initial 40-year operating period. The future projections indicate that the population within the geographic area of interest is expected to continue growing, though at a slower rate than in recent decades.

Table 3-44 provides the resident population's age and gender distribution within the geographic area of interest and the State of Tennessee. Women make up slightly more than half of the population in all of the counties. Knox County has the youngest population in the area with a median age of 37.4 years, while the other three counties have median ages noticeably higher, ranging from 43.3 years in Anderson County to 47.6 years in Loudon County. The median age for the geographic area of interest is 44.9 years, compared to the State's median age of 38.7 years (USCB 2019).

The racial and ethnic distribution of residents within the geographic area of interest is provided in Table 3-45. The geographic area of interest is less racially and ethnically diverse than Tennessee as a whole. White residents are the most prominent race in all four counties within the geographic area of interest, comprising 84.4 percent of the total population. African American residents make up 6.9 percent of the population within the area, while Hispanic residents represent 4.3 percent of the population (USCB 2019).

Table 3-43. Historical and Projected County Populations in the Geographic Area of Interest, 1970-2070

	Anderson County		Knox County		Loudon County		Roane County		Geographic Area of Interest	
Year	Population	Annual Percent Growth	Population	Annual Percent Growth	Population	Annual Percent Growth	Population	Annual Percent Growth	Population	Annual Percent Growth
1970	60,300	NA	276,293	NA	24,266	NA	38,881	NA	399740	NA
1980	67,346	1.17	319,694	1.57	28,553	1.77	48,425	2.45	464018	1.61
1990	68,250	0.13	335,749	0.50	31,255	0.95	47,227	-0.25	482481	0.40
2000	71,330	0.45	382,032	1.38	39,086	2.51	51,910	0.99	544358	1.28
2010	74,257	0.41	423,748	1.09	47,102	2.05	54,156	0.43	599263	1.01
2015	75,430	0.32	444,348	0.97	50,229	1.33	53,162	-0.37	623169	0.80
2020	77,151	0.46	473,996	1.33	54,454	1.68	53,285	0.05	658,886	1.15
2025	78,500	0.35	494,503	0.87	57,606	1.16	53,386	0.04	683,995	0.76
2030	79,454	0.24	513,318	0.76	60,311	0.94	53,111	-0.10	706,193	0.65
2035	80,197	0.19	531,397	0.70	62,691	0.79	52,587	-0.20	726,872	0.59
2040	80,872	0.17	549,800	0.69	64,917	0.71	51,956	-0.24	747,543	0.57
2045	81,560	0.17	568,606	0.68	67,203	0.70	51,318	-0.25	768,688	0.57
2050	82,280	0.18	587,800	0.68	69,712	0.75	50,723	-0.23	790,515	0.57
2055	82,995	0.17	607,234	0.66	72,468	0.79	50,177	-0.22	812,874	0.57
2060	83,731	0.18	627,120	0.65	75,426	0.82	49,683	-0.20	835,961	0.57
2065	84,524	0.19	647,574	0.65	78,518	0.82	49,249	-0.17	859,865	0.57
2070	85,377	0.20	668,482	0.65	81,718	0.81	48,876	-0.15	884,453	0.57

Sources: USCB 2010; USCB 2015; Boyd Center for Business and Economic Research 2019

Table 3-44. Age and Gender Distribution in the Geographic Area of Interest and State

	Anderson County		Knox County		Loudon County		Roane County		Geographic Area of Interest		Tennessee	
Age Groups	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**	**Number**	**Percent**
Under 5 years	4,115	5.4	26,465	5.7	2,687	5.1	2,422	4.6	35,689	5.6	40,6438	6.1
5 to 14 years	9,079	11.9	54,407	11.8	5,823	11.1	5,570	10.5	74,879	11.7	84,0813	12.5
15 to 24 years	8,602	11.3	71,866	15.6	5,539	10.6	5,939	11.2	91,946	0.1	87,4712	13.0
25 to 44 years	17,888	48.1	120,186	26.1	10,411	19.9	11,336	21.4	159,821	0.2	174,9986	26.1
45 to 64 years	21,390	28.1	116,986	25.4	14,358	27.4	16,015	30.2	168,749	0.3	176,2283	26.3
65 years and over	14,987	19.7	71,194	15.4	13,522	25.8	11,793	22.2	111,496	0.2	107,5124	16.0
Total	76,061	100	461,104	100	52,340	100	53,075	100	642,580	12.1	670,9356	100
Median Age (years)	43.3		37.4		47.6		46.4		44.95		38.7	
Gender												
Male	37,152	48.8	224,184	48.6	25,614	48.9	26,124	49.2	313,074	48.7	3,273,278	48.8
Female	38,909	51.2	236,920	51.4	26,726	51.1	26,951	50.8	329,506	51.3	3,436,078	51.2

Source: USCB 2019

Table 3-45. 2019 Racial and Ethnic Percentage Distribution within the Geographic Area of Interest

Racial or Ethnic Category	Anderson County	Knox County	Loudon County	Roane County	Geographic Area of Interest	Tennessee
Total population (persons)	76,061	461,104	52,340	53,075	642,580	6,709,356
White alone	89.1	82.3	87.7	92.7	84.4	73.8
Racial and ethnic minorities	10.9	17.7	12.3	7.3	15.6	26.2
Black or African American	3.5	8.7	0.9	2.3	6.9	16.6
American Indian and Alaska Native	0.5	0.2	0.1	0.4	0.3	0.2
Asian	1.3	2.2	0.7	0.8	1.8	1.7
Native Hawaiian and Other Pacific Islander	0.1	0.0	0.0	0.0	0.0	0.1
Some other race	0.2	0.2	0.1	0.1	0.2	0.2
Hispanic or Latino	2.9	4.3	8.8	1.8	4.3	5.4
Multiracial	2.4	2.1	1.7	1.9	2.1	2.0

Source: USCB 2019

3.15.1.2.2 Transient Population

Transient populations include people from outside the geographic area of interest who work in or visit locations such as large workplaces, schools, hospitals and nursing homes, correctional facilities, hotels and motels, recreational areas, or special events in the area. Though relatively rural in nature, the region surrounding the CRN Site has numerous tourist attractions and events that contribute to the transient population.

The transient population within the geographic area of interest was evaluated in the ESPA ER and the NRC FEIS. Transient population projections were derived from survey data collected to identify the events, facilities, parks, and attractions that contribute to the total transient population within the region. Over 100 events and attractions were identified within a 50-mile radius of the CRN Site, contributing approximately 500,000 peak daily visitors to the total transient population. Nearly 70 percent of this population occurred 20 to 30 miles from the CRN Site and included a combination of commuters, tourists, recreationists, and event attendees. Only a small percentage of the transient population was associated with facilities or events located within 10 miles of the CRN Site.

3.15.1.2.3 Migrant Labor

The USCB defines a migrant laborer as someone who works seasonally or temporarily and moves one or more times per year to perform seasonal or temporary work. Migrant labor in the geographic area of interest consists mainly of construction workers and migrant farm laborers. The 2017 Census of Agriculture indicated that 12 farms in the area employed migrant labor, but the total number of migrant workers was not disclosed (USDA-NASS 2017). It is anticipated that while migrating construction workers would outnumber migrant agricultural workers, they would be negligible compared to the total population.

3.15.1.3 Employment and Income

3.15.1.3.1 Employment

Total employment and employment values by industry for the geographic area of interest (Anderson, Knox, Loudon, and Roane Counties) are represented in Table 3-46. The principal economic centers in the geographic area of interest are Knoxville, TN (Knox County), Oak Ridge, TN (Anderson and Roane Counties), and Loudon, TN (Loudon County). Of these economic centers, Knoxville, TN is the largest.

Table 3-46 shows number of jobs by industry in the geographic area of interest. In Anderson County, as of 2019, the industry with the highest employment level was manufacturing with 11,818 jobs (26.2 percent increase), whereas in Knox County employment levels were greatest in healthcare and social assistance with 40,667 jobs (11.1 percent increase). By comparison, the respective leading employment sectors in Louden and Roane counties were manufacturing with 3,771 jobs (17.6 percent increase) and professional, scientific, and technical services with 6,976 jobs (19.5 percent) (USBEA 2019a).

The total labor force of the geographic area of interest in 2020 was 323,596 persons; of those, 303,911 people were employed. From 2010 to 2020, the number of employed people in the geographic area of interest increased by approximately six percent. During the same period, employment in Tennessee increased by approximately nine percent (BLS 2010 and BLS 2020).

A total of 19,685 people were unemployed in the geographic area of interest in 2020, while 245,532 were unemployed in the State of Tennessee in 2020. In the geographic area of interest, the unemployment rates in 2020 range from 5.9 percent (Knox County) to 6.7 percent (Anderson County). The unemployment rate in the geographic area of interest as a whole was 6.1 percent in 2020, while the State of Tennessee had an unemployment rate of 7.4 percent (BLS 2010 and BLS 2020).

The largest employer within the geographic area of interest is the DOE Y-12 National Security Complex located in Anderson and Roane Counties, which employs 11,627 persons. The largest employer in Knox and Anderson counties are the Knox County Schools and the Oak Ridge School District with 9,515 employees and 1,323 employees, respectively (East Tennessee Economic Development Agency 2021).

Work force data for the heavy construction industry was analyzed for the states of Tennessee, North Carolina, Georgia, and Kentucky because the heavy construction industry would be expected to draw workers from a larger geographic area than would general construction. In 2020, there were 16,560 people employed in heavy and civil engineering construction in Tennessee, 12,265 in Kentucky, 35,043 in North Carolina, and 34,579 people in Georgia (BLS & STL FRED 2021a, 2021b, 2021c, 2021d).

Table 3-46. Employment by Industry

	Anderson Co., TN			Knox Co., TN			Loudon Co., TN			Roane Co., TN		
Industry Type	**2010**	**2019**	**Percent Change**	**2010**	**2019**	**Percent Change**	**2010**	**2019**	**Percent Change**	**2010**	**2019**	**Percent Change**
Total employment	48,435	50,998	5%	288,226	328,096	14%	20,661	24,095	17%	24,477	26,015	6%
Farm employment	457	445	-3%	1,037	942	-9%	1,022	1,027		522	538	3%
Nonfarm employment	47,978	50,553	5%	287,189	327,154	14%	19,639	23,068	17%	23,955	25,477	6%
Private nonfarm employment	42,293	45,186	7%	251,132	292,081	16%	17,284	20,679	20%	20,048	21,516	7%
Forestry, fishing, and related activities	66	(D)		224	226	1%	(D)	(D)		(D)	(D)	
Mining, quarrying, and oil and gas extraction	281	(D)		695	441	-37%	(D)	(D)		(D)	(D)	
Utilities	(D)	(D)		11	(D)		(D)	6		(D)	(D)	
Construction	3,394	2,215	-35%	15,444	18,787	22%	1,511	1,779	18%	968	(D)	
Manufacturing	9,361	11,818	26%	12,092	13,932	15%	3,207	3,771	18%	1,277	1,178	-8%
Wholesale trade	821	(D)		13,712	13,560	-1%	(D)	470		492	456	-7%
Retail trade	3,984	4,367	10%	34,325	37,450	9%	2,304	2,670	16%	2,438	2,436	0%
Transportation and warehousing	(D)	1,052		9,680	(D)		905	1,362	50%	(D)	(D)	
Information	212	364	72%	6,023	5,888	-2%	98	217	121%	115	85	-26%
Finance and insurance	1,810	1,841	2%	14,049	17,096	22%	769	906	18%	425	499	17%

	Anderson Co., TN			Knox Co., TN			Loudon Co., TN			Roane Co., TN		
Industry Type	**2010**	**2019**	**Percent Change**	**2010**	**2019**	**Percent Change**	**2010**	**2019**	**Percent Change**	**2010**	**2019**	**Percent Change**
Real estate and rental and leasing	1,048	1,168	11%	12,193	15,979	31%	804	994	24%	548	644	18%
Professional, scientific, and technical services	6,930	4,880	-30%	18,732	21,233	13%	1,099	1,097	0%	5,836	6,976	20%
Management of companies and enterprises	85	59	-31%	3,736	7,294	95%	12	50	317%	90	66	-27%
Administrative and support and waste management and remediation services	2,976	4,454	50%	23,634	26,755	13%	1,183	1,253	6%	2,265	1,951	-14%
Educational services	317	318	0%	4,077	5,824	43%	137	245	79%	137	186	36%
Health care and social assistance	4,514	5,081	13%	36,593	40,667	11%	1,449	1,710	18%	2,055	2,136	4%
Arts, entertainment, and recreation	533	581	9%	5,611	7,488	33%	(D)	461		193	258	34%
Accommodation and food services	3,072	3,529	15%	24,368	28,054	15%	(D)	1,851		1,362	1,447	6%

Industry Type	Anderson Co., TN 2010	Anderson Co., TN 2019	Anderson Co., TN Percent Change	Knox Co., TN 2010	Knox Co., TN 2019	Knox Co., TN Percent Change	Loudon Co., TN 2010	Loudon Co., TN 2019	Loudon Co., TN Percent Change	Roane Co., TN 2010	Roane Co., TN 2019	Roane Co., TN Percent Change
Other services (except government and government enterprises)	2,167	2,556	18%	15,933	18,730	18%	1,477	1,698	15%	1,139	1,307	15%
Government and government enterprises	5,685	5,367	-6%	36,057	35,073	-3%	2,355	2,389	1%	3,907	3,961	1%
Federal civilian	1,031	855	-17%	3,908	3,624	-7%	163	159	-2%	471	396	-16%
Military	255	215	-16%	1,496	1,379	-8%	164	151	-8%	181	148	-18%
State and local	4,399	4,297	-2%	30,653	30,070	-2%	2,028	2,079	3%	3,255	3,417	5%

Source: USBEA - CAEMP25N Total Full-Time and Part-Time Employment by NAICS Industry (USBEA 2019a)
Note: (D) Not shown to avoid disclosure of confidential information; estimates are included in higher-level totals.

3.15.1.3.2 Income and Taxes

Table 3-47 presents household income distribution and poverty information. Median household income in the geographic area of interest ranges from roughly $50,000 in Anderson County to just over $58,000 in Loudon County.

Table 3-47. Household Income Distribution (Percent of Households)

Income range	Anderson County	Knox County	Loudon County	Roane County	Geographic Area of Interest	Tennessee
Total Households	30,541	187,319	20,669	20,901	259,430	2,597,292
Less than $10,000	6.9	7.1	5.6	7.4	7.0	6.9
$10,000 to $14,999	5.5	4.5	5.0	6.9	4.8	5.2
$15,000 to $24,999	12.0	10.1	7.6	10.0	10.1	10.6
$25,000 to $34,999	11.2	9.5	10.4	10.3	9.8	10.4
$35,000 to $49,000	14.1	13.0	13.4	12.3	13.1	14.0
$50,000 to $74,999	18.2	17.4	20.8	18.3	17.8	18.3
$75,000 to $99,999	12.0	13.2	13.3	13.1	13.0	12.4
$100,000 to $149,999	11.9	14.0	15.4	12.7	13.8	12.8
$150,000 to $199,999	4.7	5.6	4.3	5.1	5.4	4.7
$200,000 or more	3.6	5.7	4.3	3.9	5.2	4.8
Median Household Income	50,392	57,470	58,065	53,367	55,824	53,320

Source: USCB 2019

Table 3-48 presents the per capita income trends for the geographic area of interest. Per capita personal income ranged from $41,917 in Roane County to $51,758 in Knox County in 2019. The average personal per capita income in the State of Tennessee was $48,652 in 2019, with an average annual increase of 4 percent between 2010 and 2019. This is similar to the trends for the geographic area of interest where per capita increased an average of 3 to 4 percent during this same period (USBEA 2019b).

Table 3-48. Per Capita Income Trends

Geographic Area	2010	2019	Percentage Change	Annual Average Growth (Percent)
Anderson County, TN	34,420	43,045	25%	3%
Knox County, TN	37,305	51,758	39%	4%
Loudon County, TN	36,448	50,154	38%	4%
Roane County, TN	32,833	41,917	28%	3%
Tennessee	35,652	48,652	36%	4%

1. All dollar estimates are in thousands of current dollars (not adjusted for inflation).
2. Source: USBEA 2019b

Anderson, Knox, Loudon, and Roane Counties are the tax districts that are assumed to be most directly affected by the proposed CRN project. Total annual tax revenues for Anderson, Knox, Loudon, and Roane Counties for fiscal year (FY) 2014-2015 through FY 2019-2020 are shown in Table 3-49. Several revenue categories would be affected by the construction and operation of new power production units. These include income taxes on corporate profits, sales and use taxes on construction- and operation-related purchases and on purchases made by the project workforce.

Table 3-49. Total Revenues for Anderson, Knox, Loudon, and Roane Counties

Fiscal Year	Anderson County	Knox County	Loudon County	Roane County
2014-2015	$100,887,707	$830,536,160	$77,053,052	$87,866,243
2015-2016	$104,144,274	$861,567,066	$70,088,027	$94,486,088
2019-2017	$106,912,531	$933,557,733	$71,312,112	$95,590,990
2017-2018	$117,982,389	$888,539,822	$74,772,271	$98,027,047
2018-2019	$131,803,876	$949,960,033	$76,797,684	$100,628,605
2019-2020	$125,039,889	$946,467,910	$77,806,009	$104,406,455

Source: Tennessee Controller of the Treasury 2021b.

Corporate taxes, sales and use taxes, and property taxes contribute to the total funds for the State of Tennessee. The percentage of appropriation by category for state funds for FY 2020-2021 (July 2020 through June 2021) is shown in Table 3-50.

Table 3-50. Appropriation of Tennessee State Funds for Fiscal Year 2020-2021

Tax Appropriation Category	Percentage
Education	40%
Health & Social Services	28%
Law, Safety, & Correction	10%
Cities & Counties	7%
Transportation	6%
Resources & Regulation	3%
General Government	3%
Business & Economic Development	3%

Source: State of Tennessee 2020.

Corporate income taxes are levied pursuant to guidelines contained in Title 67 of the TCA. Businesses in Anderson, Knox, Loudon, and Roane counties have tax incentives available to them, including capital-investment tax credits.

Under Section 13 of the TVA Act of 1933, TVA makes tax-equivalent payments to eight states, including the State of Tennessee. TVA pays five percent of its gross proceeds from the sale of power (with certain exclusions) to states and counties where its power operations are carried out. Payments to each state are determined based upon the proportion of TVA power property and power sales, in each state, compared to TVA's total power property and power sales.

The State of Tennessee then allocates its tax-equivalent payments from TVA in accordance with Title 67 “Taxes and Licenses”, Chapter 9 “Payments in Lieu of Taxes”, Part 1 “Tennessee Valley Authority (Tennessee State Revenue Sharing Act)”. The TVA tax-equivalent payments are divided as follows:

- 48.5 percent is retained by the State of Tennessee
- 48.5 percent is distributed to local governments
- 3 percent is paid to impacted local governing areas that are experiencing TVA construction activity on facilities made to produce power.

3.15.1.4 Community Characteristics

The four counties that comprise the geographic area of interest either provide and maintain their own community services and infrastructure or contract with one another to provide specific services to their individual populations. Community facilities and services include public or publicly funded facilities such as police protection and other emergency services (ambulance/fire protection), schools, hospitals and other health care facilities, libraries, churches, and community centers.

3.15.1.4.1 Housing

Table 3-51 provides a summary of the housing stock for Anderson, Knox, Loudon, and Roane counties. A majority of the total existing housing units in the geographic area of interest are occupied, ranging from 81 percent in Roane County to 91 percent in Knox County. The majority of these housing units are owner-occupied, ranging from 59 percent in Knox County to 70 percent in Loudon County. Accordingly, a lower number of housing units are rental units, ranging from 19 percent in Roane County to 33 percent in Knox County. Vacancy rates in the geographic area of interest range from nine percent in Knox County to 19 percent in Roane County (USCB 2019).

Table 3-51. Housing Characteristics in Anderson County, Knox County, Loudon County, and Roane County

County/ Community	Total Housing Units	Number Occupied	% Total Occupied	Number Owner-Occupied	% Owner-Occupied	Number Renter-Occupied	% Renter-Occupied	Number Vacant	% Vacant
Anderson County	34,971	30,541	87%	20,746	59%	9,795	28%	4,430	13%
Knox County	205,620	187,319	91%	120,390	59%	66,929	33%	18,301	9%
Loudon County	23,083	20,669	90%	16,076	70%	4,593	20%	2,414	10%
Roane County	25,657	20,901	81%	16,143	63%	4,758	19%	4,756	19%

Source: USBC 2019

Some construction workers and some visiting operational staff may have a need for temporary housing in the geographic area of interest. There are 63 hotels, inns, and resorts listed on the Tennessee Department of Tourism Development website in the Knoxville/Middle East Tennessee region (TN Dept of Tourist Development 2021). And within the geographic area of interest there are approximately 9,400 hotel rooms.

3.15.1.4.2 Education

Table 3-52 identifies primary and secondary educational facilities in the geographic area of interest along with their enrollments, number of teachers and student-to-teacher ratios. The geographic area of interest encompasses eight public school districts and several private school systems. Together, these facilities provide 200 schools that serve over 96,217 elementary, middle, and high school students (IES NCES 2021a and IES NCES 2021b). For the 2019 academic year, the overall student-teacher ratio for these schools was 14.2:1 (Table 3-52). Within the geographic area of interest, Knox County has the highest level or student enrollment, 69,020 students, over 131 schools, and Roane County has the smallest student enrollment, 7,177 students, over 22 schools (IES NCES 2021a and IES NCES 2021b).

Table 3-52. Public and Private Schools in Anderson, Knox, Loudon, and Roane Counties

	Total # Schools	Elementary	Middle	Secondary	Student Enrollment	Teachers (FTEs)[a]	Student to Teacher Ratio
Anderson							
Anderson County School District	18	10	4	4	6,436	419.5	15.3:1
Oak Ridge School District	8	5	2	1	4,775	323.1	14.8:1
Clinton City Schools	3	3	0	0	974	62	15.7:1
Private Schools	4				303	18.7	16.2:1
Knox							
Knox County School District	91	54	16	21	60,735	4069.5	14.9:1
Tennessee School for the Deaf	2	1	0	1	132	41	3.2:1
Private Schools	38				8,153	669.4	12.2:1
Loudon							
Loudon County	3	1	1	1	2,435	134.7	18.1:1
Lenoir City	9	4	3	2	4,966	307.6	16.1:1
Private Schools	2				131	15	8.7:1
Roane							
Roane County School District	17	6	5	6	6,514	408.3	16.0:1
Private Schools	5				663	283.7	2.3:1
Total	200				96,217	6752.5	14.2:1

Source: IES NCES 2021a and 2021b

Note: [a]FTE = Full Time Equivalent Employee (part-time workers are reported as a fraction of one full-time worker

3.15.1.4.3 Police

Based on 2019 Federal Bureau of Investigation (FBI) data, the numbers of sworn law enforcement officers by county range from 42 in Roane County to 430 in Knox County (FBI 2019). In addition to county level law enforcement, individual cities maintain their own police departments with jurisdictions usually limited by the city limits. The number of sworn law enforcement officers by county is shown in Table 3-53.

Table 3-53. Law Enforcement Services

County	Number of Law Enforcement Officers	Residents	Officer to Resident Ratio
Anderson County	64	76,061	1:1,188
Knox County	430	461,104	1:1,072
Loudon County	57	52,340	1:918
Roane County	42	53,075	1:1,264

Source: FBI 2019 and USCB 2018

The recommended police officer-to-resident ratio ranges from 1 to 4 officers per 1,000 residents, or a police-to-resident ratio between 1:250 and 1:1,000. Officer-to-resident ratios by county in the geographic area of interest range from approximately 1:900 in Loudon County to 1:1,200 in Roane County (Table 3-53). The Officer-to-resident ratio for Loudon County is within the recommended range. However, office-to-resident ratios for Anderson, Knox, and Roane Counties are slightly under the recommended ratio of 1:1,200.

3.15.1.4.4 Fire

Fire departments staffed by volunteer and/or paid firefighters provide fire services in the geographic area of interest. The number of volunteer and career firefighters in each county, last reported in 2021, are detailed in Table 3-54. In addition, the Oak Ridge National Laboratory fire department employs 40 career firefighters (Fire Department 2021).

Table 3-54. Fire Services

County	Number of Firefighters[a]	Residents	Officer to Resident Ratio
Anderson	214	76,061	1:355
Knox	553	461,104	1:834
Loudon	202	52,340	1:259
Roane	156	53075	1:322

Source: Fire Department 2021, USCB 2018
Note:[(a)] Includes volunteer and career firefighters

The National Fire Protection Association estimates that in 2018 there were 1,115,000 firefighters in the U.S. (NFPA 2021). Dividing the 2018 estimated population of the U.S. (327,167,434) by the number of firefighters provides a ratio of 1 firefighter for every 293 persons (USCB 2018). Table 3-54 shows the firefighter-to-resident ratio which ranges from 1:259 in Loudon County to 1:834 in Knox County. Firefighter-to-resident ratios in the area of geographic interest, with the exception of Knox County, are relatively close to the national average.

The City of Oak Ridge Fire Department would provide the primary fire and emergency medical services (EMS) emergency response to the CRN Site. The City of Kingston Fire Department would be the primary backup for the CRN Site.

3.15.1.4.5 Medical Services

County health departments in the geographic area of interest provide general medical services such as pediatric and women's health clinics, immunization programs, environmental health, and social services. The Anderson County Health Department is located in Clinton; the County's Emergency Preparedness Department and Disaster Response Team are affiliated with the Health Department. The Knox County Health Department is located in Knoxville; emergency preparedness is managed through the Knox County Health Department. The Roane County Health Department is located in Rockwood. General health services in Loudon County are provided by the Tennessee Department of Health. There are 11 medical centers in the geographic area of interest for the CRN Site (TN Department of Health 2021). There are several county-based EMS services within the geographic area of interest. Anderson County operates six full time Advanced Life Support paramedic units, and five Basic Life Support units on a limited schedule. Roane County Office of Emergency Services EMS Division operates four Advanced Life Support paramedic units. Knox and Loudon Counties EMS services are provided by Rural/Metro Corporation emergency and non-emergency fleet.

3.15.1.4.6 Water and Wastewater

Residents within the geographic area of interest obtain drinking water from both communal water systems and individual wells. Anderson, Knox, Loudon, and Roane Counties are served by 16 major public water systems that obtain water from surface waterbodies. The four-county region is served by 20 major wastewater-treatment systems. The CRN Site would be serviced the City of Oak Ridge Public Works Department, which manages the City's water and wastewater treatment plants, water distribution system, and wastewater collection system (City of Oak Ridge 2021). The City of Oak Ridge Public Works Department obtains its water from the Melton Hill Reservoir, obtaining a maximum water capacity of 9.9 MGD. The average daily consumption is 7.7 MGD with an excess of 2.2 MGD. The Rarity Ridge treatment facility operated by the City of Oak Ridge would be expected to provide wastewater treatment for the CRN Site. This plant has a maximum total capacity of 0.6 MGD, with an excess of 0.5 MGD.

3.15.1.5 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions is expected to result in both construction phase and operational phase workforce requirements that could contribute to regional population increases and associated impacts on the local economy and availability of community facilities and services. Specific foreseeable future actions that may affect workforce availability, housing, and the adequacy of services in communities also served by the CRN Project include the potential development of the Kairos Hermes Reactor Project, the development of the new airport by the City of Oak Ridge (both at the ETTP, the proposed construction of new production facilities at Y-12 complex, and potential development at the Horizon Center Industrial Park. Each of these actions is located within the same socioeconomic geographic area of interest as that of the CRN project. As such, further consideration of reasonably foreseeable future actions and their effects on socioeconomic resources are included in the following section as appropriate.

3.15.2 Environmental Consequences

3.15.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, the CRN Site would remain undeveloped and managed in accordance with the Watts Bar RLMP. Therefore, there would be no impacts to land use, demographics, employment or income, or community characteristics in the geographic area of interest.

3.15.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.15.2.2.1 Land Use

As discussed in Section 3.15.1.1, local zoning ordinances are not applicable to the CRN Site. However, site land use is subject to the TVA Watts Bar RMLP. The CRN Site is designated by the RMLP as Zone 2 – Project Operations; therefore, the construction of a nuclear power generation facility is compatible with the area's existing land use designation. At such time as TVA constructs and operates one or more advanced nuclear reactors on the CRN Site, this parcel would be re-classified from "planned" reservoir land to "power plant property" and would be removed from the land planning process.

As discussed above, the proposed new 161-kV transmission line which spans the CRN Site within and adjacent to the existing 500 kV ROW and extends to Bear Creek Road intersects a small portion of land designated as Zone 3 (Sensitive Resource Management) and Zone 5 (Industrial).

The potential future transmission line modifications along the 500-kV transmission line would occur on lands that are outside of the CRN Site boundary that are managed by the DOE and are not subject to the Watts Bar RLMP. The modifications would be consistent with the use of the existing transmission corridor and would occur on land where TVA already has easements.

Alternative B would entail the development of the majority of the CRN Site in a manner that is consistent with the existing RLMP designations. Therefore, impacts associated with land zoning and land management plans are minor.

3.15.2.2.2 Demographics

3.15.2.2.2.1 Construction

The estimated construction workforce needed for the development of a Nuclear Technology Park at Area 1 would vary over the course of the construction period, averaging approximately 1,764 workers and peaking at 3,300 workers. Based on TVA's and DOE's experience in nuclear and energy facility construction, several assumptions were depended on to bound the construction workforce composition with respect to workforce commuting and relocation. The following assumptions concerning plant construction are as follows:

- Construction workers commute up to 50 miles, thus workers within 50 miles of the CRN Site area are considered local.
- 80 percent of field craft laborers would be available within 50 miles of the CRN Site area.
- 20 percent of the field craft laborers would relocate to within 50 miles of the CRN Site area and seek temporary housing.

- 80 percent of the non-manual field laborers would relocate to within 50 miles of the CRN Site and seek permanent housing.
- 20 percent of the non-manual field laborers would be available within 50 miles of the CRN Site.

These assumptions have been found to be consistent with worker location assumptions for other recent NRC licensing actions. As the geographic area of interest already supports DOE's ORR, additional information regarding the likelihood of a higher proportion of locally supplied labor and materials was also incorporated. Substantial local expertise and supply chain businesses exist in the geographic area of interest as well, which may mitigate some of the need for both labor, support services, and materials acquisition from outside the area. Table 3-55 summarizes the labor requirements expected for construction and includes estimates of the necessary number of skilled craft workers needed to be employed from outside the geographic area of interest.

Table 3-55. Projected Peak Construction Employment Onsite Labor Requirements

Labor Category	Responsibilities	Estimated Percent of Total Workforce	Peak Workforce Need	Needed from Outside the Geographic Area of Interest
Civil/Architectural Workforce	Earthwork, Yard Pipe, Piling, Concrete and Reinforcing Steel, Rigging, Structural/Miscellaneous Steel, Fire Proofing, Insulation, Coatings/Painting	25	825	166
Mechanical/Piping Workforce	Nuclear Steam Supply System; Turbine Generator; Condenser; Cooling Towers, Process Equipment; Heating, Ventilation, and Air-Conditioning; Piping; Tubing; Valves; Hangers/Supports	24	792	158
Electrical Workforce	Electrical Equipment, Cable Tray, Conduit, Supports, Cable and Wire, Connections and Terminations	14	462	92
Site Support Workforce	Scaffolding, Equipment Operation, Transport, Cleaning, Maintenance, etc.	14	462	92
Non-manual Workforce	Management, Supervision, Field Engineering, Quality Assurance/Quality Control, Environmental/Safety and Health, Administration, and Startup	23	759	607
	Total	**100**	**3,300**	**1,115**

Based on the assumptions outlined above, it is expected that during the peak construction employment, approximately 1,115 of the 3,300 workers (roughly 34 percent) would move into the geographic area of interest. It is assumed that in-migrating workers would settle in the geographic area of interest in a pattern similar to the residency pattern of the existing DOE ORR workforce. Of the 11,433 employees at the DOE Oak Ridge facilities that reside within the geographic area of interest, 27 percent reside in Anderson County, 50 percent reside in Knox County, six percent reside in Loudon County, and 17 percent reside in Roane County.

It is also assumed that each worker who relocates into the geographic area of interest would bring a family. The average household size (including single-person households) in Tennessee is approximately 2.53. Therefore, an in-migrating workforce of 1,115 would increase the geographic area of interest's population by roughly 2,821, or by approximately 0.4 percent compared to the projected 2025 population.

In addition to the construction workforce, there likely would be a time during peak construction employment when advanced nuclear reactor unit(s) are operating, while others may still be under construction. During this overlap, 366 operations employees are anticipated to join the 3,300 construction workers onsite. This results in a peak overlapping construction and operations workforce of 3,666. It is assumed that 250 of the 366 overlapping operations workers would migrate from outside of the geographic area of interest, resulting in a peak in-migrating workforce of 1,365. Assuming each worker who relocates into the geographic area of interest would bring a family, the total area population would increase by roughly 3,453, or by approximately 0.5 percent as a result of peak construction activities. Table 3-56 details the expected residency of the in-migrating construction workers and families.

Table 3-56. Estimated Population Increase and Employment in the Geographic Area of Interest during the Peak Construction Employment Period

County	In-Migrating Workers	Population Increase	Projected 2025 Population	Percent Increase
Anderson	369	934	78,500	1.19
Knox	683	1,728	494,503	0.35
Loudon	82	207	57,606	0.36
Roane	231	584	53,386	1.09
Total	**1,365**	**3,453**	**683,995**	**0.50**

As an in-migrating workforce of 1,365 workers and their families during peak construction-period employment would cause a population increase of 0.5 percent, there would not be a noticeable effect on the population demographics of the geographic area of interest as a whole or on the individual counties. Therefore, the impact associated with construction at Area 1 on area demographics would be minor.

3.15.2.2.2.2 Operation

It is estimated that 500 employees would be required during regular operations-related activities at a Nuclear Technology Park at Area 1. Based on the current residential distribution of DOE-related ORR operations workforces, TVA has estimated that 50 percent of the operations workforce for the proposed plant would already reside within the geographic area of interest. The remaining 250 workers would need to be hired from outside the area and would relocate to the geographic area of interest.

It is assumed that like the construction workforce, all in-migrating operation employees would bring their families. Using the average Tennessee household size of approximately 2.53, it is estimated that the geographic area of interest would experience a population increase of 633 people. As with the construction workforce, it is also assumed that the in-migrating operation workers would settle in the geographic area of interest, comparable to the residency pattern of the existing DOE-related ORR workforce. The subsequent operations-related increase in the population of the geographic area of interest is summarized in Table 3-57. The in-migration of operations workers and their families would result in a population increase of less than 0.1 percent in the geographic area of interest. Therefore, the impact associated with regular operational employees at Area 1 on area demographics would be minor.

Table 3-57. Estimated Population Increase in the Geographic Area of Interest during Operations, Not Including Outage Workers

County	Workers	Population Increase	Projected 2025 Population	Percent Increase
Anderson	67	170	78,500	0.22
Knox	125	316	494,503	0.06
Loudon	15	38	57,606	0.07
Roane	43	109	53,386	0.20
Total	**250**	**633**	**683,995**	**0.09**

In addition to the full-time operations workforce at Area 1 on the CRN Site, it is estimated that 1,000 temporary workers would be needed every 18 to 24 months for outages. As the geographic area of interest has a higher concentration of energy industry labor, it is believed that half of the needed labor could be acquired from within the geographic area of interest, meaning that only 500 workers would temporarily migrate into the surrounding area during the 30- to 60-day outage period. Based on the infrequent nature and limited length of time for refueling outages, it is assumed that the temporary refueling workers would not permanently relocate to the geographic area of interest and would not bring families. The maximum size of the in-migrating workforce during operations (250 operations workers and 500 outage workers) is approximately two-thirds the size of the in-migrating peak employment construction workforce (1,115). The in-migrating construction workforce and their families would constitute approximately 0.5 percent of the baseline population, which is assumed to have a minor impact on the surrounding area. As the in-migrating operations workers, including outage workers, would be significantly fewer than the number of in-migrating construction workers, population increases associated with the operations workforce would not noticeably affect the demographic character of the geographic area of interest or any of its counties and, therefore, the overall impact would be minor.

3.15.2.2.3 Employment and Income

3.15.2.2.3.1 Construction

<u>Employment</u>

Construction of a Nuclear Technology Park under Alternative B would result in an in-migration of construction workers which would stimulate spending on goods and services and would likely create new indirect service jobs in the geographic area of interest. Direct and indirect economic impacts can be predicted using employment and income multipliers which provide an estimate of increases and or decreases due to a given action. The U.S. Department of Commerce Bureau of Economic Analysis calculates multipliers for each industry based on earnings within a specific region. This model is called the Regional Input-Output Modeling System (RIMS II).

RIMS II multipliers were obtained during the ESPA ER for the geographic area of interest (Anderson, Knox, Loudon, and Roane Counties). The RIMS II direct-effect employment multiplier for construction jobs is 1.7415, meaning that for every newly created construction job, an estimated 0.7415 jobs are created in the region. Based on the construction job multiplier and a peak construction workforce of up to 3,300 persons, construction on the CRN Site under Alternative B would create approximately 2,447 indirect jobs within the region. The 3,300 construction jobs combined with the newly created 2,447 indirect jobs represent approximately 1.8 percent of the labor force in the geographic area of interest.

Indirect jobs created are assumed to be service-related and not specialized roles and therefore it is anticipated that these jobs would be filled by the labor force within the geographic area of interest. If the 2,447 indirect jobs are filled by unemployed persons in the geographic area of interest, it would result in a decrease of unemployment by 12.4 percent.

The construction workforce, of up to 3,300 total, including 1,365 in-migrating workers, would have a positive effect on the geographic area of interest for the duration of the construction period. The creation of the 2,447 indirect jobs would likely reduce unemployment and create opportunities in the service-related industry, uplifting the regional economy. Therefore, the impact of construction on employment would be beneficial and moderate.

<u>Income and Taxes</u>

Under Alternative B, the size of the workforce and associated payroll spending would vary year to year. Assuming an average of 1,764 workers per year, an estimated 78.7 million annually would be spent on construction wages. At peak construction (3,300 workers) this rises to 147.3 million. The Bureau of Economic Analysis direct-effect earning multiplier for the geographic area of interest is 1.6998, meaning for every one dollar earned by a construction worker, an additional 0.6998 dollars is added to the regional economy. During average construction needs (1,764 workers) an estimated 55.1 million is added to the regional economy. During peak construction (up to 3,300 workers) an estimated 103.1 million would be added to the regional economy. The anticipated impact of construction related income within the geographic area of interest is anticipated to be beneficial and moderate.

Primary tax revenues associated with construction within the Nuclear Technology Park would be from state sales taxes from worker expenditures, worker property taxes, sales taxes from material and supplies purchases, and TVA payments in lieu of taxes. Retail expenditures by the construction workforce throughout the geographic area of interest would generate sales and use taxes. Workers would spend some of their income on goods and services that may be taxed. The purchase of construction materials and supplies for the CRN project would also generate sales taxes. Projected retail expenditures and construction materials and supplies purchasing during construction are not available. However, it is estimated that a minimum of 89 to 121 million each year would be spent during construction activities, on which a majority would be subject to sales taxes.

TVA payments to jurisdictions within the geographic area of interest in lieu of taxes would also support jurisdictional revenue and budgets in support of community facilities and services. Therefore, the potential impact of taxes within the geographic area of interest would be minor and beneficial.

3.15.2.2.3.2 Operation
Employment

Up to 500 workers are needed to support operations at CRN Site Area 1 which is approximately 0.15 percent of the 2020 labor force of the geographic area of interest labor. The additional 1,000 supplemental outage workers represent 0.31 percent of the geographic area of interest labor force. Peak overlap of these two operational work forces represents 0.46 percent of the labor force within the geographic area of interest.

RIMS II multipliers were obtained during the ESPA ER for the geographic area of interest. The RIMS II direct-effect employment multiplier for the utilities industry is 2.2149, meaning that for every newly created operations-related job, an estimated 1.2149 jobs are created in the region. Based on the utilities industry job multiplier and a maximum operations workforce of up to 500 persons, operation of the CRN Site would create approximately 607 indirect jobs within the region. The combined 500 operations CRN Site jobs and the newly created 607 indirect jobs represents 0.34 percent of the labor force in the geographic area of interest.

The indirect jobs are assumed to be service-related and not specialized roles and therefore would be filled by the labor force within the geographic area of interest. If the jobs are filled by unemployed or underemployed persons in the geographic area of interest. If the 607 indirect jobs are filled by unemployed persons in the geographic area of interest, it would result in a decrease of unemployment by 3.1 percent.

The up to 1,000 supplemental outage workforce required during periodic refueling would temporarily reside in the geographic area of interest for approximately 30-60 days per refueling outage. Therefore, the effect on the economy would be smaller than the permanent operations workforce.

TVA would also purchase materials and supplies for operation and maintenance of the CRN Site. It is estimated that 50% of TVA's annual operation expenditures would be made in the geographic area of interest, resulting in approximately 44.4 million annually in local expenditures. These purchases would support employment in other sectors of the economy.

The operations workforce and supplemental outage workforce employed during operations at the CRN Site would have positive economic effects on the geographic area of interest. The operations workforces would help create indirect jobs and provide opportunities in service-related industries as well as boost the regional economy. However, given the size of the economies and workforces in the geographic area of interest the effect of the operational workforces on are employment would be minor and beneficial, in the context of the larger economy of the geographic area of interest.

Income and Taxes

TVA plans on employing up to 500 full-time operations workers at the CRN Site. Based on published occupation employment salary information, the annual mean wage in May 2020 for occupations related to power plant operations in the Knoxville Metropolitan Statistical

Area was $75,990 (BLS 2021b). Based on the anticipated 500 worker operations workforce an estimated 37.9 million annually would be spent on operations wages. In addition, prorating the anticipated salary to the 30-60 outage period, TVA would pay approximately 3.7 to 7.4 million every 18 to 24 months to temporary outage workers. Approximately 500 of the outage workers would come from the geographic area of interest, therefore TVA would pay 1.9 to 3.7 million to local workers every 18 to 24 months. The Bureau of Economic Analysis direct-effect earning multiplier for the geographic area of interest is 1.5423, meaning for every one dollar earned by a utility industry worker, an additional 0.5423 dollars is added to the regional economy. During operation of the CRN Site an estimated 20.6 million would be added to regional economy. The anticipated impact of operations related income within the geographic area of interest is anticipated to be minor and beneficial.

Primary tax revenues associated with operation activities and by workforce expenditures include state sales taxes, worker property taxes, and TVA payments in lieu of taxes. Because operations would require fewer workers than construction, it is expected that beneficial tax impacts during operation would be slightly smaller than impact during construction.

Sales and use taxes are generated through retail expenditures in the geographic area of interest by the operations workforce and the supplemental outage workforce. Workers would spend some of their income on good and services that may be taxed, contributing to local sales tax in the geographic area of interest.

Compared to total dollars of taxes collected within the geographic area of interest, the TVA in-lieu of tax payment is relatively small, but it would increase during and after construction of the Nuclear Technology Park. State distributed TVA in lieu of tax payments would also support revenue and budgets in support of public facilities and services. Therefore, the potential impacts to income in the geographic area of interest is anticipated to be minor and beneficial.

3.15.2.2.4 Community Characteristics

Direct impacts to community facilities and services occur when a community facility is displaced or access to the facility is altered or impeded. Activities associated with site preparation, construction, and operation of the proposed project would be limited to the CRN Site and adjacent offsite activities. Proposed project activities would not result in the displacement of any community facilities nor cut off access to any facilities in the vicinity of the CRN Site. Therefore, direct impacts to community facilities or services under Alternative B would be minor.

Indirect impacts occur when a proposed action or project results in a population increase that would generate greater demands for services and/or affect the delivery of such services. The following subsections address the potential for indirect impacts to community services during construction and operation of the proposed project.

3.15.2.2.4.1 Construction

<u>Housing</u>

Availability of housing in the geographic area of interest is described in Subsection 3.15.1.4.1 and illustrated in Table 3-51. During the peak overlap period of construction and operation, up to 3,666 workers would be at the CRN Site. Of these workers, approximately

2,301 are expected to already reside in the geographic area of interest. The remaining approximately 1,365 are expected to be in-migrating to the geographic area of interest.

Within the geographic area of interest, there are over 29,000 vacant housing units. Therefore, it is likely adequate housing would be available to accommodate all workers and their families during the peak overlap period, as the 1,365 in-migrating workers and their families would occupy less than 5 percent of the over 29,000 vacant housing units and over 9,400 hotel rooms in the geographic area of interest. The potential impacts on housing due to the in-migrating workforce during site preparation and construction (including peak overlap) would be minor.

Education

Based on 2019 USCB data, approximately 11.7 percent of the population of Tennessee is between 5 and 14 years old and 14.3 percent of the population is between 15 and 24 years old. During the peak period where construction and operational workforces overlap, it is estimated that there would 1,365 in-migrating workers and their families that include approximately 404 persons between 5 and 14 years old, and 494 persons between 15 and 24 years old (totaling approximately 898 school age students, Table 3-58). This would result in an increase of 0.9 percent in the current school enrollment in the geographic area of interest. The 0.9 percent increase in school enrollment in the geographic area of interest would change the student to teacher ratio from 14.2 students per teacher to 14.4 students per teacher. Additionally, in each individual county, the increase in the student to teacher ratio would be 0.3 students per teacher or less. Therefore, impacts to education within the geographic area of interest would be minor.

Table 3-58. School Enrollment During Peak Construction Overlap

County	Students Enrolled in Public & Private School	Teachers (FTEs)[a]	Student to Teacher Ratio	Construction-related Population Increase - Percent by County	Construction Peak Overlap School-age Population Increase	Population Increase Student to Teacher Ratio
Anderson	12,488	823.3	15.2:1	27	242	15.5:1
Knox	69,020	4,779.9	14.4:1	50	449	14.5:1
Loudon	7,532	457.3	16.5:1	6	54	16.6:1
Roane	7,177	692	10.4:1	17	153	10.6:1
Total	96,217	6,752.5	14.2:1	100	898	14.4:1

Source: IES NCES 2021a, IES NCES 2021b
Note: [a]FTE = Full Time Equivalent Employee (part-time workers are reported as a fraction of one full-time worker)

Police

Table 3-53 identifies the number of sworn law enforcement officers and the officer-to-resident ratio for the four counties in the geographic area of interest. The recommended ratio of officers to residents is 1 to 4 officers per every 1,000 residents, or 1:250 to 1:1,000. Table 3-59 details the percent increase in ratio from the peak overlap workforce population increase, as 1.2, 0.4, 0.4, 1.0 percent, in Anderson, Knox, Loudon, and Roane Counties, respectively. Based on the percentage increase in police-to-resident ratios, the impact of in-migrating construction-related population to police services would be minor.

Table 3-59. Law Enforcement to Resident Ratios during Construction

County	Number of Law Enforcement Officers	Residents	Officer to Resident Ratio	Population Increase	Officer to Resident Ratio for Population Increase	% Increase Between Officer to Resident Ratios
Anderson	64	76,061	1:1,188	934	1:1,203	1.2
Knox	430	461,104	1:1,072	1,728	1:1,076	0.4
Loudon	57	52,340	1:918	207	1:922	0.4
Roane	42	53,075	1:1,264	584	1:1,278	1.0

Source: FBI 2019

Fire

The existing levels of fire protection services in the geographic area of interest are described in Subsection 3.15.1.4.4. Firefighter-to-resident ratios range from 1:259 in Loudon County to 1:834 in Knox County. Distribution of the peak overlap workforce among the four counties within the geographic area of interest and the effect of the larger populations are shown in Table 3-54. Table 3-60 shows the percent increase in ratio from the population increase due to the peak overlap workforce in each county. Based on the percentage increase in firefighters-to-resident ratios, the impact of in-migrating construction-related population to police services would be minor.

Table 3-60. Firefighters to Resident Ratios during Construction

County	Number of Firefighters	Residents	Ratio of Firefighters to Residents	Population Increase	Firefighter to Resident Ratio with Population Increase	% Increase in Firefighter to Resident Ratios
Anderson	214	76,061	1:355	934	1:360	1.2
Knox	553	461,104	1:834	1,728	1:837	0.4
Loudon	202	52,340	1:259	207	2:260	0.4
Roane	165	53,075	1:322	584	2:324	1.1

Source: Fire Department 2021

Medical Services

Subsection 3.15.1.4.5 describes the available medical services in the geographic area of interest. During construction of the CRN Site, onsite medical personnel would be able to treat minor injuries to workers. Extensive injuries would be treated at a medical center near the CRN Site. The small influx of temporary construction workers is not anticipated to disrupt existing medical services in the geographic area of interest. An addition of approximately 3,453 peak overlap workforce and their families would increase the population in the geographic area of interest by 0.5 percent and would not disrupt existing medical services. Therefore, impacts to medical services would be minor.

Water and Wastewater

Total anticipated construction water use would be approximately 0.23 MGD. Water and wastewater would be provided by the City of Oak Ridge Public Works Department. The City of Oak Ridge has a daily excess of 2.2 MGD of water. Potable water needed to support construction activities represents less than 11 percent of the existing excess capacity based on average demand. Therefore, construction impacts on the water supply facilities would be minor and temporary.

The City of Oak Ridge Rarity Ridge wastewater treatment facility has a maximum treatment capacity of 0.6 MGD. At the peak of the construction process, a maximum of 183,300 gpd or 0.17 MGD of wastewater would be produced. If half of the workforce's water consumption would occur onsite, approximately 40 to 50 gallons of wastewater per worker per day would be generated. The onsite wastewater production of 0.17 MGD represents approximately 36 percent of excess capacity. Accordingly, the construction-related impact to wastewater treatment facilities would be minor and temporary.

3.15.2.2.4.2 Operation

Operational characteristics of the CRN Nuclear Technology Park include workforces and infrastructure demands that are less than that described above for the construction phase. As such, the operational workforce and their associated families would result in a small demographic change that would place fewer demands on community services (emergency services, medical services, education, housing, water and wastewater treatment). Thus, the potential effects on these community facilities and services during operation are bounded by the findings of impacts during construction. Therefore, impacts of operation on community facilities and services within the geographic area of interest are also considered to be minor, but long term.

3.15.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C, the impacts on land use would be the same as those discussed for Alternative B. As such, impacts associated with Alternative C on land use for the CRN Site would be minor.

Under Alternative C, effects of construction and operation activities at Area 2 on demographics, employment and income, and community characteristics (housing, education, police, fire, medical, and water services) in the geographic area of interest would be the same as those described for Alternative B. Impacts associated with construction would be temporary and short term, whereas those associated with operations would be long term. Therefore, impacts of Alternative C would be minor and adverse on demographics and community facilities and services, but minor and beneficial on employment and income and taxes.

3.15.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, the impacts on land use would be the same as those discussed for Alternative B. As such, all impacts associated with Alternative D on land use for the CRN Site would be minor.

Under Alternative D, effects of construction and operation activities at Areas 1 and 2 on demographics, employment and income, and community characteristics (housing, education, police, fire, medical, and water services) in the geographic area of interest would be the same as those described for Alternative B. Impacts associated with construction would be temporary and short term, whereas those associated with operations would be long term. Therefore, impacts of Alternative D would be minor and adverse on demographics and community facilities and services, but minor and beneficial on employment and income and taxes.

3.15.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.15.1.5, several reasonably foreseeable future actions were identified in proximity to the CRN Site that would occur within the same geographic area of interest as that of the CRN project. Specific details regarding employment and revenue generated by these other actions and their respective timing (construction duration, start of operations) are generally lacking. However, the proposed workforce of the Kairos Hermes project is 425 (212 off-peak) workers, and the maximum onsite operational phase workforce is 68 worker (Kairos 2021). Depending on the timing of implementation of this and other reasonably foreseeable projects, localized effects associated with workforce availability, housing availability, and the adequacy of services potentially may occur in combination with the proposed development of the CRN Site. Although the construction workforces are typically larger than that of operational workforces, many of these workers are expected to be drawn from the existing ROI and as such impacts of housing and many community services are expected to be minor. Locally increased demands on water and wastewater treatment would also be expected with each of these actions and depending on the timing of these projects and any proposed plans to improve treatment capacity may be expected to result in minor to moderate impacts to water and wastewater services.

3.15.2.6 Summary of Impacts to Socioeconomics

As summarized in Table 3-61, socioeconomic impacts related to the construction and operation of a Nuclear Technology Park at the CRN Site would be minor to moderate.

Table 3-61. Summary of Impacts to Socioeconomics

Alternative	Project Phase	Impact	Severity
Land Use			
Alternatives B, C, D	Construction and Operation	Land use designation and land management plans.	Minor; construction of the Nuclear Technology Park at the CRN Site is expected to occur primarily in alignment with existing zone designations.
Demographics			
Alternatives B, C, D	Construction	Population increases in the geographic area of interest associated with in-migrating construction workforce and their families.	Minor; peak construction employment would result in a population increase of 0.5 percent which would not cause a noticeable effect on the population demographics. Impacts would be the same across all action alternatives.
	Operations	Population increases in the geographic area of interest associated with in-migrating operations workforce and their families.	Minor; the in-migration of operations workers and their families would result in a population increase of the area by less than 0.1 percent. Additional workers needed during refueling outages would be in the area temporarily. Impacts would be

Alternative	Project Phase	Impact	Severity
			the same across all action alternatives.
Employment and Income			
Alternatives B, C, D	Construction	Job creation due to development of CRN Site and associated indirect job creation, resulting decrease of unemployment in geographic area of interest.	Impacts to employment would be moderate and beneficial and the same for all action alternatives.
		Payroll and associated earning multiplier and tax generation to impact economy in geographic area of interest.	Impacts to income and taxes would be minor to moderate and beneficial and the same for all action alternatives.
	Operations	Impacts similar but less than those described for construction.	Minor and similar as those for construction, but less adverse and beneficial.
Community Characteristics			
Alternatives B, C, D	Construction	Increased demand on available housing and on existing education facilities, police services, fire services, medical services, and water use.	Impacts to community services and characteristics would be minor and the same for all alternatives.
	Operations	Impacts similar but less than those described for construction.	Minor and similar as those for construction Minor to moderate potential cumulative impacts on water/wastewater treatment.

3.16 Environmental Justice

3.16.1 Affected Environment

Environmental justice has been defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies (EPA 2018). According to EPA, environmental justice goals are achieved when everyone enjoys the same degree of protection from environmental and health hazards and has equal access to the decision-making process to have a healthy environment in which to live, learn and work. On February 11, 1994, President Clinton signed EO 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. EO 12898 mandates that some federal-executive agencies consider environmental justice as part of their NEPA process. On January 27, 2021, President Biden issued EO 14008 Tackling the Climate Crisis at Home and Abroad. Amongst other objectives, the EO calls for the federal government to make environmental justice a defining feature of the response to the climate crisis by developing programs, policies, and activities to address current and historic injustices and by investing and building a clean energy economy that spurs economic opportunity for disadvantaged communities. For these reasons, TVA routinely considers environmental justice impacts as part of the project decision-making process. Guidance for addressing environmental justice considerations in this PEIS includes CEQ's Environmental Justice Guidance under the NEPA (CEQ 1997).

TVA also considered information requirements for environmental justice determinations in the NUREG-1555 and the NRC's Environmental Issues Associated with New Reactors Interim Staff Guidance (Combined License and Early Site Permit COL/ESP-ISG-026). This guidance suggests that a 50-mile radius (i.e., the CRN Site region) could reasonably be expected to establish the outer limit of all potential impacts associated with the proposed action. Thus, all census block groups that are located within or are intersected by the boundary of the CRN Site region are included in the environmental justice analysis. The 50-mile region extends into three states: Tennessee, North Carolina, and Kentucky. These states are considered an appropriate geographic area for comparative analysis. Demographic characteristics of populations within the region were assessed using 2015-2019 American Community Survey 5-year estimates provided by the USCB (USCB 2021a) to identify specific block groups within the region that exceed environmental justice thresholds.

3.16.1.1 Minority Populations

The CEQ defines minority as any race and ethnicity, as classified by the USCB, that is: Black or African American; American Indian or Alaska Native; Asian; Native Hawaiian and Other Pacific Islander; some other race (not mentioned above); two or more races (also referred to as multiracial); or a race whose ethnicity is Hispanic or Latino (CEQ 1997).

Identification of minority populations requires analysis of individual race and ethnicity classifications as well as comparisons of all minority populations in the region. Thus, each minority category was evaluated separately, and the total of all minority categories combined was evaluated as the aggregate minority population. Aggregate minority population is calculated as the total population minus people who identified themselves as White, Not Hispanic or Latino. Minority populations exist if either of the following conditions is met:

- The minority population of the impacted area exceeds 50 percent of the total population.
- The ratio of minority population is meaningfully greater (i.e., greater than or equal to 20 percent) than the minority population percentage in the general population or other appropriate unit of geographic analysis (CEQ 1997).

For each of the block groups within a 50-mile radius from the CRN Site, the percentage of the block group's population represented by each minority category was calculated. If any block group minority percentage exceeded 50 percent, then the block group was identified as containing a minority population. Each state served as the geographic area of comparison for the block groups within that state that fell within the 50-mile radius. Percentages of each minority category within each state were calculated. The individual block group percentages were compared to the appropriate state percentage. If any block group percentage exceeded the corresponding state percentage by 20 percentage points or more, then a minority population was determined to exist within that block group.

Table 3-62 and Figure 3-24 identify the census block groups with minority populations, as defined above, within the 50-mile region surrounding the CRN Site. There are 760 census block groups in the region, of which approximately 4.2 percent (32 block groups) have an individual minority population and/or an aggregate minority population that exceed one of the above criteria. The majority of the block groups with a minority population are located within the geographic area of interest discussed in Subsection 3.15 (i.e., Anderson, Knox, Loudon, and Roane counties), and most that exceed the threshold criteria for minority populations do so because of the number of Black or African American residents. Knox County has 21 block groups with minority populations, primarily located within the City of Knoxville. Loudon County also has three block groups with minority populations, while Anderson and Roane Counties each have one. The closest minority block group to the CRN Site is located in Loudon County, approximately 8 miles to the south.

In addition to the identification of minority populations based on census data, two locations of potential significance to minority communities were identified: the Wheat Community Burial Ground and the community of Scarboro. The African American Wheat Community Burial Ground is located approximately 1 mile northwest of the northern boundary of the CRN Site on the east side of TN 58. Approximately 90 to 100 graves with no inscribed markers are present within this cemetery. It is presumed that slaves that lived and worked on plantations and farms in the area are buried here. Historical records indicate the cemetery dates from the mid-19th century. The Scarboro community is a small residential area in Anderson County within the City of Oak Ridge, approximately 8 miles northeast of the CRN Site and approximately 0.5 miles from the ORR Y-12 plant. It is separated from the Y-12 plant by Pine Ridge. The community was established in 1950 to provide housing and an elementary school to African American Oak Ridge residents. The population of Scarboro has remained predominantly African American.

Table 3-62. Minority and Low-Income Populations within 50-Mile Radius of CRN Site

STATE/County	Total Number of Block Groups	Black or African American	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Hispanic or Latino	Multiracial[1]	Aggregate[2]	Low-Income[3]
		Number of Minority or Low-Income Block Groups[4]								
TENNESSEE	**746**									
Anderson	53	0	0	0	0	0	0	1	0	7
Bledsoe	8	0	0	0	0	0	0	0	0	1
Blount	78	1	0	0	0	0	0	0	1	2
Bradley	6	0	0	0	0	0	0	0	0	0
Campbell	32	0	0	0	0	0	0	0	0	4
Claiborne	4	0	0	0	0	0	0	0	0	0
Cumberland	32	0	0	0	0	0	0	0	0	0
Fentress	12	0	0	0	0	0	0	0	0	0
Grainger	6	0	0	0	0	0	0	0	0	0
Hamilton	2	0	0	0	0	0	0	0	0	0
Jefferson	12	0	0	0	0	0	0	0	0	0
Knox	242	17	0	0	0	0	3	0	17	31
Loudon	31	0	0	0	0	0	3	0	1	0
McMinn	34	0	0	0	0	0	0	0	0	7
Meigs	6	0	0	0	0	0	0	0	0	0
Monroe	28	0	0	0	0	0	0	0	0	2
Morgan	15	1	0	0	0	0	0	0	1	1
Overton	3	0	0	0	0	0	0	0	0	0
Pickett	1	0	0	0	0	0	0	0	0	0
Polk	7	0	0	0	0	0	0	0	0	0

STATE/County	Total Number of Block Groups	Black or African American	American Indian or Native Alaskan	Asian	Native Hawaiian or Other Pacific Islander	Some Other Race	Hispanic or Latino	Multiracial[1]	Aggregate[2]	Low-Income[3]
		Number of Minority or Low-Income Block Groups[4]								
Putnam	2	0	0	0	0	0	1	0	0	0
Rhea	19	0	0	0	0	0	0	0	0	3
Roane	41	0	0	1	0	0	0	0	0	0
Scott	16	0	0	0	0	0	0	0	0	2
Sevier	39	0	0	0	0	0	2	0	1	1
Union	14	0	0	0	0	0	0	0	0	0
Van Buren	1	0	0	0	0	0	0	0	0	0
White	2	0	0	0	0	0	0	0	0	0
KENTUCKY	**4**									
McCreary	2	0	0	0	0	0	0	0	0	0
Whitley	2	0	0	0	0	0	0	0	0	1
NORTH CAROLINA	**10**									
Cherokee	3	0	0	0	0	0	0	0	0	0
Graham	5	0	1	0	0	0	0	0	0	1
Swain	2	0	0	0	0	0	0	0	0	0
50-mile Region Total	**760**	**19**	**1**	**1**	**0**	**0**	**9**	**1**	**20**	**63**
	State Population	Percentage of Population								
TENNESSEE	6,709,356	16.6%	0.2%	1.7%	0.1%	0.2%	5.4%	2.0%	26.2%	15.2%
KENTUCKY	4,449,052	8.0%	0.2%	1.5%	0.1%	0.1%	3.7%	2.0%	15.4%	17.3%
NORTH CAROLINA	9,535,483	21.1%	1.1%	2.8%	0.1%	0.2%	9.4%	2.2%	36.9%	14.7%

[1] Persons who identified themselves as a member of two or more races.
[2] Everyone except persons who identified themselves as White, Not Hispanic or Latino.
[3] Based on poverty status of individuals in family households and in non-family households.
[4] Block groups where minorities and low-income populations exceed 50 percent or exceed the state average by 20 percentage points or more.

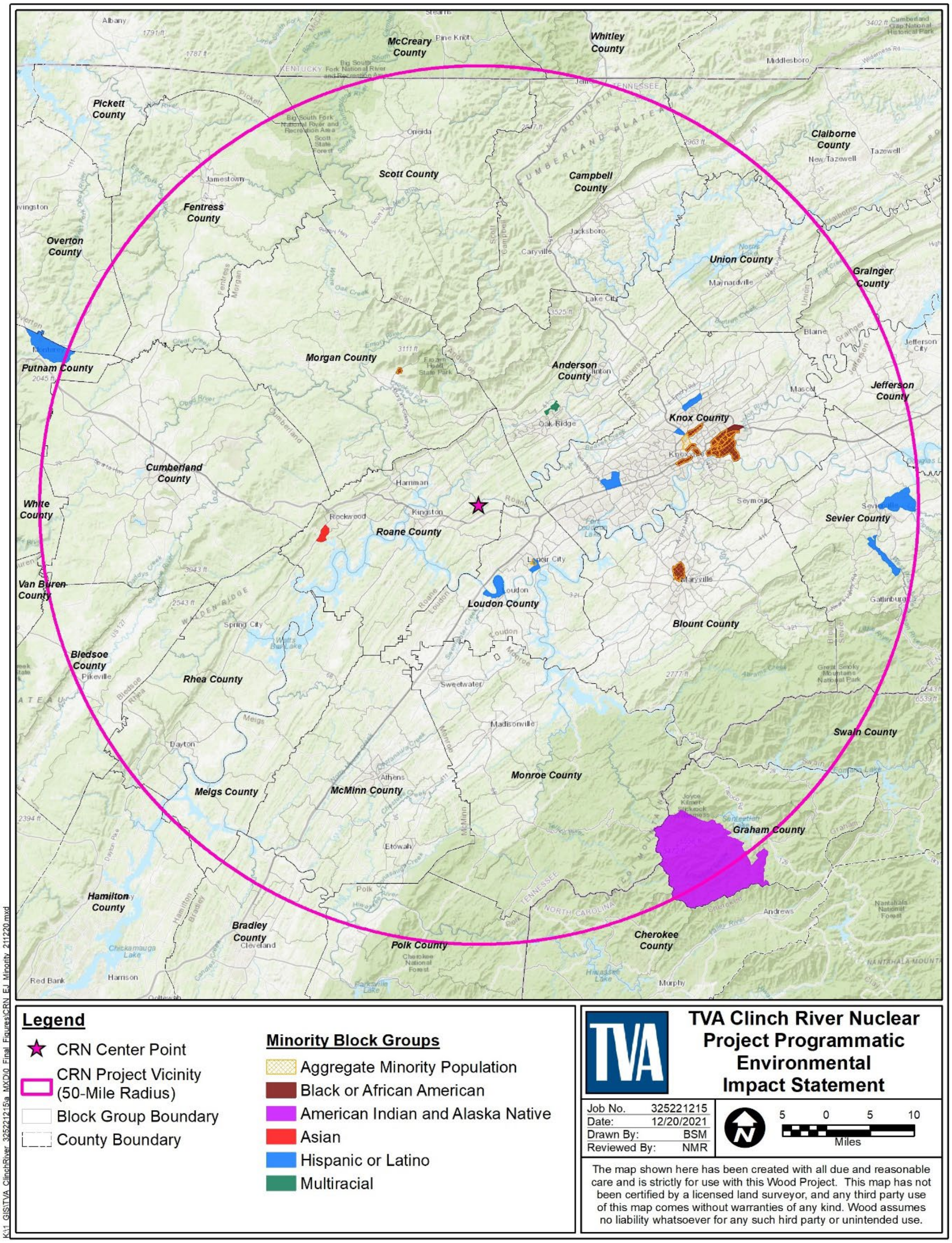

Figure 3-24. Block Groups with Minority Populations within 50 Miles of the CRN Site

3.16.1.2 Low-Income Populations

The nationwide poverty level is determined annually by the USCB and varies by the size of family and number of related children under 18 years of age. The 2020 USCB Poverty Threshold for an individual under the age of 65 is an annual income of $13,465, and for a family of four it is an annual household income of $26,695 (USCB 2021b). For the purposes of this assessment, the low-income population consists of individuals or families whose annual household income is below the USCB poverty thresholds. A low-income environmental justice population exists if either of the following two conditions is met:

- The low-income population exceeds 50 percent of the total population.
- The ratio of low-income population significantly exceeds (i.e., greater than or equal to 20 percent) that of the general population or the appropriate geographic areas of analysis.

The same 50-mile geographic region was used for this analysis (i.e., all census block groups that are located within or are intersected by the boundary of the CRN Site region). The number of low-income individuals in each census block group was divided by the total number of individuals within that block group to obtain the percentage of low-income persons per block group. These were compared to the respective state percentages to determine the block groups with low-income populations that meet either of the criteria listed above.

Table 3-62 and Figure 3-25 illustrate the number and distribution of low-income block groups within the 50-mile radius. Table 3-62 also displays the percentage of low-income individuals within each state. Among the 760 block groups within the 50-mile radius, 13.3 percent (63 block groups) meet the low-income criteria. The majority of the low-income population (38 block groups) are in the geographic area of interest, most of which (31 block groups) are located in the City of Knoxville, in Knox County. There are also seven low-income population block groups in Anderson County, in the cities of Oak Ridge and Clinton. The closest low-income population to the CRN Site is located in Oak Ridge, in Anderson County, approximately 8 miles northeast of the CRN Site.

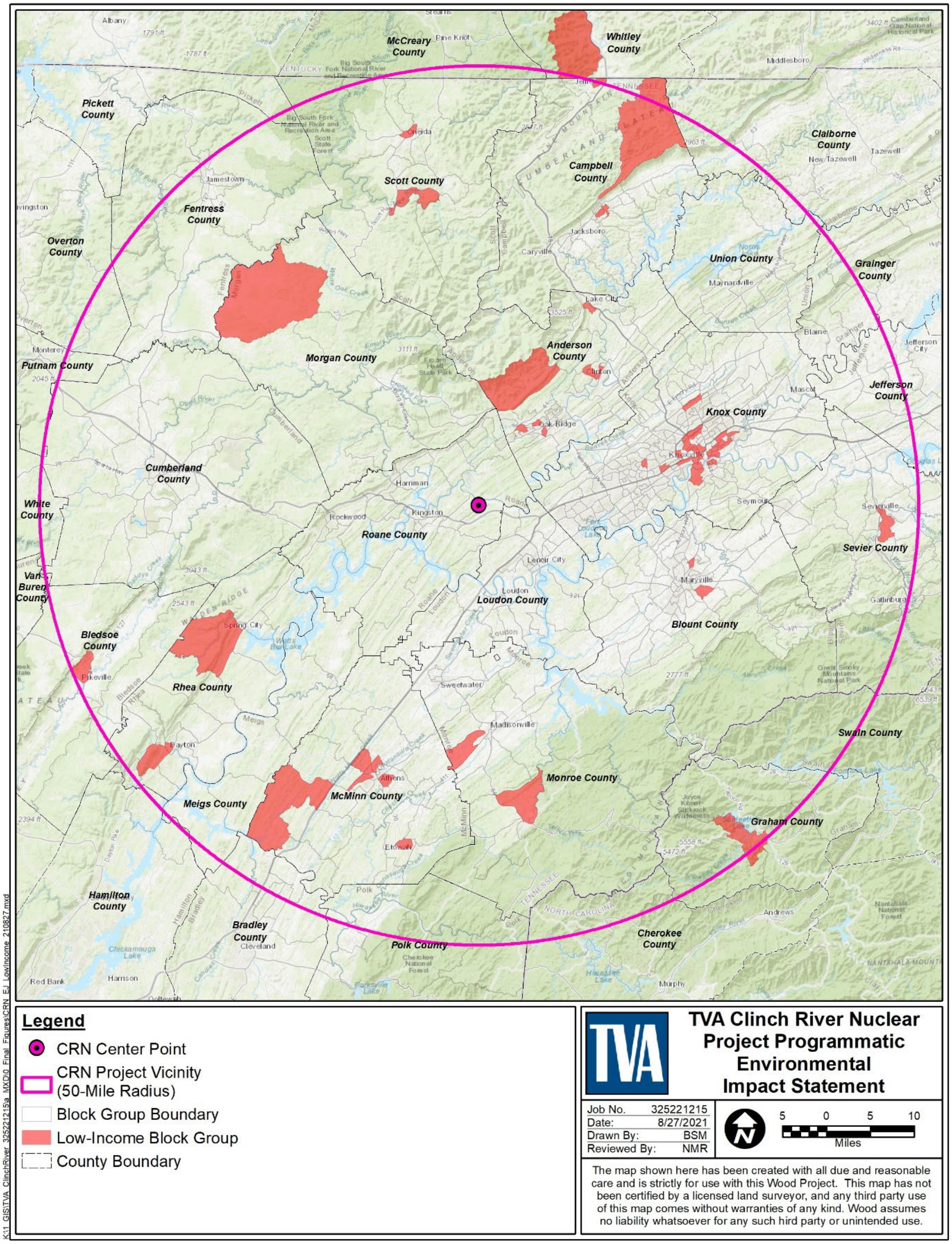

Figure 3-25. Block Groups with Low-Income Populations within 50 Miles of the CRN Site

3.16.1.3 Communities with Unique Characteristics

The characterization of potentially affected environmental justice populations also includes the identification of any unique economic, social, or human health circumstances and lifestyle practices of minority and low-income populations that could result in disproportionately high and adverse impacts to these populations from proposed project actions. Such circumstances and practices may include, for example, exceptional dependence on subsistence resources such as fish and wildlife, unusual concentrations of minority or low-income population within a compact area (e.g., Native American settlement), or pre-existing health conditions within a community that might make it more susceptible to potential plant-related impacts. Migrant workers, who are often members of minority or low-income populations, may also warrant additional consideration. Because they travel and can spend a significant amount of time in an area without being actual residents, migrant workers may be unavailable for counting by census takers and thus underrepresented in USCB minority and low-income population counts.

As part of TVA's ESPA, inquiries were made to local agencies, such as planning departments and social services agencies, health departments, academic institutions, and local businesses. None of the persons contacted identified any unique economic, social, or human health circumstances and lifestyle practices through which minority or low-income populations could be disproportionately adversely affected by the proposed plant construction and operation. Notably, previous public health assessments and sampling efforts in the community of Scarboro indicate that chemical, metal, and radionuclide concentrations are not elevated above a regulatory health level of concern and the residents of Scarboro are not being exposed to harmful levels of substances from the Y-12 plant. Additionally, health conditions within Roane County were investigated in regard to the release of fly ash following a dike failure at the TVA Kingston Fossil Plant in December 2008; lung function tests found that abnormalities for those living within a 2-mile radius of the spill were of a similar distribution to the population living outside that radius. In summary, no pre-existing health conditions were found specific to Anderson, Knox, Loudon, or Roane County, Tennessee or the other counties in the region that might make residents more susceptible to potential plant-related impacts.

Migrant populations within the economic region are generally associated with local construction activity and agricultural activities in the area. However, based on migrant worker data collected by the Census of Agriculture (see Section 3.15.1.2.3), as well as local outreach conducted by TVA and the NRC, migrant labor occurring in the region is minimal. No migrant labor populations were identified that would require further consideration.

3.16.1.4 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may have the potential to result in impacts to minority or low-income populations if these populations are present in the areas surrounding the respective project locations. However, the specific details regarding the scope of these actions are unknown at this time. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on environmental justice populations are included in TVA's analysis.

3.16.2 Environmental Consequences

3.16.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, a nuclear technology park would not be constructed or operated at the CRN Site and there would be no impacts to environmental justice populations associated with the proposed actions.

3.16.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.16.2.2.1 Construction

Under Alternative B, construction would occur primarily within the CRN Site boundaries or the associated offsite areas. All associated offsite activities are located on federal property managed by TVA or DOE, near the CRN Site. Physical and environmental impacts from construction activities, such as construction noise, visual discord, fugitive dust, and equipment emissions, would attenuate with distance, intervening foliage, and terrain. Thus, direct construction-related impacts would be limited to the properties adjacent to the CRN Site and associated offsite areas, which are largely industrial or undeveloped. The closest minority or low-income block groups are located approximately 8 miles north of the CRN Site in the City of Oak Ridge and approximately 8 miles south in Loudon County. These environmental justice communities would not be affected by any physical or environmental construction-related impacts given their distances from the site.

Increased traffic during construction would be expected to have a minor to moderate impact on local roads, and moderate impacts at TN 58 and Bear Creek Road. No identified environmental justice communities are located along these local roads in the areas likely to be impacted by the construction traffic. Although the Wheat Community Burial Ground is located off TN 58, construction traffic would not impede public access to the cemetery. No temporary detours of traffic to local offsite roads as a result of the construction at the CRN Site are anticipated. Therefore, minority and low-income populations and locations of potential significance to minority populations would not be adversely impacted by construction traffic.

Beneficial socioeconomic impacts related to facility construction, both directly and indirectly, are described in Section 3.15.2.2.3. These include increased employment opportunities and associated wages, as well as generation of additional tax revenues which contribute to community services and programs. These beneficial impacts would be realized across the geographic area of interest, including in minority and low-income communities. An increased demand for housing in the geographic area of interest has the potential to increase rental housing costs and displace low-income renters. However, as the in-migrating construction workforce would occupy less than five percent of the more than 29,000 vacant housing units in the geographic area of interest (see Section 3.15.2.2.4.1), there is ample housing available to support the workforce. Thus, nearby minority and low-income populations, including the Scarboro community, would not be adversely impacted by the construction-related demand for housing. Overall, construction-related impacts to environmental justice communities would be minor and would not be disproportionate based on the distribution patterns of minority and low-income populations.

3.16.2.2.2 Operation

Similar to construction, operational impacts associated with noise, visual impacts, air quality, and traffic would generally be limited to the areas adjacent to the CRN Site where no minority or low-income populations were identified. Additionally, operation of the Nuclear Technology Park would result in additional employment opportunities and associated wages, and generation of tax revenues that would be realized by the geographic area of interest, including minority and low-income populations. Housing impacts for the in-migrating operational workforce would be long-term but of lesser magnitude than the construction workforce; thus, operational demand for housing would not adversely affect minority or low-income populations.

Section 3.20 assesses the radiological doses to the local population, concluding that doses would be within NRC and EPA dose standards. For normal operation, annual collective doses to the public, based on the population within the 50-mile CRN Site region, were estimated to be within the regulatory limits for protection of the maximum exposed individual and negligible compared to background doses. In addition, in the event of a severe accident, the 50-mile population dose risks and the population fatality risks for the advanced nuclear reactors considered in the PPE are less than those calculated for other operating reactors or new reactors currently under construction and the individual fatality risks are several orders of magnitude below the NRC safety goals. Based on the spatial distribution of the low-income and minority populations, operational impacts on environmental justice populations would be minor and would not be disproportionate as impacts would be similar throughout the region, much of which consists of non-environmental justice populations.

3.16.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C, a Nuclear Technology Park would be constructed and operated at Area 2 of the CRN Site. As the workforce characteristics and socioeconomic impacts would be the same as those described under Alternative B, and the distance between Area 2 and identified environmental justice communities is similar to that described for Area 1, impacts to environmental justice communities would be the same as those described under Alternative B. Construction and operation of the Nuclear Technology Park at Area 2 would have minor impacts on minority and low-income populations which would not be disproportionate compared to non-environmental justice populations.

3.16.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, a Nuclear Technology Park would be constructed and operated at Area 1 and Area 2 at the CRN Site. Although development would be spread out between the two areas, impacts to environmental justice communities would be the same as those described in Alternative B, as the distance from the CRN Site to identified minority and low-income communities would essentially be the same. Therefore, construction and operation of the Nuclear Technology Park at Area 1 and Area 2 would have minor impacts on minority and low-income populations which would not be disproportionate compared to non-environmental justice populations.

3.16.2.5 Summary of Environmental Justice Impacts

As summarized in Table 3-63, TVA has determined that impacts to environmental justice populations related to the development of the CRN Site and associated offsite areas would be minor and would not be disproportionate compared to non-environmental justice populations which comprise the majority of the population of the region.

Table 3-63. Summary of Environmental Justice Impacts

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Physical and environmental impacts associated with construction activities, such as noise, visual impacts, fugitive dust, air quality, and increased traffic would be localized to areas adjacent to the CRN Site and associated offsite areas. Socioeconomic benefits, including increased employment opportunities and wages and generation of additional tax revenues, would be realized by the geographic area of interest, including minority and low-income populations.	Due to distance from the CRN Site, impacts to environmental justice populations would be minor and would not be disproportionate. Impacts would be the same across Alternatives B, C, and D.
	Operation	Similar to construction, with addition of potential health impacts associated with radiological doses.	Radiological effects to the population in the region associated with normal operation would be within be within the regulatory limits for protection of the maximum exposed individual and negligible compared to background doses. Therefore, operational impacts to environmental justice populations would be minor and would not be disproportionate. Impacts would be the same across Alternatives B, C, and D.

3.17 Archaeological Resources and Historic Structures

3.17.1 Affected Environment

3.17.1.1 Statutory and Regulatory Background

Federal agencies are required by the NHPA and NEPA to consider the possible effects of their undertakings on historic properties. Undertaking means any project, activity, or program that is funded under the direct or indirect jurisdiction of a federal agency or is licensed, permitted, or assisted by a federal agency. An agency may fulfill its statutory obligations under NEPA by following the process outlined in the regulations implementing Section 106 of NHPA, at 36 CFR Part 800. Under these regulations, considering an undertaking's possible effects on historic properties is accomplished through a four-step review process: 1) initiation (defining the undertaking and the area of potential effects [APE], and identifying the consulting parties); 2) identification (studies to determine whether cultural resources are present in the APE and whether they qualify as historic properties); 3) assessment of adverse effects (determining whether the undertaking would damage the qualities that make the property eligible for the NRHP); and resolution of adverse effects (by avoidance, minimization, or mitigation). Throughout the process the agency must consult with the appropriate SHPO, federally recognized Indian tribes that have an interest in the undertaking, and any other party with a vested interest in the undertaking.

Cultural resources include prehistoric and historic archaeological sites, districts, buildings, structures, and objects, and locations of important historic events that lack material evidence of those events. Cultural resources that are included or considered eligible for inclusion in the NRHP maintained by the National Park Service are called historic properties. To be included or considered eligible for inclusion in the NRHP, a cultural resource must possess integrity of location, design, setting, materials, workmanship, feeling, and association. In addition, it must also meet one of four criteria: (a) association with important historical events; (b) association with the lives of significant historic persons; (c) having distinctive characteristics of a type, period, or method of construction, or representing the work of a master, or having high artistic value; or (d) having yielded or having the potential to yield information important in history or prehistory.

If the agency determines (in consultation) that the undertaking's effect on a historic property within the APE would diminish any of the qualities that make the property eligible for the NRHP (based on the criteria for evaluation at 36 CFR Part 60.4), the effect is said to be adverse. Examples of adverse effects would be ground disturbing activity in an archaeological site, or erecting structures within the viewshed of a historic building in such a way as to diminish the structure's integrity of feeling or setting. Federal agencies are required to resolve the adverse effects of their undertakings on historic properties. Resolution may consist of avoidance (such as choosing a project alternative that does not result in adverse effects), minimization (such as redesign to lessen the effects), or mitigation. Adverse effects to archaeological sites are typically mitigated by means of excavation to recover the important scientific information contained within the site. Mitigation of adverse effects to historic structures sometimes involves thorough documentation of the structure by compiling historic records, studies, and photographs. Agencies are required to consult with SHPOs, tribes, and others throughout the Section 106 process and to document adverse effects to historic properties resulting from agency undertakings.

3.17.1.2 APE

APE is defined at 36 CFR Part 800.16(d), as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist." For the currently proposed actions at the CRN Site and associated offsite areas, the APE consists of the areas where ground-disturbing activities would take place (land clearing, construction, roadway improvements, and transmission line modifications), and areas within a one-half mile radius of all proposed new above-ground features that would have unobstructed views to those features. The area of ground-disturbing activities is referred to as the project footprint; areas within which visual effects could occur on historic properties is referred to as the project viewshed.

- Alternative A is the No Action Alternative, and therefore, no APE was established.
- The APE for Alternative B includes the boundary of Area 1, and the laydown area (Figure 2-1), as well as the associated viewshed.
- For Alternative C, the APE includes the boundary of Area 2, the laydown area (Figure 2-2), and the associated viewshed.
- The APE for Alternative D includes the boundary of Area 1 and Area 2, the laydown area (Figure 2-3), and the viewsheds associated with Area 1 and Area 2.
- All three action alternative APEs also include:
    - The proposed 161-kV transmission line corridor that would be built from Area 2 north toward DOE property, and the viewshed associated with the new transmission line.
    - The TN 95 Access (Jones Island Road from the CRN Site to the intersection with TN 95), and the viewshed of the proposed roadway improvements (which could include highly visible safety features such as guardrails, signage, and light poles).
    - Modifications within the BTA.

3.17.1.3 Cultural Resources in the APE

3.17.1.3.1 Archaeological Surveys

Two early archaeological investigations included the project footprint and vicinity. Cyrus Thomas (1897) visited the Project Area during his riverboat survey of the Clinch River in the 1890s. He documented a pair of precontact earthen mounds on the opposite shore but did not record any sites on the CRN Site. Charles Nash of the University of Tennessee (UT) explored the area in the 1940s and recorded five archaeological sites (40RE104-108) on the CRN Site. These were described as a village site with an earthen mound, three large village sites, and one small site of unknown cultural association. Nash was unable to complete a report due to the outbreak of World War II (Jolley 1982).

Several archaeological investigations have been carried out in the project footprint in the modern era, in connection with various federal undertakings. Beginning in the 1970s, as part of its planning effort for the CRBRP on the CRN Site, TVA contracted with UT for archaeological surveys and excavations of several sites. As part of that effort Schroedl (1972) revisited the sites that Nash had identified and recorded four historic Euro-American farmstead sites (40RE119, 40RE120, 40RE121, and a historic cemetery (the Hensley Cemetery, 40RE119). Schroedl (1974a) also documented the ruins of several rural domestic and agricultural structures, including a log cabin (40RE123), on the CRN Site, and provided archaeological site numbers for those resources. In November 1973, it was discovered that the historic log structure at 40RE123 had been completely destroyed by parties unknown. UT also identified site 40RE124 (Schroedl 1990), an earthen mound within the boundaries of site 40RE105 (identified by Nash in 1941). Schroedl (1974a) also identified 40RE128, a Woodland period open habitation site. Nick Fielder (1975) surveyed Bear Creek Valley and recorded five additional archaeological sites, 40RE125, 40RE135, 40RE138, 40RE139, and 40RE140 (cave).

Following these identification efforts, UT (under TVA's direction) carried out intensive investigations of several sites (Cole 1974; Schroedl 1974b, 1974c). Schroedl conducted excavations at sites 40RE107, 40RE108, 40RE124, and 40RE127 in the mid-1970s. The most intensive efforts were focused on site 40RE124, a Late Woodland burial mound, and 40RE108, a shell midden occupied during multiple precontact time periods. Jolley (1982) conducted a survey of previously unexplored areas at the CRN Site in the winter of 1981-1982 and identified 17 additional sites (40RE151-40RE169). Jolley also identified two stone pile clusters, one with 19 stone piles and one with 15 stone piles. Jolley suggested these could be prehistoric burial mounds similar to those previously recorded in the Powell River area and the Bear Creek watershed. Jolley recommended no further investigation for sites 40RE151, 40RE152, 40RE153, 40RE154, 40RE155, 40RE156, 40RE157, 40RE158, 40RE159, 40RE160, 40RE161, 40RE162, 40RE163, and 40RE164. He also recommended that in the event of potential disturbance, sites 40RE166, 40RE167 and two unassigned loci (L-19 and L-20) be further investigated and that site 40RE165 was a "significant cultural resource".

UT also conducted a survey of a ca. 50.9-acre tract in the north extremity of the CRN Site, in the Grassy Creek Area (Turner 1988). This survey failed to identify any archaeological sites. A geoarchaeological investigation completed in 1999 along the shoreline in the CRN Site indicated a high probability for deeply buried alluvial deposits that could contain intact archaeological sites dating to the past 13,000 years (Leigh 1999).

DuVall and Associates, Inc. completed an archaeological survey in 1995 in the northwestern portion of the project archaeological APE during the planning stages for proposed modifications to TN 58 and TN 95 (Pace 1995), on behalf of TDOT. This survey identified seven archeological sites within the new ROW needed for the road modifications. Two of these sites (40RE138 and 40RE139) are in the project archaeological APE, and two (40RE135 and 40RE233) are partially within the APE. Additionally, site 40RE232 (of undetermined NRHP eligibility) is located outside of, but adjacent to, the project archaeological APE. Site 40RE233 was recommended as potentially eligible for the NRHP under Criterion A; and further investigation was recommended. Lastly, profile cuts were made in the riverbanks in the vicinity of Gallaher Bridge during the 1995 survey. No precontact artifacts were found; only historical items that were presumed to be from the construction of the bridge in the 1960s were found.

In late 2002, TVA conducted an archaeological survey (Stanyard et al. 2003) of a 188-acre tract on the CRN Site. This survey revisited five of the previously recorded sites; the locations of historic sites 40RE121 and 40RE122 were confirmed, but the survey was unable to relocate sites 40RE156, 40RE167, or 40RE158, which indicated the sites may not have been extant. The survey also identified three previously unrecorded sites. These included two small, precontact sites (40RE547 and 40RE548) consisting of lithic artifacts of unknown cultural affiliation and a Woodland site (40RE549) with stone and ceramic artifacts and deposits potentially extending to 5 meters in depth.

When TVA began studies for the ESPA, TVA contracted with TRC Environmental Corporation (TRC) to perform two systematic archaeological surveys of the CRN Site (Barrett et al. 2011a; Barrett et al. 2011b). These surveys excluded the area surveyed by Stanyard et al. (2002) but included areas that were investigated in 1970s and 1980s and revisited all of the previously recorded sites in those areas. The first survey (Barrett et al. 2011a) focused on areas to be affected by geotechnical investigation, totaling 156.7 acres. This survey revisited 12 previously identified sites (40RE106, 40RE107, 40RE108, 40RE120, 40RE129, 40RE152, 40RE153, 40RE154, 40RE159, 40RE163, 40RE165, and 40RE166) and identified five additional sites (40RE585-589). The authors recommended that sites 40RE106, 40RE107, 40RE108, 40RE165, and 40RE166 are eligible for the NRHP and should be avoided. The authors further concluded that sites 40RE120, 40RE152, 40RE154, and 40RE163 are ineligible for the NRHP and no further work is recommended at these sites. The site number for 40RE129 has been vacated. No further work was recommended at 40RE129. The survey did not identify any evidence of site 40RE159, and this site was assumed to have been destroyed during previous site activities. No further work was recommended at 40RE159. Additionally, no further work was recommended for site 40RE153 because it was located outside of the winter 2011 survey area for the site investigations and infrastructure improvements work (Barrett et al. 2011a). TVA determined that sites 40RE106-108, 40RE165, and 40RE166 are potentially eligible for the NRHP. TVA consulted with the SHPO in February 2011 with regard to the findings of the winter 2011 survey. The SHPO concurred with TVA's determinations on NRHP eligibility (Appendix E).

The second survey (Barrett et al. 2011b) focused on the remaining areas within the CRN Site not covered by the first survey or the 2002 survey; it encompassed 692 acres. The second survey resulted in the identification of 15 previously unrecorded sites (40RE590-598, 40RE600-602, and 40RE605-607) and three isolated finds and the report (Barrett et al. 2011b) provided NRHP eligibility recommendations for those as well as for 20 previously identified sites in their 692-acre survey area. The authors recommended sites 40RE585, 40RE586, 40RE587, and 40RE589 as ineligible for listing on the NRHP and recommended no further work at these sites. Site 40RE588 is the historic Hensley Cemetery, which was recommended as ineligible for the NRHP. However, because of the presence of human burials, avoidance was recommended for the cemetery (Barrett et al. 2011b). Twelve of the 15 previously unrecorded sites investigated were recommended as potentially eligible for the NRHP (40RE104, 40RE105, 40RE106, 40RE108, 40RE124, 40RE128, 40RE140, 40RE167, 40RE549, 40RE595, 40RE600, and 40RE601). The remaining 23 sites and the three isolated finds were recommended as ineligible for the NRHP. The survey also investigated two caves. No cultural material was identified in these caves; therefore, no further work was recommended for these locations. TVA consulted with the SHPO in August 2011 regarding the results of the spring 2011 survey. The SHPO concurred with TVA's determinations on NRHP eligibility and requested that the 12 potentially eligible sites identified in the survey be avoided by all ground-disturbing activities or subjected to Phase II archaeological testing investigations (Appendix E).

New South Associates previously conducted an archaeological survey that included a ca. 14.6-acre tract of DOE land in the northwestern part of the project footprint (Reed et al. 2011). Survey and testing of 40RE233 was performed in January 2008, May 2009, and July 2010. Site 40RE233 lies partially within the CRN project footprint. This site is known historically as the Happy Valley temporary worker housing area. The site was occupied by African American workers at the K-25 Oak Ridge Gaseous Diffusion Plant, part of the Manhattan Project during World War II. Based on the investigation, DOE and the Tennessee SHPO agreed, in consultation, that site 40RE233 is eligible for the NRHP under Criteria A, C, and D. Site 40RE219, the Wheat Community African Burial Ground (outside the CRN project footprint), was also reinvestigated and further investigation of the immediate vicinity of the cemetery was recommended if ground disturbing activities were to occur in this area.

In the winter of 2014-2015, after TVA began considering possible roadway improvements along Bear Creek Road near the mouth of Grassy Creek, including the Bear Creek Road/TN 58 interchange, TVA completed a phase I archaeological survey (Hunter et al. 2015) of the areas that would be affected by this work. AMEC Foster Wheeler carried out the survey and compiled the report. This survey encompassed an area of approximately 110.5 acres. The survey included a revisit of previously recorded sites 40RE135, 40RE138, 40RE139, and 40RE202. Although a small portion of 40RE233 extended into the survey area, that site was not revisited, as the recent DOE investigations of that site made any additional survey unnecessary. The AMEC Foster Wheeler survey also identified one previously unrecorded isolated find, a non-site locality. Based on the investigation, TVA found that three of the revisited archaeological sites are ineligible for inclusion in the NRHP; that site 40RE135 had been destroyed by the construction of the Gallaher Road/TN 587 overpass; that no deposits associated with 40RE139 are located in the survey area; and that site 40RE202 has been destroyed by the construction of a sedimentation basin for the adjacent K-1515 Sanitary Water Treatment Plant. It was determined that site 40RE138 may have research potential and should be avoided by TVA's project if possible.

These surveys have identified a total of 59 archaeological sites and one historic cemetery within the project footprint. TVA consulted with the Tennessee SHPO and federally recognized Indian tribes regarding the 2002 cultural resources survey, the two archaeological surveys conducted in 2011, the 2015 survey, and the 2011 architectural survey. TVA consulted with the Eastern Band of Cherokee Indians, Cherokee Nation, Chickasaw Nation, Alabama Quassarte Tribal Town, Muscogee (Creek) Nation, Alabama-Coushatta Tribe of Texas, Thlopthlocco Tribal Town, Seminole Nation of Oklahoma, Eastern Shawnee Tribe of Oklahoma, Absentee Shawnee Tribe of Oklahoma, Kialegee Tribal Town, United Keetoowah Band of Cherokee Indians in Oklahoma, Seminole Tribe of Florida, Shawnee Tribe, and Poarch Band of Creek Indians. The SHPO has concurred with TVA's determinations on the eligibility of the 59 archaeological sites and one cemetery that have been identified within the CRN Site. The TVA and the SHPO agree that 16 of the archaeological sites (40RE104, 40RE105, 40RE106, 40RE107, 40RE108, 40RE124, 40RE128, 40RE138, 40RE140, 40RE165, 40RE166, 40RE167, 40RE549, 40RE595, 40RE600, and 40R601) are potentially eligible for listing in the NRHP, and the remaining 44 archaeological sites, four isolated finds, one non-site locality, and the cemetery are ineligible for listing in the NRHP. In addition, based on the DOE's consultation with SHPO, site 40RE233 (which extends into the APE) is also considered eligible for the NRHP.

TVA also consulted with federally recognized tribes with cultural interest in Roane County, Tennessee. TVA received a reply from the United Keetoowah Band of Cherokee Indians in Oklahoma on August 29, 2011, who stated they had no objections to TVA's proposed undertaking. In April 2015, in response to notification from TVA regarding the expanded APE, the Muscogee Nation responded they were unaware of any culturally significant sites within the project areas and concurred with TVA's determination that Site 40RE233 is eligible for the NRHP and would be avoided. ESPA ER Appendix A includes letters sent to and received from regulatory agencies and Indian tribes regarding the cultural resources consultation associated with the proposed SMR project.

None of these prior surveys included a small (approximately 2-acre) section of land on DOE property that would be affected by the proposed 161-kV transmission line, or the areas to be affected by the proposed road improvements on the TN 95 Access (Jones Island Road and the Jones Island Road/TN 95 intersection). Therefore, TVA contracted with Wood Environment and Infrastructure, Inc. (Wood) for an archaeological survey (Hunter et al. 2021) that included these areas, in connection with the proposed CRN Nuclear Technology Park project. This survey included the footprint of proposed improvements to the TN 95 Access. It also included a corridor for the proposed 161-kV transmission line, including a small section of DOE land that would be affected. The survey revisited six previously recorded archaeological sites (40RE101, 40RE103, 40RE104, 40RE156, 40RE159, and 40RE162) but did not identify any archaeological deposits associated with any of the sites. The survey identified two previously unrecorded sites (40RE631 and 40RE632). The results of the survey indicate that site 40RE632 (a low-density precontact site of unknown cultural affiliation) lacks research value and is ineligible for inclusion in the NRHP, and that 40RE631, a late nineteenth/early twentieth-century farmstead site that contains structural remains and artifact scatters, may be eligible for the NRHP. TVA consulted with the Tennessee SHPO and federally recognized Indian tribes regarding these findings. The SHPO did not disagree with TVA's survey or NRHP eligibility recommendations for the identified sites, but did request updated site forms. The SHPO also noted that TVA completed background research related to the project after beginning the field survey and asked that TVA detail the steps that TVA would take to ensure that background research is completed prior to fieldwork in future surveys. In addition, SHPO requested that site 40RE631 be avoided or subjected to additional archaeological evaluation. TVA has provided the updated site forms and is providing the information that SHPO requested.

Based on these surveys and TVA's consultation to date, the project footprint contains 12 archaeological sites that TVA has determined, in consultation, are potentially eligible for inclusion in the APE: 40RE106, 40RE108, 40RE124, 40RE128, 40RE138, 40RE140, 40RE167, 40RE549, 40RE595, 40RE600, 40RE601, and 40RE631. A small portion of archaeological site 40RE233, which the DOE and TN SHPO have agreed is eligible for the NRHP, extends into the CRN project footprint. One historic cemetery (40RE119, Hensley Cemetery) is located in the project footprint. Although this cemetery does not qualify for inclusion in the NRHP, TVA does not plan to affect this site and would take steps to ensure that the cemetery remains undisturbed by TVA's actions. Finally, TVA considers the two stone pile sites identified by Jolley, which have not been intensively investigated, to be potentially eligible as they may be precontact sites associated with Native American spiritual activity or burial of the dead. Prior to any ground-disturbing project activities within 100 meters of either site, TVA would conduct additional investigations of the site and consult further with the Tennessee SHPO and federally recognized Indian tribes.

3.17.1.3.2 Historic Architectural Surveys

TVA conducted a survey of historic architectural properties within the APE in connection with the Clinch River SMR project (Karpynec 2011). This survey focused on the viewshed of the powerblock area. The survey identified no properties listed in, or eligible for, listing in the NRHP within the viewshed within 0.5 mile. In 2015, TVA conducted a desktop review within the 0.5-mile radius to identify any NRHP-listed, -eligible, or potentially eligible historic architectural properties. This review included close examination and comparison of the following: the 1941 and 1968 (photo revised 1990) editions of the USGS Elverton, TN 7.5-minute quadrangle; the 1941 and 1998 editions of the Bethel Valley, TN 7.5-minute quadrangle; the 1939 TVA Watts Bar Reservoir land acquisition maps; and current aerial photography available from public domain sources through ESRI ArcGIS. Structures shown on the 1941 quadrangles that were absent from later editions were considered to be non-extant. Structures shown in the same location on both quadrangles and also visible in current aerial photography were considered to be extant structures that are at least 70 years old.

Seven structures within the CRN Technology Park APE appear on both the 1941 USGS quadrangles and later editions. Structure 2 (a barn) does not appear on current aerial imagery and has apparently been demolished. Four of the structures (numbers 4-7) are within the 2011 APE and were recommended ineligible by TRC in 2011. Structures 1 and 3 are within 0.5 mile of Areas 1 and 2 but were not included in the 2011 survey. On the 1939 TVA land acquisition map, Structure 1 is indicated as a two-story frame house surrounded by scattered fruit trees, a smoke house, and a shed. This property is located in the western side of the 0.5-mile radius, on the opposite shore of the Reservoir. The 1939 map shows Structure 3 as a one-story frame house surrounded by an orchard and several outbuildings: a barn, two chicken houses, a smoke house, and two corn cribs. This property is located in the east side of the 0.5-mile radius, on the opposite side of the Reservoir, near the base of Hood Ridge.

A TVA archaeologist visited Structures 1 and 3 on May 8, 2015 and documented them with photographs. Structure 1 was extant and in good condition and shows signs of having been modified by at least one modern addition. Structure 3 was abandoned and in poor condition. Neither structure is within the undertaking's viewshed. No part of the proposed project would be visible from a person standing at either property. At Structure 1, views would be blocked by a stand of mature trees on the property, as well as a wooded area along the top of the hill overlooking the Reservoir. Structure 3 is entirely surrounded by thick secondary vegetation and is not visible from Industrial Park Road, which is the nearest public road. TVA found that both structures are outside the APE. TVA consulted with the Tennessee SHPO regarding this finding, and the SHPO agreed. Therefore, TVA finds there are no NRHP-listed or -eligible historic architectural properties within the viewsheds associated with Areas 1 and 2.

In 2021, TVA completed a survey of historic architectural properties in the viewshed of the Jones Island Road portion of the project, as part of a cultural resources survey that also included the archaeological survey described above (Hunter et al. 2021). The survey included a viewshed analysis of areas within 0.5 mile of the proposed Jones Island Road and Jones Island Road/TN 95 improvements. The viewshed analysis took into consideration vegetation, topography, land use/land cover, and the built environment and created a model of areas that would have direct lines of sight to the Jones Island Road portion of the project. This survey identified nine architectural resources within the 0.5-mile radius. TVA recommends that eight of these resources do not meet criteria of eligibility for the NRHP. TVA recommends that one property (FS-5), which consists of a circa 1830 Colonial Revival house located near the south edge of the 0.5-mile radius on the opposite side of the Reservoir, is eligible for the NRHP under Criterion C for its architectural significance in relation to regional architectural styles. However, based on the viewshed analysis, no unobstructed views to the project would be possible from this property due to topography and vegetation (which includes abundant evergreen trees); therefore, property

FS-5 is not located in the APE. TVA has not, therefore, identified any NRHP-listed or -eligible historic architectural properties in the undertaking's APE.

In 2016, TVA began considering a number of alternative actions to provide additional flow in order to regulate water temperatures in the Clinch River during times of low water levels, depending on the reactor design ultimately selected for the site. Among the alternatives being considered were possible modifications to Melton Hill Dam, located approximately 3.5 river miles upstream from the CRN site. The modifications under consideration included some that might involve physical and visual changes to the dam. Melton Hill Dam is the principal feature of the Melton Hill Hydroelectric Project, which was constructed 1960-1965. The Melton Hill Hydroelectric Project was listed in the NRHP in 2016. It meets the NPS significance Criteria A and C for its historical and engineering significance at the local and state levels as an integral part of the Tennessee Valley Authority Hydroelectric Project. TVA re-determined the APE to include Melton Hill Dam, and a 0.5-mile radius surrounding it, and consulted with the Tennessee SHPO regarding the enlarged APE. The SHPO agreed with this APE modification by letter dated August 23, 2016. Depending on the technology selected for deployment at the CRN Site, it is possible that instead of modifying the Melton Hill Dam structure, TVA could manage releases from the Melton Hill Dam to augment flow and maintain water quality. Details regarding the need for augmentation of Melton Hill Dam Flow and its associated impacts would be evaluated further in a subsequent NEPA review when more technology-specific design and construction information is available.

In summary, the two historic architectural surveys and TVA's desktop review have identified one historic architectural property within the APE that is listed in the NRHP – the Melton Hill Hydroelectric Project. The review did not identify any unlisted properties that are eligible for listing in the NRHP.

3.17.1.3.3 Programmatic Agreement

TVA and the SHPO executed a PA to address the management of cultural resources affected by the Clinch River SMR Project (*Programmatic Agreement between the Tennessee Valley Authority and the Tennessee State Historic Preservation Office regarding the management of historic properties affected by the Clinch River SMR Project*). In July 2015, TVA received a response from the United Keetowah Band of Cherokee Indians in Oklahoma acknowledging the revised PA. This response is also included in ESPA ER Appendix A. The PA was initially signed in August 2015, was later revised, and signed in April 2016 by TVA and May 2016 by the SHPO. In August 2016, TVA reinitiated consultation with the SHPO under Section I.A of the PA to expand the CRN Project APE to include the Melton Hill Dam and a 0.5-mile radius around the dam. The PA stipulates the steps that TVA would take in order to make any needed changes to the APE as project plans develop; identify historic properties in the APE; evaluate the project's potential effects on historic properties; and seek ways to avoid, minimize, or mitigate adverse effects on historic properties.

3.17.1.4 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions may entail adverse effects to archaeological resources and historic structures within their respective project footprints or viewsheds. However, the specific details regarding the scope of these actions are lacking. Furthermore, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor are considered to have a causal relationship to the proposed development of the CRN Site. As such, no further consideration of reasonably foreseeable future actions and their effects on archaeological resources and historic structures are included in TVA's analysis.

3.17.2 Environmental Consequences

3.17.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would continue to manage the CRN Site and the public would continue to have access to the Hensley Cemetery and to the CRN Site for hunts managed by TWRA, but no site disturbance is planned. Therefore, there would be no impacts to existing archaeological resources located at or in the vicinity of the CRN Site in association with implementation of the No Action Alternative. As TVA would make no changes to Melton Hill Dam under Alternative A, and no historic architectural properties are located within the viewshed of the CRN Site, Alternative A would not result in adverse impacts to any historic architectural properties.

3.17.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

Four of the potentially eligible archaeological sites (40RE106, 40RE107, 40RE108, and 40RE601) are located within the Area 1 footprint area and could be adversely affected by Alternative B. In addition, potentially eligible site 40RE595 is located near Bear Creek Road and potentially eligible site 40RE631 is located near the TN 95 Access. Both of these sites could be adversely affected by roadway improvements associated with Alternative B. Once specific project plans are available, TVA would, as required by the PA, take steps to evaluate potential effects of Alternative B on archaeological sites. Should any activities associated with Alternative B have potential for physical effects on any of the potentially eligible archaeological sites, TVA would conduct additional investigations to generate the data needed for full evaluations of the NRHP eligibility status of those sites. TVA would seek ways to avoid or minimize adverse project impacts on NRHP-eligible archaeological sites, and if avoidance or sufficient minimization are not possible, TVA would mitigate the adverse effects. TVA would consult with the Tennessee SHPO and federally recognized tribes throughout the process. Based upon the above referenced impacts from construction activities on historic and cultural resources, impacts would be moderate and appropriately mitigated in conjunction with the terms of the PA.

As TVA would make no changes to Melton Hill Dam under Alternative B, and no historic architectural properties are located within the viewshed of the CRN Site, Alternative B would not result in adverse impacts to any historic architectural properties.

3.17.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

One potentially eligible archaeological site (40RE549) is located within the footprint associated with Area 2. As with Alternative B, roadway improvements on Bear Creek Road and the TN 95 Access could result in adverse impacts to potentially eligible site 40RE595 and potentially eligible site 40RE631. As described for Alternative B, once specific project plans are available, TVA would undertake steps required in the PA including additional investigations, determination of NRHP eligibility, mitigation, and consultation with the Tennessee SHPO and federally recognized tribes. Impacts from construction activities on historic and cultural resources impacts would be moderate and appropriately mitigated in conjunction with the terms of the PA.

As TVA would make no changes to Melton Hill Dam under Alternative B, and no historic architectural properties are located within the viewshed of the CRN Site, Alternative C would not result in adverse impacts to any historic architectural properties.

3.17.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Four of the potentially eligible archaeological sites (40RE106, 40RE107, 40RE108, and 40RE601) are located within the Area 1 footprint area and one potentially eligible archaeological site (40RE549) is located within the footprint associated with Area 2, both of which could be adversely affected by Alternative D. In addition, potentially eligible site 40RE595 is located near Bear Creek Road and potentially eligible site 40RE631 is located near the TN 95 Access. Both of these sites could be affected by roadway improvements associated with Alternative D. As described for Alternative B, once specific project plans are available, TVA would undertake steps required in the PA including additional investigations, determination of NRHP eligibility status, mitigation, and consultation with the Tennessee SHPO and federally recognized tribes. Impacts from construction activities on historic and cultural resources impacts would be moderate and appropriately mitigated in conjunction with the terms of the PA.

As TVA would make no changes to Melton Hill Dam under Alternative B, and no historic architectural properties are located within the viewshed of the CRN Site, Alternative D would not result in impacts to any historic architectural properties.

3.17.2.5 Summary of Impacts to Archaeological Resources and Historic Structures

As summarized in Table 3-64, TVA has determined that impacts to cultural resources resulting from the alternatives would be moderate with mitigation as required and outlined in the PA. There would be no impacts to archaeological resources and historic structures associated with operations of the Nuclear Technology Park. Any site-specific impacts that are analyzed in the future that are expected to fall outside of the bounding analysis in this PEIS will be analyzed in subsequent NEPA analysis.

Table 3-64. Summary of Impacts to Archaeological Resources and Historic Structures

Alternative	Project Phase	Impact	Severity
B	Construction	Potential disturbance of six NRHP potentially eligible archaeological sites. No impacts to eligible historic architectural properties.	Moderate adverse effects, mitigated through PA actions.
C	Construction	Potential disturbance to three NRHP potentially eligible archaeological sites. No impacts to eligible historic architectural properties.	Moderate adverse effects, mitigated through PA actions.
D	Construction	Potential disturbance to seven NRHP potentially eligible archaeological sites. No impacts to eligible historic architectural properties.	Moderate adverse effects, mitigated through PA actions.

3.18 Solid and Hazardous Waste

3.18.1 Affected Environment

3.18.1.1 Solid Waste

Regulations concerning the generation, management, handling, storing, treating, and disposal of solid wastes are contained in federal regulations issued and administered by the EPA, and in Tennessee regulations administered by the TDEC. Nonradioactive wastes are managed in accordance with applicable federal, state, and local laws, regulations, and permit requirements as well as TVA procedures, including the CAA, CWA, and the Resource Conservation and Recovery Act of 1976, as amended (RCRA). Preliminary descriptions of the Nuclear Technology Park's solid waste and nonradioactive hazardous waste systems and bounding chemical parameters are presented in Chapter 2. Any hazardous waste produced at the proposed CRN Site would be administered in accordance with RCRA, associated regulations and permits, the TDEC Hazardous Waste Management Program regulations, and any associated special permit conditions.

3.18.1.2 Hazardous Waste

As previously stated, TVA maintains multiple procedures for management of hazardous and mixed waste at their facilities, and any hazardous waste generated at the proposed CRN Site would be managed in accordance with applicable regulatory requirements and permit conditions. The proposed Nuclear Technology Park is expected to be a small quantity generator of hazardous wastes. As such, hazardous wastes produced by the Nuclear Technology Park would not be expected to have a notable effect on area disposal facilities. TVA maintains procedures for management of hazardous and mixed waste at their facilities, and these procedures would be followed for hazardous wastes generated at the CRN Site.

Small amounts of hazardous and mixed waste (waste containing radioactive and nonradioactive material) would be generated during routine operation, maintenance, refueling, radiochemical lab activities, and health protection activities. During development of the Nuclear Technology Park, specific hazardous and mixed waste management practices, treatment methods, and storage areas would be established, and industry standards and regulatory-compliant measures would be applied during all forms of handling hazardous and mixed wastes. All hazardous and mixed waste would be shipped offsite for treatment and/or disposal at licensed facilities.

TVA would implement a waste-minimization plan for the CRN Site that would be similar to those developed for other TVA nuclear power facilities. BMPs that could be part of a CRN waste-minimization plan include the following:

- Inventory identification and control that uses a tracking system to manage waste-generation data and waste-minimization opportunities.
- Work planning to reduce mixed-waste generation. (An example of work planning is pre-task planning to determine what materials and equipment are needed to perform the anticipated work.)
- Mixed-waste reduction, recycling, and reuse methods that maximize opportunities for reclamation and reuse of waste materials are used whenever feasible.
- Training and education of employees on the principles and benefits of waste minimization.

3.18.1.3 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions is expected to result in both construction phase and operational phase solid and hazardous waste generation. Specific foreseeable future actions that may contribute wastes to landfills served by the CRN Project include the potential development of the Kairos Hermes Reactor Project, the development of the new airport by the City of Oak Ridge (both at the ETTP, the proposed construction of new production facilities at the Y-12 complex, and potential development at the Horizon Center Industrial Park. None of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. Specific details regarding volumes of solid wastes generated by these other actions and their respective timing (i.e., construction duration, start of operation) are currently unavailable. However, depending on the timing of implementation of these various projects, localized increases in wastes sent to regional landfills may occur that could reduce existing landfill capacity.

3.18.2 Environmental Consequences

3.18.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, advanced nuclear reactors would not be constructed, operated, maintained, or potentially decommissioned at the CRN Site. As such, under the No Action Alternative, the CRN Site would generate no construction- or operation-related nonradioactive solid or hazardous wastes; therefore, there are no impacts associated with nonradioactive solid wastes.

3.18.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.18.2.2.1 Solid Waste

3.18.2.2.1.1 Construction

It is expected that various types of solid waste would be generated during construction activities at Area 1 on the proposed CRN Site. These wastes would include nonhazardous nonradioactive wastes such as construction and demolition waste, wood, metal, paper, municipal solid waste, and debris collected on trash screens at the water-intake structure. TVA predicts that up to 290 tons per month of nonradioactive, nonhazardous waste could be generated during construction and operation of a Nuclear Technology Park at the CRN Site. This prediction was based on the average waste generated at the Watts Bar Nuclear (WBN) site during the 3-year duration when WBN Unit 2 was being constructed and WBN Unit 1 was operating and represents a conservative upper bound. WBN Units 1 and 2 are larger reactors and require more staff than the advanced nuclear reactors planned for the CRN Site.

Construction activities associated with Area 1 would produce solid waste materials from excavation and land clearing. TVA could construct and operate a permitted, onsite construction and demolition landfill to accommodate construction waste produced by excavation and land clearing at Area 1. Any construction debris and other associated waste (including municipal solid waste) not disposed of onsite would be managed by a solid-waste disposal vendor, shipped from the CRN Site, and disposed of at authorized sanitary landfills in accordance with TVA standard procedures. Solid waste would be managed by a TVA-approved solid waste disposal vendor and disposed in a state-approved sanitary landfill, such as the Chestnut Ridge Sanitary Landfill.

Waste-minimization procedures would be implemented, and standard processes related to the handling of nonradioactive solid waste utilized at other TVA plants would be employed at the CRN Site. Any generated solid waste would typically be managed by a solid-waste disposal vendor and disposed of at authorized sanitary landfills in accordance with TVA standard procedures. The disposal vendor applicant would be required to confirm that they would comply with all applicable federal, state, and local requirements and standards for handling, transporting, and disposing of solid waste.

Solid wastes generated during construction at the CRN Site would be managed by TVA in compliance with applicable federal, state, and local laws, ordinances, and regulations intended to prevent or minimize adverse environmental impacts. Therefore, it is expected the impacts from nonradioactive solid wastes generated during the construction activities for CRN units would be minimal, and no further mitigation would be warranted. Therefore, solid waste impacts due to construction are minor.

3.18.2.2.1.2 Operation

Management procedures regarding solid waste management at Area 1 would likely be comparable to procedures used at TVA's Watts Bar Nuclear Plant. Operational solid wastes such as office waste, cardboard, wood, or metal would be recycled or reused to the furthest degree possible. Based on a 3-year average (2014 through 2016) of solid nonhazardous waste generated at WBN Units 1 and 2, TVA estimates an upper bound value of 290 tons of trash per month. Since this amount of solid waste per month generated by Watts Bar Nuclear Plant is meaningfully greater than what is expected to be eventually produced by the reactors in the CRN PPE, 290 tons per month provides a conservative upper bound to use in this analysis. TVA plans to dispose of municipal solid waste such as resins and debris from the trash racks and screens gathered from the water-intake structure using offsite, licensed commercial disposal facilities. TVA would follow all pertinent federal, state, and local requirements and standards for handling, transporting, and disposing of solid waste.

Specific measures and controls that would be implemented to limit adverse impacts to land during operations include:

- Minimize potential impacts through compliance with permitting requirements, BMPs, and TVA procedures.
- Develop and follow a waste minimization plan to reduce the amount of waste that is generated.
- Generate and dispose of nonhazardous nonradioactive waste according to applicable local, state, and federal regulations, including the Solid Waste Disposal Act, as amended, and 40 CFR Part 261, "Identification and Listing of Hazardous Waste," and TVA procedures.
- Comply with Waste Minimization Plans developed for existing TVA reactors to address hazardous waste management, treatment (decay in storage), work planning, waste tracking, and awareness training.
- Perform inspections for compliance with applicable waste management laws and regulations and TVA procedures.
- As appropriate, train employees to follow applicable procedures and waste regulations.

Strategies to manage solid wastes would be similar to the existing solid waste management strategies at existing TVA nuclear plants, in accordance with all applicable federal, state, and local requirements and standards, and the effective practices for reusing, recycling, and minimizing waste. As such, it is expected that impacts from solid wastes generated during the construction and operation of any CRN units would be minimal, and no further mitigation would be warranted.

3.18.2.2.2 Hazardous Waste

3.18.2.2.2.1 Construction

As stated previously in Section 3.3.2.2.1, there would be underwater excavation and dredging required along the shoreline, for construction of the intake and discharge structures needed for operation of plants to be constructed in the Nuclear Technology Park. In addition, underwater excavation and dredging would be required to bury the diffuser pipe at the discharge. The Lower Clinch River sediments are listed as impaired for mercury, PCBs, and chlordane. Additional legacy contamination present in the portion of the Reservoir adjacent to the CRN Site includes radionuclides from DOE activities.

As described in Section 3.3.2.2.1, TVA is party to the Watts Bar Interagency Agreement, along with the USACE, DOE, TDEC, and the EPA, to coordinate review of permitting and other use authorization activities that could result in the disturbance, re-suspension, removal, and/or disposal of contaminated sediments in the Reservoir. TDEC requires monitoring of sediment in the area(s) where disturbance of sediment is proposed. In addition, Section 404 and Section 10 permit conditions intended to ensure that activities that disturb sediments do not further degrade surface water quality would be followed. Any sediment removed may also contain manmade radionuclides; therefore, coordination of the disposition of the sediment with DOE is also anticipated. Excavated sediments would be managed as potentially hazardous and contaminated and would be disposed in accordance with applicable state and federal regulations, along with any applicable or relevant requirements from the Watts Bar Interagency Agreement's associated CERCLA decision documents, based on the results of analyses for hazardous or radioactive contaminants. It is expected that any hazardous waste impacts from stream bed evacuation during construction activities would be minor.

Any other hazardous wastes generated during construction would be disposed of at a licensed facility in accordance with Tennessee solid-waste regulations. It is expected that any hazardous waste impacts generated during construction activities would be minor.

3.18.2.2.2.2 Operation

As stated previously, it is anticipated that reactors in the Nuclear Technology Park would be a small quantity generator of hazardous waste. These wastes would be packaged, transported and disposed using a TVA-approved vendor. TVA maintains procedures for management of hazardous and mixed wastes at their facilities.

The term "mixed waste" refers specifically to waste that contains both hazardous waste and source, special nuclear, or byproduct material. Because radioactive materials at nuclear power facilities are regulated by NRC and hazardous wastes are regulated by EPA and authorized states, nuclear power facilities managing mixed waste must meet the requirements of both regulatory regimes.

Additionally, entities that generate, treat, store, or dispose of mixed wastes are subject to the requirements of the Atomic Energy Act, the Solid Waste Disposal Act of 1965, as amended by the RCRA in 1976, and the Hazardous and Solid Waste Amendments, which amended RCRA in 1984. In the State of Tennessee, the EPA has authorized the state to regulate those portions of the federal act under RCRA.

Nuclear power facilities typically do not generate large volumes of hazardous or mixed waste due to industry-wide, ongoing efforts to reduce mixed-waste generation. A 1990 survey conducted by NRC identified the types of hazardous and potentially mixed low-level waste listed below as common to reactor facilities. The types of hazardous and potentially mixed waste that would be generated by any reactors selected for Area 1 is expected to be consistent with the types identified by the survey. Types of hazardous or mixed waste may include:

- Waste oil from pumps and other equipment
- Chlorinated fluorocarbons resulting from cleaning, refrigeration, degreasing, and decontamination activities
- Organic solvents, reagents, compounds, and associated materials such as rags and wipes
- Metals such as lead from shielding applications and chromium from solutions and acids
- Metal-contaminated organic sludge and other chemicals
- Aqueous corrosives consisting of organic and inorganic acids

Specific hazardous and mixed waste management practices, treatment methods, and storage areas have not been established for Area 1 of the Nuclear Technology Park. However, industry standard and regulatory compliant hazardous chemical control and radiological control measures would be applied during testing, handling, and storage (accumulation area) of hazardous and mixed wastes. In accordance with hazardous material management regulations in 40 CFR 261 and 265, onsite storage of hazardous and mixed wastes is limited. Therefore, hazardous, and mixed wastes would be shipped offsite for treatment or disposal after a short accumulation period.

Examples of BMPs for hazardous and mixed waste storage and disposal include:

- Development of an emergency response plan
- Segregation of hazardous and mixed wastes from nonhazardous wastes
- Securing waste accumulations areas
- Posting accumulation areas with signs containing language similar to the following: “MIXED/HAZARDOUS WASTE AREA” and “DANGER-UNAUTHORIZED PERSONNEL-KEEP OUT”
- Use of secondary containment and the presence of spill kits for liquid hazardous and mixed waste storage
- Compliant container labeling
- Routine inspections of waste accumulation areas
- Any other pertinent and applicable permit requirements

Furthermore, TVA maintains procedures for management of hazardous and mixed waste at their facilities and would abide by the applicable federal and state regulations.

The development and implementation of hazardous and mixed waste management BMPs and a Waste Minimization Plan would ensure that generation of hazardous and mixed wastes is minimized by the advanced nuclear reactor units in Area 1. Due to the projected small volume of hazardous and mixed waste, no significant emissions or releases of hazardous materials are expected as a result of mixed waste management practices. Therefore, it is believed that environmental impacts from hazardous and mixed waste management would be minor.

3.18.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Solid and hazardous waste generation and associated management practices, and impacts during construction and operation under Alternative C, would be the same as those discussed for Alternative B. TVA would manage solid and hazardous wastes in accordance with all applicable federal, state, and local requirements and standards and apply recycling and waste minimization practices. As such, impacts from nonradioactive solid and hazardous wastes generated under Alternative C would be minor.

3.18.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, construction-related solid wastes generated during construction of the facility would be similar to those described under Alternative B; Solid and hazardous waste generation and associated management practices and impacts during operation under Alternative D would be the same as those discussed for Alternative B. TVA would manage solid and hazardous wastes in accordance with all applicable federal, state, and local requirements and standards and apply recycling and waste minimization practices. As such, impacts from nonradioactive solid and hazardous wastes generated under Alternative D would be the same as Alternative B during construction and operation, but would still be minor.

3.18.2.5 Summary of Impacts to Solid and Hazardous Waste

As summarized in Table 3-65, impacts resulting from solid and hazardous wastes during construction are minor. During operation of advanced nuclear reactors, impacts from solid and hazardous wastes are also expected to be minor.

Table 3-65. Summary of Impacts from Solid and Hazardous Wastes

Alternatives	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Construction-related solid waste management and disposal. TVA could construct and operate a permitted, onsite construction and demolition landfill to accommodate construction solid waste produced by excavation and land clearing. Any construction debris and other nonhazardous wastes (including municipal solid	Minor impact. Application of waste minimization procedures would be utilized. Alternatives B, C, and D all have the same level of impact.

Alternatives	Project Phase	Impact	Severity
		waste) not disposed of onsite would be transported to an offsite sanitary landfill. Management and disposal of hazardous sediments excavated from the Reservoir.	
Alternatives B, C, D	Operation	Operation-related solid waste management and disposal.	Minor impact. Application of waste minimization procedures would be utilized. Municipal solid waste produced would be disposed of using offsite licensed commercial disposal facilities.
		Operation-related hazardous wastes management and disposal.	Minor impact. Waste minimization procedures would be utilized. Hazardous and mixed wastes would be shipped offsite to licensed facilities for treatment and disposal after a short accumulation period. Implementation of BMPs would help reduce the quantity of hazardous waste to be disposed of.

3.19 Public Safety and Nonradiological Health

3.19.1 Affected Environment

3.19.1.1 Occupational Safety

Workplace health and safety regulations are designed to eliminate personal injuries and illnesses from occurring in the workplace. The Occupational Safety and Health Administration (OSHA) is the main statute protecting the health and safety of workers in the workplaces. TVA has a robust safety conscious culture that is focused on awareness and understanding of workplace hazards, prevention, intervention, and active integration of BMPs to avoid and minimize hazards.

Personnel at TVA are well trained about health and safety practices and are conscientious about following procedures for reducing or eliminating occupational hazards through implementation of safety practices, training, and control measures.

Programs and process for workplace safety that are communicated to work crews include the following:

- *Pre-Job Brief* – allows the worker to think through a job and use that knowledge to make the job as safe as possible.

- *Two-Minute Rule* (situational awareness) – take time before starting a job to familiarize yourself with the work environment and to identify conditions that were not identified during the pre-job brief.
- *Stop When Unsure* – when confronted with a situation that creates a question and what to do is uncertain, stop and get help.
- *Self-Check* – use of “STAR” acronym to promote self-check awareness: **S**top and focus, **T**hink what would happen with right or wrong action, **A**ct correctly, **R**eview that the results are as expected.
- *Procedure Use and Adherence* – allows for proper application of procedures and work packages based on expected activities.
- *Flagging and Operational Barriers* – key to ensure control of the work zones and avoidance of exposure to work hazards by public.
- *Three-Way Communication* – essential for all job tasks to ensure they are completed safely and productively.

TVA’s Safety Standard Programs and Processes would be strictly adhered to during the implementation of the proposed actions. The safety programs and processes are designed to identify actions required for the control of hazards in all activities, operations, and programs. It also establishes responsibilities for implementing OSHA and state requirements.

3.19.1.2 Etiological (Disease-Causing) Agents

Public and occupational health can be compromised by activities at the CRN Site that might result in the growth of disease-causing microorganisms (etiological agents). Thermal discharges from the proposed cooling system into the Reservoir have the potential to increase the growth of thermophilic microorganisms (microorganisms that favor warmer water). The types of microorganisms of concern for public and occupational health include enteric pathogens (such as *Salmonella* spp. and *Pseudomonas aeruginosa*), bacteria (such as *Legionella* spp.), thermophilic fungi, and freeliving amoeba (such as *Naegleria fowleri* and *Acanthamoeba* spp.). These microorganisms are known to occur in many types of freshwater bodies such as lakes, rivers, and thermally polluted effluents from power plants throughout the U.S. and proliferate during warm summer months. Water quality within the Upper Tennessee River Basin is discussed further in Section 3.3.1.1.3.

Epidemiological reports from the State of Tennessee indicate a very low risk of outbreaks from etiologic agents associated with recreational water. Available data assembled by the U.S. Centers for Disease Control and Prevention (CDC) for the years 2016 to 2019 report that outbreaks of Legionellosis, Salmonellosis, or Shigellosis in Tennessee were low compared to the number of cases nationally (CDC 2021a). Although *Naegleria fowleri* is common in freshwater ponds, lakes, and reservoirs throughout the southern states, only one case was reported in Tennessee between 1962 and 2020 (CDC 2021b). The main recreational activities associated with the Reservoir near the proposed Nuclear Technology Park are boating, fishing, and hunting. Recreational areas located within the proposed CRN Site vicinity are described in detail in Section 3.10.

3.19.1.3 Electromagnetic Fields

Operation of power transmission systems generate both electric and magnetic fields, referred to collectively as EMFs. Public and worker health can be compromised by acute and chronic exposure to electrical sources associated with power transmission systems, including switching stations (or substations) on the site and transmission lines connecting the plant to the regional electrical distribution grid. Transmission lines operate at a frequency of 60 Hz (60 cycles per second), which is considered to be an extremely low frequency.

The existing transmission corridors at the CRN Site are discussed in Section 2.4.2. Potential transmission system upgrades required to support the construction of a plant or a combination of plants generating a maximum of 800 MWe, which would connect the Nuclear Technology Park to the grid are also identified in Section 2.4.2.

3.19.1.4 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions is expected to result in impacts to public safety and nonradiological health. However, none of the identified reasonably foreseeable future actions is overlapping geographically with the CRN Project Area nor is considered to have a causal relationship to the proposed development of the CRN Site. Specific details regarding these other actions and their respective timing (i.e., construction duration, start of operation) are lacking. As such, no further consideration of reasonably foreseeable future actions and their effects on public safety and nonradiological health are included in TVA’s analysis.

3.19.2 Environmental Consequences

3.19.2.1 Alternative A – No Action Alternative

Under the No Action Alternative, no activities would be undertaken in conjunction with the development of the CRN Site or associated offsite areas. TVA’s safety conscious efforts would continue such that no changes to current public safety and nonradiological health are anticipated under this alternative. Therefore, Alternative A would not have an impact on public safety and nonradiological health.

3.19.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.19.2.2.1 Construction

Construction under Alternative B would include a range of activities including clearing and grubbing, excavation, and transport of materials and workforce. The equipment required for construction of a Nuclear Technology Park includes dozers, compactors, dump trucks, scrapers/pans, track hoes and diesel pumps. Deep excavations can result in increased risks to workforce health and safety. Customary industrial safety standards including OSHA requirements for workers engaged in excavation activities would help reduce these risks. Also, the establishment of appropriate BMPs and job site safety plans would describe how job safety would be maintained during the project. These BMPs and site safety plans address the implementation of procedures to ensure that equipment guards, housekeeping, and personal protective equipment are in place; the establishment of programs and procedures for lockout, right-to-know, hearing conservation, heavy equipment operations, excavations, and other activities; the performance of employee safety orientations and regular safety inspections; and the development of a plan of action for the correction of any identified hazards. All of these measures would help ensure that job site safety risks are reduced.

The U.S. Bureau of Labor Statistics provides reports that account for occupational injuries and illnesses as incidence rates, which represent the number of injuries and illnesses per 100 full-time workers (full-time equivalent employees [FTEs]). Additionally, the State of Tennessee also tracks annual incidence rates of injuries and illnesses for "utility system construction". In 2019, the national incidence rate for "utility system construction" was 2.1 illness/injuries per 100 FTEs (BLS 2021a) and the Tennessee incidence rate for "utility system construction" was 1.8 illnesses/injuries per 100 FTEs (BLS 2021c). It is TVA policy that all contractors have in place a site-specific health and safety plan prior to operation on TVA properties. The contractor site-specific health and safety plans must address the hazards and controls as well as contractor coordination for various construction tasks. With the high level of safety awareness and preparation during construction activities, safety and security plans and safety awareness would reduce potentially large safety risks (e.g., excavations, working at heights, blasting) down to a minor and temporary impact.

The highway and rail transportation network arterials located near the CRN Site are I-40 (south of the CRN Site), TN 58 (northwest of CRN Site), and TN 95 (northeast of CRN Site). Existing access to the CRN Site is provided via Bear Creek Road (from either of the three arterials). However, in conjunction with the construction of the CRN Nuclear Technology Park, TVA would develop the TN 95 Access which would carry approximately 20 percent of the construction traffic. As indicated in Section 3.12.2 impacts to the traffic conditions on roadways surrounding the CRN Site would be generally minor. Impacts are expected to be moderate at Bear Creek Road and TN 95 due to increased traffic on TN 95 and moderate at primary CRN Site access at Bear Creek Road intersection and on Bear Creek Road due to delays entering CRN Site during peak hours.

Nonradiological traffic related effects are primarily a function of workforce related commuting but are also influenced by trips associated with the delivery of materials to the CRN Site. As indicated in the PPE value (Table 2-4), construction phase activities would entail an average workforce of 2,200 workers, and a peak workforce of 3,300 workers on a daily basis. Assuming an average of 1.3 workers per vehicle, the peak workforce would entail an estimated 2,539 vehicles that would enter and leave the CRN site on a daily basis. This would equate to an estimated increase of 5,078 trips that would be construction related on the regional roadway network. Assuming the average commuting distance of 50 miles for each worker and a similar distance for shipping of materials, the total annual construction fatalities related to building the facility represent an approximate 7.5 percent increase over the average 10 traffic fatalities per year that occurred in Roane County from 2012 to 2016. This percentage represents negligible increases relative to the current traffic fatality risks in the areas surrounding the proposed CRN Site. As such nonradiological impacts on traffic related safety would be minor.

Use of BMPs, safety procedures, and security measures would minimize possible safety effects. Therefore, impacts to public safety and nonradiological health from the implementation of Alternative B would be minor.

3.19.2.2.2 Operation

3.19.2.2.2.1 Workforce Safety

TVA's Safety Standard Programs and Processes would be strictly adhered to during the proposed actions. The safety programs and processes are designed to identify actions required for the control of hazards in all activities, operations, and programs. It also establishes responsibilities for implementing OSHA and state requirements. Use of BMPs, safety procedures, and security measures would minimize possible safety effects. Therefore, impacts to workplace safety from the implementation of Alternative B would be minor.

3.19.2.2.2.2 Etiological (Disease-Causing) Agents

Operation under Alternative B would result in a thermal discharge to the Reservoir. Such discharges of warmer water have the potential to increase the growth of thermophilic microorganisms, including etiological agents, both in the CWS and the Clinch River. Thermophilic microorganisms include enteric (intestinal) pathogens such as *Salmonella* spp., *Pseudomonas aeruginosa*, thermophilic fungi, bacteria such as *Legionella* spp., and free-living amoeba such as *Naegleria fowleri* and *Acanthamoeba* spp. These microorganisms could result in potentially serious human health concerns, particularly at high exposure levels. However, as described above, the reported incidence of these outbreaks in in Tennessee in recent years is low compared to the number of cases nationally (CDC 2021a). While it is possible that the thermal discharge from reactors in Area 1 could have an impact on the abundance of etiological agents present in the Reservoir, the thermal plume would be small under normal operating conditions at most times of the year. Based on the historically low risk of diseases from etiological agents in Tennessee and the limited extent of thermal impacts to the Reservoir, the impacts on human health would be minor.

3.19.2.2.2.3 Electromagnetic Fields

In NUREG-1437, Rev 1 (NRC 2013), the NRC indicates that the greatest electrical shock hazard from a transmission line is direct contact with the conductors and that tower designs preclude direct public access to the conductors. However, electrical shocks can occur without physical contact. Secondary shock can happen when humans make contact with either capacitively charged bodies (such as a vehicle parked near a transmission line) or magnetically linked metallic structures (such as fences near transmission lines). The shock received by the person could be painful. The intensity of the shock would depend on the EMF strength, the size of the object, and the degree of insulation between the object, the person, and the ground. (NRC 2013).

The National Electrical Safety Code (NESC) is the basis for design criteria that are intended to limit the risk of shock and other hazards due to transmission lines. The NESC calls for transmission lines to be designed with minimum vertical clearances to the ground so that the short-circuit current to ground produced from the largest anticipated vehicle or object is limited to less than 5 milliamperes. In NUREG 1437, Rev. 1, NRC indicated that the electrical shock issue is of small significance for transmission lines that are operated in adherence with the NESC (NRC 2013).

Like the existing transmission lines, all new transmission lines, switchyards, and associated structures required for power generation and distribution at the CRN Site and associated offsite areas would conform to the applicable NESC guidelines. Therefore, the impact on the public from acute effects of EMFs would be minor.

Because public exposure to EMFs from existing transmission lines would not change and EMFs associated with new transmission lines would be localized and can be decreased to negligible levels, impacts to the public resulting from EMF exposure would be minor. As such, impacts of EMFs on public and worker health is minor.

3.19.2.2.2.4 Occupational Health

In general, occupational health risks to workers and onsite personnel engaged in activities related to building and operating nuclear power plants would be dominated by occupational injuries (e.g., falls, electric shock, asphyxiation) or occupational illnesses. Historically, actual injury and fatality rates at nuclear reactor facilities have been lower than the average U.S. industrial rates. In 2019, the U.S. Bureau of Labor Statistics reported that the rate for “nuclear electric power generation” was 0.2 illness/injuries per 100 FTEs (BLS 2021a). The State of Tennessee also tracks annual incidence rates of injuries and illnesses for “utility system construction” but not for nuclear power generation. These records of statistics, combined with those discussed previously in Section 3.19.2.2.1, are used to estimate the likely number of occupational injuries and illnesses for the proposed new unit.

Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures to minimize worker exposures to injuries or illnesses (29 CFR Part 1910). Appropriate state and local statutes also must be considered when assessing the occupational hazards and health risks associated with the proposed Nuclear Technology Park. Compliance with site permits, adherence to worker safety and health procedures, and application of BMPs would be protective of workers during all phases of Nuclear Technology Park projects. TVA would implement Health and Safety Plans for the proposed site for building and operating SMRs. TVA would implement OSHA requirements throughout all phases of the proposed project. TVA would require all its employees, contractors, and subcontractors to review and comply with all safety policies and safe work practices, including all Federal and State regulations.

3.19.2.2.2.5 Transportation Related Effects

Nonradiological traffic related effects are primarily a function of workforce related commuting but are also influenced by trips associated with the delivery of materials to the CRN Site. As indicated in the PPE value (Table 2-4), operational phase activities would entail an average workforce of 500 workers on a daily basis. Normal delivery and services trips to the CRN Site are notably smaller than that expected during construction. Additionally, 1,000 temporary workers are estimated to be needed for refueling outages. Assuming an average of 1.3 workers per vehicle, the operational workforce would entail an estimated 385 vehicles that would enter and leave the CRN site on a daily basis. This would equate to an estimated increase of 770 trips that would be operations related on the regional roadway network. Assuming the average commuting distance of 50 miles for each worker the total annual operations fatalities related to building the facility represent an approximate 2 percent increase over the average 10 traffic fatalities per year that occurred in Roane County from 2012 to 2016. This percentage represents negligible increases relative to the current traffic fatality risks in the areas surrounding the proposed CRN Site. As such nonradiological impacts on traffic related safety would be minor.

3.19.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C, Area 2 and associated offsite areas would be developed in a manner similar to those described for development of Area 1 under Alternative B as the proposed actions, activities, and project elements would be similar. However, based on the area of land disturbance and related construction effort, impacts to public safety and nonradiological health under Alternative C would be slightly less than, those described for Alternative B. Operational impacts would be the same as Alternative B. Based on the discussion of the potential impacts and mitigation strategies above, impacts to public safety and nonradiological health from construction and operation of a Nuclear Technology Park under Alternative C would be minor.

3.19.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D the CRN Site and associated offsite areas would be developed in a manner similar to those described for Alternative B. Although Alternative D would entail the development of both Area 1 and Area 2 and would therefore entail additional effort for site preparation, equipment operation, and development. However, the proposed actions, activities, and project elements would be similar to those previously described for Alternative B. Therefore, impacts to public safety and nonradiological health under Alternative D are similar, but incrementally greater than those described for Alternative B. As such, impacts to public safety and nonradiological health under Alternative D would be minor.

3.19.2.5 Summary of Impacts to Nonradiological Public Health and Safety

As summarized in Table 3-66, TVA has determined that public safety and nonradiological health impacts associated with the implementation of Alternatives B, C, and D would be minor. This includes impacts relating to construction activities as well as impacts of operation, including workplace safety, etiological agents, electromagnetic fields, and occupational health.

Table 3-66. Summary of Impacts to Public Safety and Nonradiological Health

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Construction	Potential impacts during construction would be associated with activities including clearing and grubbing, excavation, and transport of materials and workforce.	Use of BMPs, safety procedures, and security measures would minimize possible safety effects. Minor increase in rate of transportation-related accidents during construction. Impacts associated with these activities would be minor. Based on magnitude of land area and construction activities, severity of impact as follows: Alternative D is greater than Alternative B, which is greater than Alternative C.
	Operation	Workforce safety hazards.	Use of BMPs, safety procedures, and security measures would minimize possible safety effects. Impacts to workplace safety would be minor.

Alternative	Project Phase	Impact	Severity
		Disease-Causing Agents: Thermal discharges from the proposed cooling system into the Clinch River have the potential to increase the growth of thermophilic microorganisms.	Epidemiological reports from the State of Tennessee indicate a very low risk of outbreaks from etiological agents associated with recreational water. Impacts resulting from an increase of thermophilic microorganisms would be minor.
		Electromagnetic Fields: Operation of power transmission systems generates both electric and magnetic fields, which have the potential to impact public and worker health. Potential for acute effects (electric shock) from transmission lines and associated equipment.	Transmission lines operate at an extremely low frequency, energy dissipated within the ROW and the very low residual amount is reduced to background levels near the ROW edge. Design would conform to NESC guidelines to enhance worker/public safety. Tower designs preclude direct public access to the conductors. Overall, impact from electromagnetic fields would be minor.
		Occupational Health: Occupational injuries and illnesses could result during operation.	Occupational injury and fatality risks are reduced by strict adherence to NRC and OSHA safety standards, practices, and procedures. Impact to occupational health would be minor.
		Transportation Related Effects: Potential for minor increase in transportation-related accident rate.	Minor increase in rate of transportation-related accidents during construction. Strict adherence to BMPs and OSHA standards during construction activities would minimize possible safety effects. Transportation related impacts would be minor.

3.20 Radiological Effects of Normal Operation

3.20.1 Affected Environment

3.20.1.1 Exposure Pathways

Small quantities of radioactive gases and liquids are expected to be released to the environment during normal operation of the Nuclear Technology Park. The major pathways of concern are those that could result in any significant offsite radiological dose. The relative importance of a pathway depends on the type and amount of radioactivity released, its environmental transport mechanism, and usage of the land surrounding the CRN Site (e.g., residences, gardens). Factors such as the relative location of homes and the local production of milk cattle and vegetable gardens are taken into consideration when evaluating pathways of radiological exposure. In addition, the environmental transport mechanisms for gaseous effluents are dependent on the meteorological characteristics of the area, and for liquid effluents, are dependent on the characteristics of the affected water sources in the area.

Radiation doses to humans from the potential release of radionuclides during operation of the CRN Nuclear Technology Park have been evaluated for gaseous emissions released to the atmosphere and for liquid effluents released into the Reservoir. The critical pathways to humans for routine releases at the CRN Site are radiation exposure from submersion in air, inhalation of contaminated air, and ingestion (e.g., drinking milk from an animal that feeds on open pasture near the CRN Site, eating vegetables and meat raised near the CRN Site, eating fish caught in the Reservoir, and drinking water from downstream sources). Other less significant pathways considered include external irradiation from radionuclides deposited on the ground surface, activities on the shoreline of the Reservoir, and direct radiation from the Nuclear Technology Park. The relative importance of the potential pathways to humans has been evaluated by calculating the doses from routine operation for each pathway.

The release of small amounts of radioactive effluents is permitted as long as releases comply with the requirements in Title 10 of the CFR (10 CFR) Part 20 and 40 CFR Part 190. The design and operation of the Nuclear Technology Park at the CRN Site would also limit gaseous and liquid effluent releases such that doses to the public would be ALARA in accordance with the objectives of 10 CFR 50, Appendix I.

The exposure pathways considered and the calculation methods used to estimate doses to the maximally exposed individual (MEI) and to the population within 50 miles surrounding the CRN Site were based on NRC Regulatory Guide (RG) 1.109, Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR 50, Appendix I, and on NRC RG 1.111, Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light Water-Cooled Reactors. The MEI is defined as a member of the general public at an assumed location that results in the maximum possible calculated dose. The source terms used in estimating exposure pathway doses were based on the total projected bounding site release activity levels, based on the PPE approach. There are no unusual animals, plants, agricultural practices, game harvests, or food processing operations within the surrounding region requiring special consideration.

Exposure pathways considered when evaluating dose to nonhuman biota include the following: ingestion of aquatic foods, ingestion of water, external exposure from water immersion or surface effect, inhalation of airborne radionuclides, external exposure to immersion in gaseous effluent plumes, and surface exposure from deposition of iodine and particulates from gaseous effluents.

3.20.1.2 Exclusion Area Boundary

As defined in 10 CFR Part 100, the Exclusion Area Boundary (EAB) identifies the area surrounding the reactor(s), in which TVA has the authority to determine all activities including exclusion or removal of personnel and property from the area. The boundary on which limits for the release of radioactive effluents are based is bounded by the property boundary and is identified in Figure 2-1. There are no residents living in this exclusion area and access within the property boundary is controlled. Areas outside the EAB are unrestricted areas in the context of 10 CFR Part 20 and open to the public.

3.20.1.3 Reasonably Foreseeable Future Actions in Proximity to the CRN Site

As noted in Section 3.1.3, TVA identified several foreseeable future actions in proximity to the CRN Site. The scope of these other proposed actions is expected to result in radiological effects that could contribute to regional impacts. Many of the proposed actions identified entail both construction and operational phase activities, but do not have radiological effects. However, those listed that have a potential to contribute to cumulative radiation exposures include the past operations at ORR, the existing and proposed ORR facilities (Y-12, ORNL, and disposal sites); the existing EnergySolutions Bear Creek Facility, and proposed operations at the CRN site, and the proposed Kairos Power Hermes Project. Furthermore, none of the identified reasonably foreseeable future actions are considered to have a causal relationship to the proposed development of the CRN Site. However, given the presence of other facilities in the vicinity of the CRN Site that may have radiological emissions and associated effects, further consideration of reasonably foreseeable future actions and their effects on radiological effects are included in the following section as appropriate.

3.20.2 Environmental Consequences

The information provided in the following sections is based on the analysis in the ESPA for SMRs located at Area 1 of the Nuclear Technology Park at the CRN Site. For the purposes of this Draft PEIS, this analysis is used as a surrogate for SMRs and advanced non-LWRs located at Area 1, to evaluate potential impacts.

3.20.2.1 Alternative A – No Action Alternative

Under this alternative, a Nuclear Technology Park at the CRN Site would not be constructed. As such, there would be no radiological effects.

3.20.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

Estimates of doses to the MEI and the general population during routine operation for Alternative B, and for both the liquid and gaseous effluent pathways, are described in the following paragraphs. Dose modeling to evaluate the dose from the direct radiation pathway, though not conducted for this Draft PEIS, would be conducted at a later date in conjunction with potential technology-specific construction applications to the NRC and subsequent NEPA analysis, as necessary. The direct radiation doses from the reactors are expected to be negligible based on operating data for existing large PWRs. NUREG-1437, Rev. 1 (NRC 2013), states that direct radiation from an LWR is due primarily to Nitrogen-16, a radionuclide produced in the reactor core, and because the primary coolant of an LWR is contained in a heavily shielded area, dose rates in the vicinity of LWRs are generally undetectable and less than 1 millirem (mrem)/year at the site boundary. However, it was conservatively assumed in the ESPA that the total direct radiation dose from all units on the CRN Site would be 1 mrem/year at the site boundary.

3.20.2.2.1 Liquid Pathways

The LADTAP II computer program, as described in NUREG/CR-4013, LADTAP II – Technical Reference and User Guide, was used to calculate hypothetical doses to the MEI and to the general population surrounding the CRN Site from normal operation of the SMR(s) at the CRN Site. This program implements the radiological exposure models described in NRC RG 1.109 to estimate the dose resulting from modeled radioactive releases in liquid effluents. A conservative site-specific mean flowrate was used and the transit time from liquid discharge to receptor was conservatively assumed to be zero.

LADTAP II was used to evaluate both internal and external doses to the MEI and the general population from radionuclides in liquid effluents based on the following pathways:

- Internal exposure from ingestion of aquatic foods
- Internal exposure from ingestion of drinking water
- Internal exposure from ingestion of milk and meat from livestock consuming water and pasture feed from farms irrigated by contaminated water
- Internal exposure from ingestion of vegetables and fruits from farms irrigated by contaminated water
- External exposure to shoreline sediments
- External exposure from boating and swimming

Aquatic food consumption rates, water consumption rates, and aquatic recreation usage rates used for the average individual and the MEI are based on the values in NRC RG 1.109 Tables E-4 and E-5, respectively. Population consumption rates of aquatic food obtained from the Reservoir are for the projected 2067 population within 50 miles of the CRN Site. The resulting liquid effluent doses are shown in Table 3-67. Although contaminants were not detected in sediments near the CRN Site, the TDEC Division of Water Pollution Control has issued fish consumption advisories for Watts Bar Reservoir due to PCBs and for Melton Hill Reservoir due to PCBs and chlordane. These fish consumption advisories were issued because these contaminants were detected in sediments in other areas of these reservoirs.

Table 3-67. Liquid Effluent Doses from All Units to MEI (mrem/yr)

Pathway	Total Body	GI-LLI	Liver	Kidney	Lung	Skin	Thyroid	Bone
Fish	9.2E-02	4.5E-02	1.1E-01	3.2E-02	1.2E-02	0	3.2E-02	1.6E-01
Invertebrate	2.3E-02	2.3E-01	5.2E-02	7.7E-03	2.0E-03	0	7.7E-03	3.4E-02
Drinking	1.3E-02	1.7E-02	2.1E-02	1.8E-01	1.5E-02	0	1.8E-01	1.9E-02
Shoreline activities	1.1E-04	1.1E-04	1.3E-04	1.3E-04	1.3E-04	7.0E-04	1.3E-04	1.3E-04
Swimming	8.8E-06	8.8E-06	1.0E-05	1.0E-05	1.0E-05	0	1.0E-05	1.0E-05
Boating	4.4E-06	4.4E-06	5.1E-06	5.1E-06	5.1E-06	0	5.1E-06	5.1E-06

Pathway	Total Body	GI-LLI	Liver	Kidney	Lung	Skin	Thyroid	Bone
Irrigated Vegetables	2.2E-02	3.2E-02	6.8E-02	1.8E-01	2.2E-02	0	1.8E-01	2.1E-01
Irrigated Milk	1.4E-03	1.5E-02	5.1E-02	2.5E-01	1.4E-02	0	2.5E-03	1.1E-02
Irrigated Meat	3.5E-02	9.9E-02	4.2E-02	5.0E-03	1.7E-03	0	5.0E-01	1.4E-01
Total Dose	1.7E-01	4.4E-01	3.1E-01	6.6E-01	6.8E-02	7.0E-04	6.6E-01	5.4E-01
Age group[1]	Adult	Adult	Child	Child	Child	Teen	Child	Child

[1]The age group receiving the maximum dose for each organ shown.
Notes:
GI-LLI = Gastrointestinal – Lower Large Intestine
mrem/yr = millirems per year
MEI = maximum exposed individual

3.20.2.2.2 Gaseous Pathways

The GASPAR II computer program was used to calculate hypothetical doses from gaseous pathways to offsite receptors from normal operation of the SMR(s) at the CRN Site. This program, described in NUREG/CR-4653, GASPAR II – Technical Reference and User Guide, implements the radiological exposure models described in NRC RG 1.109 for radioactivity releases in gaseous effluents. Routine dilution and deposition estimates were calculated using the XOQDOQ modeling program, which is the dispersion model for evaluating routine releases recommended by the NRC in NUREG/CR-2919, XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations. Site-specific, validated meteorological data for June 2011 through May 2013 were used as input to the model. The site-specific dilution and deposition estimates were used by the GASPAR II computer program to calculate radiation doses.

By using projections of food production and consumption rates coupled with the projected population within a 50-mile radius of the CRN Site, GASPAR II evaluated both external and internal hypothetical exposures to gaseous effluents from the operation of the SMR(s) at the CRN Site based on the following pathways:

- External exposure to gases
- External exposure to ground contaminated by gases
- Inhalation of gases
- Ingestion of milk contaminated from the grass-to-cow-to-milk pathway
- Ingestion of contaminated vegetables and meats

Annual consumption rates for the average individual and the MEI were obtained from NRC RG 1.109 Tables E-4 and E-5, respectively. The projected total 2067 population within a 50-mile radius of the CRN Site as a function of direction and distance was used in the analysis. The resulting gaseous effluent doses are shown in Table 3-68.

Table 3-68. Gaseous Effluent Doses from All Units to MEI

Location	Pathway		Dose for All Units (mrem/yr)							
			Total Body	**GI-Tract**	**Bone**	**Liver**	**Kidney**	**Thyroid**	**Lung**	**Skin**
Site Boundary (0.21 miles WNW)	External	Plume	4.0E+01	4.0E+01	4.0E+01	4.0E+01	4.0E+01	4.0E+01	4.1E+01	8.4E+01
		Ground	2.9E+00	2.9E+00	2.9E+00	2.9E+00	2.9E+00	2.9E+00	2.9E+00	3.3E+00
		Total	4.3E+01	4.3E+01	4.3E+01	4.3E+01	4.3E+01	4.3E+01	4.3E+01	8.8E+01
	Inhalation	Adult	4.8E+00	5.0E+00	9.4E-01	5.0E+00	5.1E+00	4.1E+01	6.6E+00	0
		Teen	4.9E+00	5.0E+00	1.2E+00	5.2E+00	5.3E+00	5.2E+01	7.7E+00	0
		Child	4.3E+00	4.3E+00	1.4E+00	4.7E+00	4.7E+00	6.2E+01	6.7E+00	0
		Infant	2.5E+00	2.5E+00	7.3E-01	2.8E+00	2.8E+00	5.5E+01	4.2E+00	0
	All	Adult	4.8E+01	4.8E+01	4.4E+01	4.8E+01	4.8E+01	8.4E+01	5.0E+01	8.8E+01
		Teen	4.8E+01	4.8E+01	4.4E+01	4.8E+01	4.8E+01	9.5E+01	5.1E+01	8.8E+01
		Child	4.7E+01	4.7E+01	4.4E+01	4.8E+01	4.8E+01	1.0E+02	5.0E+01	8.8E+01
		Infant	4.5E+01	4.5E+01	4.4E+01	4.6E+01	4.6E+01	9.8E+01	4.8E+01	8.8E+01
Residence (0.66 miles WNW)	External	Plume	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.0E+00	5.1E+00	1.1E+01
		Ground	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	4.3E-01	5.1E-01
		Total	5.4E+00	5.4E+00	5.4E+00	5.4E+00	5.4E+00	5.4E+00	5.4E+00	1.1E+01
	Inhalation	Adult	6.0E-01	6.2E-01	1.1E-01	6.3E-01	6.4E-01	5.1E+00	8.2E-01	0
		Teen	6.1E-01	6.3E-01	1.4E-01	6.5E-01	6.6E-01	6.4E+00	9.6E-01	0
		Child	5.4E-01	5.4E-01	1.7E-01	5.8E-01	5.9E-01	7.6E+00	8.2E-01	0
		Infant	3.1E-01	3.1E-01	8.9E-02	3.5E-01	3.4E-01	6.8E+00	5.2E-01	0
Vegetable Garden (1.15 miles WNW)	Veg	Adult	1.1E+00	1.1E+00	3.7E+00	1.1E+00	1.0E+00	4.0E+00	1.0E+00	0
		Teen	1.5E+00	1.5E+00	5.8E+00	1.6E+00	1.5E+00	5.2E+00	1.4E+00	0
		Child	3.1E+00	3.0E+00	1.4E+01	3.2E+00	3.1E+00	1.0E+01	3.0E+00	0
Meat Animal (0.70 miles WNW)	Meat	Adult	7.0E-01	7.5E-01	2.7E+00	7.0E-01	6.9E-01	9.0E-01	6.8E-01	0
		Teen	5.5E-01	5.8E-01	2.3E+00	5.6E-01	5.5E-01	7.0E-01	5.4E-01	0
		Child	9.6E+00	9.8E+00	4.3E+00	9.8E+00	9.6E+00	1.2E+00	9.6E-01	0

Location	Pathway		Dose for All Units (mrem/yr) Total Body	GI-Tract	Bone	Liver	Kidney	Thyroid	Lung	Skin
MEI	All	Adult	7.8E+00	7.9E+00	1.2E+01	7.9E+00	7.8E+00	1.5E+01	8.0E+00	1.1E+01
		Teen	8.1E+00	8.1E+00	1.4E+01	8.2E+00	8.1E+00	1.8E+01	8.4E+00	1.1E+01
		Child	1.0E+01	1.0E+01	2.3E+01	1.0E+01	1.0E+01	2.4E+01	1.0E+01	1.1E+01
		Infant	5.8E+00	5.8E+00	5.5E+00	5.8E+00	5.8E+00	1.2E+01	6.0E+00	1.1E+01
		Max	1.0E+01	1.0E+01	2.3E+01	1.0E+01	1.0E+01	2.4E+01	1.0E+01	1.1E+01
		Group	Child	Child	Child	Child	Child	Child	Child	All

Note: In the first four rows for the MEI, MEI doses are obtained by conservatively summing the residence total external dose with the residence inhalation, vegetable, and meat maximum doses even though they are not all at the same location.

3.20.2.2.3 Impacts to Members of the Public

This subsection summarizes the impacts to individuals from radioactive effluents released during normal operation of the Nuclear Technology Park at Area 1. Impacts to the public are evaluated by comparing estimated dose to regulatory acceptance criteria. Doses to the MEI and collective doses to the public were evaluated.

Doses to the MEI from liquid effluent from all units are shown in Table 3-67 (all units), and doses from gaseous effluent are shown in Table 3-68 (all units).

Table 3-69 summarizes the estimated doses to the MEI per operating unit and compares them to the ALARA design objectives from 10 CFR Part 50, Appendix I to determine compliance with dose rates protective of the general public. All of the doses are less than or equal to the corresponding regulatory dose limits in 10 CFR Part 50, Appendix I; thus, the criteria are met.

Table 3-69. Compliance of MEI Annual Doses Per Unit with 10 CFR 50, Appendix I Criteria

Type of Dose	Location	Annual Dose	Limit[5]
Liquid Effluent[1]			
Total Body (mrem)	Reservoir	2.0E-02	3
Maximum Organ – GI-LLI (mrem)	Reservoir	9.7E-02	10
Gaseous Effluent			
Gamma Air[2] (mrad)	Site Boundary	9.5E+00	10
Beta Air[2] (mrad)	Site Boundary	1.2E+01	20
Total Body[3] (mrem)	Residence	9.0E-01	5
Skin[3] (mrem)	Residence	1.9E+00	15
Iodines and Particulates[4]			
Maximum Organ – Thyroid (mrem)	Residence/Garden/Meat	4.5E+00	15

[1]Annual liquid effluent doses for the MEI determined by LADTAP II; the MEI is the adult receptor.
[2]Annual gaseous effluent doses for the MEI determined by GASPAR II; dose for a receptor at the site boundary, near ground level.
[3]Annual gaseous effluent external doses for the MEI determined by GASPAR II.
[4]Annual gaseous effluent total thyroid doses from iodines and radioactive material in particulate form for the MEI determined by GASPAR II.
[5]Dose limits in 10 CFR 50, Appendix I.

Notes:
mrem = millirem
mrad = millirad
MEI = maximum exposed individual

Annual doses to the MEI from the Nuclear Technology Park are summarized in Table 3-70. The sum of the direct radiation dose, liquid effluent dose, and gaseous effluent dose yields an annual total body dose of 11.0 mrem/year. (As discussed previously, the direct radiation dose would be negligible but is assumed to be 1 mrem/year.) Similarly, the sum of direct, liquid, and gaseous contributions for the thyroid and the bone pathways yields a total dose of 25 mrem/year and 24 mrem/year respectively. The EPA radiation protection standards in 40 CFR Part 190 provide criteria that apply to the annual dose equivalent received by members of the general public exposed to planned discharges of radioactive materials from the operation of nuclear power plants. The most restrictive portion of the standards specified in this regulation states that the annual dose equivalent shall not exceed 25 mrem/year to the whole body. The regulation also provides standards limiting the annual dose equivalent to the thyroid (75 mrem/year) and any other organ (25 mrem/year). As shown in Table 3-70, the total body annual dose, estimated to be 11.0 mrem/year, is below the limit of 25 mrem/year. Similarly, total doses to the thyroid and bone also are below their respective limits. This annual dose was compared to EPA's environmental radiation protection standards for individual members of the public from 40 CFR 190.10 to determine compliance. The doses are less than the corresponding regulatory dose limits; thus, the criteria are met. As indicated in NUREG-1555, demonstration of compliance with the limits of 40 CFR 190 is considered to also indicate compliance with the 100 mrem limit in 10 CFR 20.1301.

Table 3-70. Compliance of MEI Doses from All Units with 40 CFR 190.10 Criteria (mrem/yr)

Pathway	Liquid[1]	Gaseous[2]	Direct[3]	Total[4]	Limit[5]
Total Body	1.7E-01	1.0E+01	1.0E+00	1.1E+01	25
Thyroid	6.6E-01	2.4E+01	0.0E+00	2.5E+01	75
Other Organ - Bone	5.4E-01	2.3E+01	0.0E+00	2.4E+01	25

[1]Annual liquid effluent doses for the MEI determined by LADTAP II; the MEI is the adult receptor for total body dose and the child for thyroid and bone dose.
[2]Annual gaseous effluent doses for the MEI determined by GASPAR II; the MEI is the child receptor.
[3]Annual direct dose is assumed to be 1 mrem per year.
[4]Site totals are summed across receptors and locations to provide a conservative site total.
[5]Dose limits in 40 CFR 190.10.

Notes:
mrem/yr = millirems per year
MEI = maximum exposed individual

Collective doses to the population from liquid and gaseous effluents are shown in Table 3-71 and Table 3-72, respectively. Annual collective doses to the public based on the population within 50 miles of the CRN Site also were estimated based on the operation of all SMR units. Table 3-73 shows the total body and thyroid doses from all liquid and gaseous pathways expressed in units of person-rems per year. For comparison, Table 3-73 also includes the annual collective background radiation dose calculated from the estimated population within 50 miles of the CRN Site in 2067 and the average natural background dose in the U.S. of approximately 311 mrem/year. The total of the doses to the population for the total body (68 person-rem/year) and thyroid (100 person-rem/year) are negligible compared to the background dose of over 820,000 person-rem/year.

Table 3-71. Liquid Effluent Doses Per Unit to Population Within 50 Miles[1] (person-rem/yr)

Pathway	Total Body	Thyroid
Sport fish	7.1E-01	1.7E-01
Commercial fish	7.8E-01	1.5E-01
Sport invertebrate	1.3E-01	6.3E-02
Commercial invertebrate	3.9E-01	1.7E-01
Drinking water	3.8E-01	1.2E+00
Shoreline activities	3.4E-02	3.4E-02
Swimming	4.1E-03	4.1E-03
Boating	2.0E-03	2.0E-03
Irrigated milk	2.2E-04	9.3E-04
Irrigated meat	1.7E-04	2.1E-04
Irrigated non-leafy vegetables	5.3E-04	4.0E-04
Irrigated leafy vegetables	6.7E-05	3.2E-04
Total Dose	2.4E+00	1.8E+00

[1]Annual liquid effluent dose for the 50-mile population determined by LADTAP II.
Notes: person-rem/yr = person-rems per year

Table 3-72. Gaseous Effluent Dose per Unit to Population Within 50 Miles[1] (person-rem/yr)

Pathway	Total Body	Thyroid
Plume	8.0E-01	8.0E-01
Ground	5.7E-01	5.7E-01
Inhalation	1.4E+00	8.1E+00
Vegetable	7.7E+00	7.6E+00
Cow milk	1.8E+00	4.7E+00
Meat	2.6E+00	2.8E+00
Total Dose	1.5E+01	2.5E+01

[1]Annual gaseous effluent dose for the 50-mile population determined by GASPAR II.
Notes: person-rem/yr = person-rems per year

Table 3-73. Doses from All Units to Population Within 50 Miles (person-rem/yr)[1]

Pathway	Total Body	Thyroid
Liquid	9.6E+00	7.2E+00
Gaseous		
Noble gases	3.2E+00	3.2E+00
Iodines	8.0E-02	4.0E+01
Particulates	2.9E+00	2.3E+00

Pathway	Total Body	Thyroid
C-14	4.0E+01	4.0E+01
H-3	1.3E+01	1.3E+01
Gaseous Total	6.0E+01	1.0E+02
Pathways Total	6.8E+01	1.0E+02
Background Radiation[2]	8.3E+05	

[1]Doses per unit multiplied by 4 to approximate doses from all units

[2]The background dose is obtained by multiplying the average natural background dose rate in the U.S. of 311 mrem/yr (0.311 rem/yr) by the 2067 population of 2.66E6 persons.

Because the doses to members of the public from operation of the Nuclear Technology Park at the CRN Site based on the example analyses are calculated to be within the regulatory limits for protection of the MEI and the contribution to the collective population dose is estimated to be negligible compared to background, the radiological impacts to members of the public from normal operation of the Nuclear Technology Park at the CRN Site would be minor.

3.20.2.2.4 Impacts to Biota Other than Members of the Public

This subsection examines potential radiation exposure pathways to biota other than members of the public to determine if these pathways could result in doses to biota greater than the doses predicted for humans. This assessment uses surrogate biota species that provide representative information on the various dose pathways potentially affecting broader classes of living organisms, including the important terrestrial and aquatic species identified for the CRN Site. Surrogates are used because important attributes are well defined and are accepted as a method for judging doses to biota. As described in NUREG/CR-4013 the use of surrogate biota in this analysis includes the use of algae as a surrogate for aquatic plants and the use of invertebrates as a surrogate for freshwater mollusks and crayfish. Other surrogates used in this analysis include fish, muskrat, raccoon, heron, and duck. There are no unusual plants, animals, or pathways in the vicinity of the CRN Site that would require specific evaluation.

Doses to surrogate biota from liquid effluents were calculated using the LADTAP II program and the parameters included in the computer program. As described in NUREG-CR/4013, pathways evaluated for aquatic biota include internal exposure from bioaccumulation and external exposure from swimming and the shoreline. Exposure pathways for terrestrial biota include ingestion of aquatic biota and external exposure from swimming and the shoreline.

Because the GASPAR II program does not perform biota dose calculations, the human doses calculated for the gaseous pathway were assumed to be applicable to biota. Because biota are closer to the ground than are humans, the ground deposition doses calculated by the GASPAR II computer program were doubled. This is consistent with the approach used for biota in LADTAP II. It was also assumed that the internal dose and the external plume dose received by the biota are the same as the doses received by humans. This is reasonable because the plume dose is independent of the size of the receptor, and it is conservative because the internal dose for humans is based on a much longer retention period than would be expected for biota.

The total doses to surrogate biota from liquid and gaseous effluents released from normal operation of the Nuclear Technology Park at the CRN Site are shown in Table 3-74. The total dose to each of the biota was calculated by summing the annual doses from gaseous and liquid pathways in millirad (mrad) per year (mrad/year). The total doses also were converted to units of mrad/day for comparison to criteria for the protection of biota.

Use of exposure guidelines, such as 40 CFR Part 190, which regulate radionuclide exposure from commercial nuclear facilities to members of the public in unrestricted areas, is considered very conservative when evaluating calculated doses to biota. As noted in NUREG-1555, Subsection 5.4.4, the International Council on Radiation Protection uses human protection to infer environmental protection from the effects of ionizing radiation. In addition, no biota have been discovered that show significant changes in morbidity or mortality due to radiation exposures from nuclear power plants.

The International Atomic Energy Agency (IAEA) and National Council on Radiation Protection and Measurements (NCRP) reported that a chronic absorbed dose rate of no greater than 1,000 mrad/day would ensure protection of aquatic organism populations. IAEA also concluded that a chronic absorbed dose rate of 100 mrad/day or less does not appear to cause observable changes in terrestrial animal populations. As shown in Table 3-74, total doses to the surrogate aquatic animals are 0.0045 mrad/day for fish and 0.021 mrad/day for invertebrates. For surrogate terrestrial biota, total body doses range from 0.23 mrad/day for the raccoon to 0.25 mrad/day for the heron. The highest of these doses (0.021 mrad/day for aquatic biota and 0.25 mrad/day for terrestrial biota) are significantly less than their respective dose rate criteria based on the NCRP and IAEA guidance (i.e., 1 rad/day and 0.1 rad/day for aquatic and terrestrial biota, respectively).

Because the doses to surrogate biota presented in Table 3-74 are significantly below the IAEA/NCRP biota dose guidelines, the impact to biota other than members of the public due to operation of the Nuclear Technology Park at the CRN Site is minor.

Table 3-74. Nonhuman Biota Dose Rates from All SMR Units at the CRN Site

Biota	Gaseous[1] (mrad/yr)	Liquid[2] (mrad/yr)	Total[3] (mrad/yr)	Total[4] (mrad/day)
Algae	0	2.5E+00	2.5E+00	6.7E-03
Invertebrate	0	7.6E+00	7.6E+00	2.1E-02
Fish	0	1.6E+00	1.6+00	4.5E-03
Muskrat	8.4E+01	3.4E+00	8.7E+01	2.4E-01
Raccoon	8.4E+01	1.3E+00	8.5E+01	2.3E-01
Heron	8.4E+01	8.9E+00	9.3E+01	2.5E-01
Duck	8.4E+01	3.2E+00	8.7E+01	2.4E-01

[1]Total body dose determined from GASPAR II for human receptors located 0.25 mi from the reactor release point was used to model biota dose.
[2]Biota dose from liquid effluent as modeled from LADTAP II.
[3]Annual total body dose for biota from gaseous and liquid effluent.
[4]Daily total body dose for biota from gaseous and liquid effluent as determined by dividing the annual dose by 365 days per year.
Notes: mrad/yr = millirads per year; mrad/day = millirads per day

3.20.2.2.5 Occupational Doses

The projected radiation dose to a construction worker from licensed operation would be less than 100 mrem annually as specified in 10 CFR 20.1301. The annual occupational dose to operational workers, including outage activities, is dependent on the specific plant design chosen, and is determined in accordance with applicable criteria in 10 CFR 20 and 10 CFR 50 Appendix I. Individual doses to operational workers would be maintained within 5 rem annually as specified in 10 CFR 20.1201 and incorporate ALARA provisions to maintain doses below this limit. Therefore, the impacts from radiation exposure to the operation workforce would be minor based on individual doses for workers being maintained within regulatory limits.

3.20.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Under Alternative C, the cumulative electrical output is the same as that under Alternative B and the radiological effects for Area 2 are considered to be similar to Area 1, based on the close proximity of the locations. Therefore, the environmental consequences from the radiological effects of normal operation would also be minor for Alternative C.

3.20.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Under Alternative D, the cumulative electrical output is the same as that under Alternative B and the radiological effects are considered to be similar to Area 1, based on the close proximity of Area 1 and Area 2. Therefore, the environmental consequences from the radiological effects of normal operation would also be minor for Alternative D.

3.20.2.5 Potential Contributing Effects of Other Reasonably Foreseeable Future Actions

As described in Section 3.20.1.3, several existing and reasonably foreseeable future actions were identified in proximity to the CRN Site that may have radiological emissions. These include existing operations at ORNL, the Y-12 complex, the existing EnergySolutions Bear Creek Facility, and the proposed Kairos Hermes Project.

In the 2020 ORR Annual Site Environmental Report, (DOE 2021) detailed analysis of the effective dose received by the MEI from air pathways was determined to be 0.4 mrem/yr. The effective dose to the MEI from water, including drinking, bathing, irrigating, recreating, and fish consumption, was determined to be 2 mrem/yr. The effective dose from consumption of wildlife harvested on the ORR, including turkeys, geese, and deer, was determined to be 0.07 mrem/yr. Combined, the annual dose to the hypothetical MEI from normal operations at ORR is 3 mrem/yr. This is approximately 1 percent of the average background radiation dose in the United States (DOE 2021). According to Kairos Power the proposed Hermes Project would result in an estimated total body dose to the hypothetical MEI from gaseous effluents and direct radiation during operation would be 1.2 mrem/yr. (Kairos Power 2021).

There are several non-DOE facilities on or near the ORR that could also contribute to radiation doses to the public. In 2017, DOE requested information from these facilities regarding their potential radiation doses to members of the public, and fifteen facilities responded with information about their dose contributions. Ten facilities had no radiological emissions. Three facilities reported annual doses from airborne releases with annual doses of 0.4 mrem, 0.21 mrem, and less than 10 mrem. Doses from direct radiation ranged from none to 2 mrem based measurements at the facility and immediate surrounding (DOE 2018).

The sum of the direct radiation dose, liquid effluent dose, and gaseous effluent dose yields an annual total body dose of 11 mrem/yr for the MEI due to operations of the Nuclear Technology Park at the CRN Site. (See Section 3.20.2.2.3, Impacts to Members of the Public, for further details.) Even if it is conservatively assumed that an individual could be exposed to a total dose based on adding the ORR's total dose estimate of 3 mrem/yr, 1.2 mrem/yr from the Kairos Power Hermes Project, and the other non-DOE sources evaluated by the DOE, the cumulative dose impact would be less than the NRC dose limit for members of the public of 100 mrem/yr. Accordingly, cumulative radiological impacts to members of the public during operation would be minor and the incremental contribution to cumulative impacts from the Nuclear Technology Park at the CRN Site would also be minor.

3.20.2.6 Summary of Impacts from Radiological Effects of Normal Operation

As summarized in Table 3-75, the impacts of radiological effects from normal operation at the CRN Site are minor. Doses to members of the public and to operation workforces would be maintained within regulatory limits as part of normal operation and, therefore, the environmental impacts are considered to be minor. Additionally, doses to biota would be well below the IAEA/NCRP biota dose guidelines. Therefore, the environmental impact to biota other than members of the public due to the radiological effects of normal operation at the CRN Site is minor.

Table 3-75. Summary of Impacts from the Radiological Effects of Normal Operation

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Operation	Direct dose from normal operation.	Minor impacts. Direct doses from nuclear plants are negligible (less than 1 mrem/year at the site boundary). Cumulative effects from other nearby facilities are minor.
		Release of liquid radiological effluents.	Minor impacts. Doses to the maximally exposed individual (i.e., member of the public) from liquid and gaseous effluents would meet the regulatory limits in 10 CFR 20, 40 CFR 190, and 10 CFR 50, Appendix I. Dose to occupation workers would also meet the applicable regulatory limits. The total of the doses to the population near the CRN Site are negligible compared to the background dose. Doses to aquatic and terrestrial biota are well below the IAEA/NCRP biota dose guidelines. In addition, no biota have been discovered that show significant changes in morbidity or mortality due to radiation exposures predicted for nuclear power plants.

Alternative	Project Phase	Impact	Severity
		Release of gaseous radiological effluents.	Minor impacts. Doses to the maximally exposed individual (i.e., member of the public) from liquid and gaseous effluents would meet the regulatory limits in 10 CFR 20, 40 CFR 190, and 10 CFR 50, Appendix I. Dose to occupation workers would also meet the applicable regulatory limits. The total of the doses to the population near the CRN Site are negligible compared to the background dose. Doses to aquatic and terrestrial biota are well below the IAEA/NCRP biota dose guidelines. In addition, no biota have been discovered that show significant changes in morbidity or mortality due to radiation exposures predicted for nuclear power plants.

3.21 Uranium Fuel Use Effects

The environmental effects from the uranium fuel cycle (UFC) to support operation of SMRs at the CRN Site using Table S-3, “Table of Uranium Fuel Cycle Environmental Data,” in 10 CFR 51.51, are described and assessed in this subsection. The UFC is defined as the total of those options and processes associated with the provision, utilization, and ultimate disposition of fuel for nuclear power reactors.

3.21.1 Affected Environment

3.21.1.1 Uranium Fuel Cycle

The fuel cycles for SMRs and advanced non-LWRs are assumed to be similar to the UFC cycle referenced in NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants,” Rev. 0 (NRC 1996) and Rev. 1 (NRC 2013), for the purposes of impact evaluations.

The evaluation in this section addresses the following stages of the UFC:

- Uranium mining and milling
- Conversion to uranium hexafluoride
- Enrichment of uranium-235
- Fabrication of reactor fuel
- Reprocessing of irradiated fuel

Natural uranium is extracted from the earth through either open-pit or underground mining or by an in-situ leaching (ISL) process. Recent UFC trends include increasing use of ISL, which does not produce mine tailings and lowers the release of radon gas. ISL involves injecting an acidic solution into the groundwater aquifer to partition uranium from a solid to aqueous phase and then pumping the uranium-rich solution to the surface for further processing. The ore or leaching solution is processed to produce uranium oxide (U_3O_8). The uranium oxide is then converted to uranium hexafluoride (UF_6) in preparation for the enrichment process.

The UF_6 is transported to a separate facility for uranium enrichment. Uranium enrichment involves increasing the percentage of the more fissile isotope U-235 and decreasing the percentage of the isotope U-238. Current enrichment technologies use only a small fraction of the electrical energy per separation unit compared to gaseous diffusion, which was assumed to be the means of enrichment as the basis for Table S-3 of 10 CFR 51.51.

At a fuel-fabrication facility, the enriched uranium is converted from UF_6, typically to UO_2. The UO_2 is formed into pellets, inserted into hollow rods, and loaded into fuel assemblies. The fuel assemblies are placed in the reactor to produce power. For advanced non-LWRs, the fuels being considered include homogenous fuel salts (e.g., U-Cl) and HALEU TRISO coated pebble fuel.

Existing LWRs use nuclear fuel more efficiently due to higher fuel burnup. Less uranium fuel per year of reactor operation is required to generate the same amount of electricity as compared to basis for Table S-3 of 10 CFR 51.51.

After a significant amount of the U235 contained within a fuel assembly has decayed, the nuclear fission process becomes inefficient, and spent fuel assemblies are then replaced. For existing LWRs, spent fuel assemblies are placed in an onsite, interim, wet storage to allow for short-lived fission product decay and to reduce the heat generation rate. Afterward, the fuel assemblies are transferred to dry storage casks and stored onsite at an Independent Spent Fuel Storage Installation (ISFSI) while awaiting transportation to a spent fuel storage facility or a waste repository.

The Nuclear Non-proliferation Act of 1978 banned any reprocessing or recycling of spent fuel from U.S. commercial nuclear power. The ban on reprocessing spent fuel was lifted in 1981, but the combination of economics, uranium ore stockpiles, and nuclear industry stagnation provided little incentive for the industry to pursue reprocessing. The Energy Policy Act of 2005 authorized the DOE to research and develop proliferation-resistant fuel recycling and transmutation technologies that minimize environmental or public health and safety effects. Therefore, federal policy does not prohibit reprocessing, but there are currently no mature projects pursuing commercial reprocessing or recycling of spent fuel in the U.S.

Table S-3 of 10 CFR 51.51 provides estimates of the environmental effects of the UFC. The effects are calculated for a reference 1000 MWe LWR operating at an annual capacity factor of 80 percent for an effective electric output of 800 MWe. This LWR design is referred to as the reference plant throughout this section. Data are calculated and presented in tables for land use, water consumption, thermal effluents, radioactive releases, waste burial, and radiation doses. In accordance with 10 CFR 51.51, the data in Table S-3 is required to be used as the basis for evaluation of an SMR proposed project. For the purposes of this Draft PEIS, it is assumed that the analysis for SMRs is also bounding for advanced non-LWRs.

In developing the reference plant data, the NRC staff considered two UFC options. The “no recycle” and “uranium-only recycle” options differ only in the resting place of spent fuel. The “no recycle” option assumes that all spent fuel would be stored at a federal waste repository. The “uranium-only recycle” option assumes that spent fuel would be reprocessed to recover unused uranium, which would be returned to the UFC. The reference plant values provided for reprocessing, waste management, and transportation are from the UFC option resulting in the larger environmental effect.

The reference plant values provided in Table S-3 were derived from industry averages for each type of facility or operation associated with the UFC. Recognizing that this approach results in a range of values for each estimate, the NRC staff defined the assumptions or factors to be applied so the calculated values are not underestimated. This conservative bounding approach was intended to ensure that the actual environmental effects are less than the quantities shown for the reference plant and envelop the widest range of operating conditions for SMRs.

The NRC regulation recommends evaluating UFC parameters, nuclear plant characteristics, and impacts to the environment based on a reference plant. To determine the annual fuel requirement, the NRC staff defined the “reference plant” as a 1,000 MWe LWR. The characteristics of the reference plant include an 80 percent capacity factor, a 12-month fuel reloading cycle, and an average fuel burnup rate of 33,000 megawatt-days (MWd) per metric ton (MT) of uranium (MTU). Table S-3 of 10 CFR 51.51 does not address the length of time that the reference plant would operate. However, the Atomic Energy Act authorizes the NRC to issue licenses for commercial power reactors to operate for up to 40 years and permits the renewal of operating licenses for up to an additional 20 years at a time dependent upon assessments of whether the plant can continue to operate safely and protect the environment during its initial licensing period and any period of extended operation. The length of time that a plant would be licensed, and any period of extended operation, would also depend on the specific technology and the type of license. Due to the variability of technologies discussed in this PEIS, the assumed 60-year lifetime of the reference plant (i.e., a 40-year initial licensing term plus one 20-year license renewal term), is considered to be bounding of these reactor technologies. There are no specific limitations in the Atomic Energy Act or the NRC’s regulations restricting the number of times a license may be renewed. The sum of the initial fuel loading and all of the expected reloads for the lifetime of the reference plant is divided by the assumed 60-year lifetime to obtain an average annual fuel requirement. This quantity of fuel was determined for both BWRs and PWRs; the higher annual requirement, a BWR using 35 MTU, was chosen in Section 6.2.3, paragraph 3, of NUREG-1437, “Generic Environmental Impact Statement for License Renewal of Nuclear Plants,” Rev. 0 (NRC 1996), as the basis for the reference plant.

In NUREG-1437, Rev. 0, the NRC staff provided a detailed analysis of the environmental effects of the UFC. NUREG-1437, Rev. 1 (NRC 2013), provides a less detailed analysis and often references NUREG-1437, Rev. 0 for additional details. Although NUREG-1437, Rev. 0 and Rev. 1, are specific to license renewal, the information is potentially relevant because the SMRs described by the PPE use the same fuel cycle process and the same type of fuel as the reference plant. Section 6.2 of NUREG-1437, Rev. 0 discusses the sensitivity to changes in the UFC on the environmental effects in detail.

In the past, uranium market conditions led to the closing of most domestic uranium mines and mills, and substantially reduced the environmental effects in the U.S. from these activities. Thus, the majority of uranium purchased by U.S. reactors has historically been imported. The environmental effects of mining and milling effects are still bounded by the reference numbers in NUREG-1437, Rev. 0 and Rev. 1. Therefore, for the purposes of this analysis, the reference plant estimates have not been reduced.

The maximum net power output of the proposed Nuclear Technology Park would be no more than 800 MWe. A capacity factor of 98 percent is assumed, resulting in an effective net power output 784 MWe. The ratio of the effective net power output value for the Nuclear Technology Park as described by the PPE (784 MWe) to the net electrical output for the 1,000 MWe reference plant (800 MWe) provides a scaling factor of 0.98 to convert reference plant values to park-specific values at the CRN Site. The environmental effects of the UFC from operating SMRs or advanced non-LWRs at the CRN Site were evaluated to assess qualitative effects to the environment as discussed in Section 0.

3.21.1.2 Radioactive Waste

Radioisotopes are produced during the normal operation of nuclear reactors through the processes of fission and activation. Radioisotopes can leave the reactor coolant via plant systems designed to remove impurities, via small leaks that occur in the reactor coolant system and auxiliary systems, or via breaching of systems for maintenance. Therefore, each plant generates radioactive waste that can be liquid, solid, or gaseous. This section describes the liquid, gaseous, and solid radioactive waste management systems proposed to be used as part of the operation of one or more SMRs and/or advanced non-LWRs at the CRN Site. For the purpose of this PEIS, the bounding values have been developed for the quantities of radioactive wastes that are projected to be generated and processed and then stored or released as liquid or gaseous effluents or as solid waste equivalent to 800 MWe of power generation. The radioactive waste management system is designed to minimize releases from reactor operations to ALARA values. These systems are designed and maintained to meet the requirements of 10 CFR Part 20 and 10 CFR Part 50, Appendix I. For the purposes of this Draft PEIS, it is assumed that the analysis for SMRs is also representative or bounding for advanced non-LWRs. Any site-specific impacts that are analyzed in the future that are expected to fall outside of the bounding analysis in this PEIS will be analyzed in subsequent NEPA analysis.

3.21.1.2.1 Liquid Radioactive Waste

The liquid radioactive waste systems would be designed to control, collect, process, handle, store, and dispose of liquid radioactive waste generated as the result of normal operation, including anticipated operational occurrences. Sources of liquid radioactive waste include leakage from systems, wastes generated by processing systems, and maintenance activities. During the design phase of the selected technologies that might be constructed in the Nuclear Technology Park, these sources and potential sources would be identified and collection and processing systems would be designed to remove the radioactivity to the extent that the processed liquid can be recycled or discharged in accordance with the requirements of 10 CFR 20 and the ALARA principles of 10 CFR 50, Appendix I. Discharges would be to the Reservoir and would be controlled and monitored to measure the activity released. Liquid waste processing systems would be designed to maintain the radiation exposures of plant personnel ALARA. The total projected bounding annual release activity in liquid effluents from the CRN Site is 887 Ci/yr.

3.21.1.2.2 Gaseous Radioactive Waste

Typical gaseous radioactive wastes include vents from collection tanks and processing equipment and noncondensables in steam systems. The radioactive isotopes contained in these waste streams can include fission product iodines and the noble gas fission products, xenon and krypton, as well as activation products such as argon-41 and cobalt-60. These wastes would be collected and processed to decrease the radioactivity content to the point that they can be released to the environment through a controlled and monitored release point (plant vent or plant stack). The typical processing technique is one of holdup or delay to allow the short-lived activity to decay. Adsorption on activated charcoal or compression and storage are two methods used to create the necessary holdup time. Processing systems would be designed to process gaseous wastes generated by normal plant operation and anticipated operational occurrences.

Minor leakage of radioactive gases from plant systems to building atmosphere would be detected by area radiation monitors. Ventilation systems would process these gases by filtration, if needed, and direct them to a controlled and monitored release point.

Gaseous radioactive waste discharges would be controlled to the requirements of 10 CFR 20 and the ALARA principles of 10 CFR Part 50, Appendix I. Gaseous radioactive waste system equipment would be designed to ensure occupational exposures to plant personnel are ALARA. The total projected bounding release activity in gaseous waste from the CRN Site is 7,130 Ci/yr.

3.21.1.2.3 Solid Radioactive Waste

Solid radioactive wastes are produced by multiple activities in a nuclear power station. The solid waste can be either wet or dry, depending on whether the source is a processing activity, maintenance, or other function such as housekeeping. A solid radioactive waste management system is designed to collect, monitor, segregate, process, and prepare solid radioactive wastes prior to and for their shipment or onsite storage. The systems design for reactors to be placed in the Nuclear Technology Park would ensure that the wastes are handled, processed, and stored in a manner that minimizes exposure to plant personnel and the public in accordance with 10 CFR 20 and 10 CFR 50, Appendix I. Wastes would be packaged to meet DOT (49 CFR 173 and 178) and NRC (10 CFR 71) regulations for transportation of radioactive material. Radioactive waste would be transported to either a licensed waste processing facility or a licensed low-level radioactive waste disposal facility. The projected bounding total annual activity of solid radioactive waste from the CRN Site is 57,200 Ci/yr. The projected bounding generated volume of solid radioactive waste from the CRN Site is 5,000 ft^3/yr.

3.21.1.3 Spent Fuel Storage

Many of the reactor designs considered for the CRN Site would likely require onsite spent fuel storage, in a spent fuel pool and/or ISFSI for dry cask storage, depending on the technology selected. The SMR designs being considered require spent fuel to be stored in the spent fuel pool for at least 5 years before being stored in interim dry cask storage. For SMR designs, the spent fuel pool is planned to be sized to hold approximately 20 years of spent fuel. The expected lifetime of the SMRs are to be at least 60 years. For the purposes of this Draft PEIS, it is assumed that the spent fuel storage requirements for SMRs are also representative or bounding for advanced non-LWRs. Therefore, it is planned that an ISFSI would be required for the CRN Site, scaled appropriate to the selected technology, and be of a similar design to a facility for a traditional nuclear plant site.

3.21.1.4 Transportation of Radioactive Materials

As detailed in the following subsections, the SMR designs considered in the ESPA do not meet all of the conditions for the reactor and fuel provided in 10 CFR 51.52(a). For example, for SMRs, the fuel enrichment can be greater than four percent by weight and fuel burnup can be greater than 33,000 MWd per MT. Therefore, additional analyses of fuel transportation effects were required for the ESPA to account for normal conditions and for accidents. Advanced non-LWRs would require detailed future analyses as they do not meet the conditions for use of 10 CFR 51.52, Table S4. For the purposes of this Draft PEIS, it is assumed that the analysis for SMRs is also representative or bounding for advanced non-LWRs.

Nonradiological effects from the transportation of fuel (new and spent) and other radiological wastes are traffic density (i.e., due to the increased number of vehicles resulting from fuel or waste shipments), weight of the loaded truck or railcar, heat from the fuel cask, and transportation accidents. The NRC evaluated the environmental effects of transportation of fuel and waste for existing LWRs and found the impacts to be minor. The NRC analyses provided the basis for Table S-4 in 10 CFR 51.52, which summarizes the environmental effects of transportation of fuel and radioactive wastes to and from a reference plant. Table S-4 addresses two categories of environmental consideration: (1) normal conditions of transport, and (2) accidents during transport.

Paragraphs 10 CFR 51.52(a)(1) through (5) delineate specific conditions a reactor licensee must meet to use Table S-4 as part of its ER. For reactors not meeting all of the conditions in paragraph (a) of 10 CFR 51.52, paragraph (b) of 10 CFR 51.52 requires further analysis of the transportation effects.

The conditions in paragraph (a) of 10 CFR 51.52 establishing the applicability of Table S-4 are reactor core thermal power, fuel form, fuel enrichment, fuel encapsulation, average fuel irradiation, time after discharge of irradiated fuel before shipment, mode of transport for unirradiated fuel, mode of transport for irradiated fuel, radioactive waste form and packaging, and mode of transport for radioactive waste other than irradiated fuel. The following subsections describe the characteristics of the SMRs and advanced non-LWRs at the CRN Site relative to the conditions of 10 CFR 51.52 for use of Table S-4. If the conditions of Table S-4 are not met, detailed transportation accident analyses are required.

3.21.1.4.1 Reactor Core Thermal Power

Paragraph 10 CFR 51.5(a)(1) requires that for comparison to the reference plant, the new reactor must have a core thermal power level not exceeding 3,800 MWt. The advanced nuclear reactor designs considered for the CRN Site have a combined maximum thermal power level of 2,420 MWt. Therefore, the sum of the thermal power for all new reactors at the that potentially would be sited within the Nuclear Technology Park would meet this condition.

The initial core loading of the reference plant is 100 MTU. For LWRs, the surrogate SMR core contains 96 fuel assemblies. The mass of the uranium in the fuel assemblies is 0.304 MTU per fuel assembly, resulting in an initial core loading of about 30 percent of the 100 MTU assumed for the reference plant.

3.21.1.4.2 Fuel Form

Paragraph 10 CFR 51.52(a)(2) requires that the reactor fuel be in the form of sintered UO_2 pellets. Sintering is a process by which a powdered material is compacted and heated, without melting, to form a solid mass. Fuel for the SMRs at the CRN Site would be a sintered UO_2 fuel. Therefore, the requirement is met for SMRs. Advanced non-LWRs would use fuel salts or TRISO fuel pebbles and would require detailed future analyses as they do not meet the conditions of Table S4.

3.21.1.4.3 Fuel Enrichment

Paragraph 10 CFR 51.52(a)(2) requires that the reactor fuel have a U-235 enrichment not exceeding four percent by weight. The LWR fuel is enriched up to five percent, which exceeds this condition. NUREG/CR-6703, "Environmental Effects of Extending Fuel Burnup Above 60 GWd/MTU" (NRC 2001), supported the conclusion that environmental impacts of enrichments up to five percent were bounded by the impacts reported in Table S-4. However, a detailed transportation accident analysis was performed for LWRs for fuel enriched up to five percent. Some of the Non-LWRs under consideration would use HALEU fuel and, therefore, do not meet this requirement and would require future detailed analyses.

3.21.1.4.3.1 Fuel Encapsulation

Paragraph 10 CFR 51.52(a)(2) requires that the reactor fuel pellets be encapsulated in Zircaloy rods. The LWR fuels use Zircaloy cladding and, therefore, meet the requirement. Non-LWRs would use fuel salts or TRISO fuel pebbles and would require future detailed analyses.

3.21.1.4.3.2 Average Fuel Irradiation

Paragraph 10 CFR 51.52(a)(2) requires that the average fuel burnup not exceed 33,000 MWd per MTU. The average burnup for the LWR fuel assembly would be less than or equal to 51,000 MWd per MTU, which exceeds the limits of Table S-4. However, NUREG/CR-6703 supports the conclusion that the environmental impacts of higher fuel burnup rates were bounded by the impacts reported in Table S-4. Non-LWRs would use fuel salts or TRISO fuel pebbles, does not meet the Table S-4 conditions, and therefore would require future detailed analysis.

3.21.1.4.3.3 Time After Discharge of Irradiated Fuel Before Shipment

Paragraph 10 CFR 51.52(a)(3) requires that no irradiated fuel assembly be shipped until at least 90 days after it is discharged from the reactor. The analysis provided by the NRC and referenced in Table S-4 assumes 150 days of decay time before shipment of any irradiated fuel assemblies (AEC 1972). NUREG/CR-6703 assumes a minimum of five years between removal from the reactor and shipment. NUREG-1437, Rev. 1, indicates that the NRC specifies five years as the minimum cooling period when it issues certificates of compliance for casks used for shipment of power reactor fuel. Therefore, five years is considered the minimum decay time expected before shipment of irradiated fuel assemblies. SMRs and advanced non-LWRs at the CRN Site would have a minimum five-year storage capacity, to accommodate cooling of irradiated fuel before removal from the spent fuel pool and transfer to onsite dry storage or transport offsite. Therefore, the requirement could be met.

3.21.1.4.3.4 Mode of Transport for Unirradiated Fuel

Paragraph 10 CFR 51.52(a)(5) requires that unirradiated fuel be shipped to the reactor site by truck. Fuel is expected to be shipped to the CRN Site by truck from a fuel fabrication facility as far away as Washington State. Table S-4 includes a condition that truck shipment would not exceed 73,000 pounds. Fuel shipments to the CRN Site would comply with this and other state and federal requirements. Therefore, the criterion could be met.

3.21.1.4.3.5 Mode of Transport for Irradiated Fuel

Paragraph 10 CFR 51.52(a)(5) allows irradiated fuel to be shipped by truck, rail, or barge. Irradiated fuel is expected to be shipped from the CRN Site by truck. Currently, the DOE is responsible for spent fuel transportation from reactor sites.

Table S-4 of 10 CFR 51.52 includes a condition that the heat generated from irradiated fuel per shipping cask in transit would not exceed 250,000 British thermal units (Btu)/hour. Using the guidance provided in ANSI/ANS 5.1-2014, “American National Standard for Decay Heat Power in Light Water Reactors,” a conservative estimate of the heat load in a shipping cask is approximately 233,000 Btu/hour. This estimate is based on the following assumptions and PPE values: the NRC approved General Atomics GA-4 or similar cask would be used for shipping spent fuel (NUREG-2125, Spent Fuel Transportation Risk Assessment (NRC 2014b); SMR fuel assemblies are one-third the length of standard PWR fuel assemblies; 12 SMR fuel assemblies would be shipped in a GA-4 shipping cask; the power density of each fuel assembly is approximately 9 MWt; fuel assemblies are burned through three fuel cycles and loaded into casks five years after the core offload of the third fuel cycle; fuel burnup is 51 giga-watt days (GWd)/MTU; and 0.304 MTU per assembly. Several of the proposed fuel assembly designs for SMRs are similar or the same as the existing U.S. LWR fleet. Also, while many advanced non-LWR fuel design elements are in development, assessing and adhering to the CFR requirements are part of the design process. Therefore, while no new cask has final design explicitly performed for shipment of irradiated SMR or advanced non-LWR reactor fuel, it is expected that the Table S-4 criterion would be met for fuel shipments from the CRN Site.

3.21.1.4.3.6 Radioactive Waste Form and Packaging

Paragraph 10 CFR 51.52(a)(4) requires that radioactive waste be shipped from the reactor in packages and in a solid form (with the exception of irradiated fuel). The low-level waste (LLW) generated by the SMRs and advanced nuclear reactors at the CRN Site would be prepared, packaged, and shipped according to DOT regulations. Therefore, the requirement could be met.

3.21.1.4.3.7 Mode of Transport for Radioactive Waste

Paragraph 10 CFR 51.52(a)(5) requires that the mode of transportation of LLW be either by truck or rail. LLW is expected to be shipped from the CRN Site by truck in accordance with state and federal requirements, including limiting shipments to 73,000 pounds. Therefore, the requirement could be met.

3.21.1.4.3.8 Number of Truck Shipments

The NRC references the “Environmental Survey of Transportation of Radioactive Materials to and from Nuclear Power Plants,” also referred to as “WASH-1238” (AEC 1972), for transportation impacts from the 10 CFR 51.52 Table S-4 reference reactor. Table S-4 specifies the following conditions for traffic density: less than one truck shipment per day or less than three rail cars per month. The WASH-1238 truck shipments per year (traffic density) are compared to the CRN Site shipments in Table 3-76.

Table 3-76. Number of Radioactive Waste Shipments

Reactor Type	Waste Generation Rate	Number of Shipments per reactor-year	Normalized Shipments per reactor-year
Irradiated Fuel			
Reference LWR	30 MTU per year	60[1]	N/A
SMRs or advanced nuclear reactors at the CRN Site	56.1 MTU per year	46	137[1]
Solid Radioactive Waste			
Reference LWR	3,800 cubic feet per year	46	N/A
SMRs or advanced nuclear reactors at the CRN Site	5,000 cubic feet per year	61	75

[1] Source: AEC 1972
[2] Normalized based on 0.5 MTU per shipping container and the net power using a conservative 90 percent capacity for the 800 MWe CRN Site SMRs or advanced nuclear reactors.
N/A = Not Applicable

TVA estimates that 492 shipments of unirradiated fuel would be required for operating 800 MWe SMRs or advanced nuclear reactors described by the PPE over 40 years. In WASH-1238, the NRC assumed 18 shipments of new fuel would be made for the initial reactor loading of the 10 CFR 51.52 Table S-4 reference reactor and an additional six shipments per year for 39 years resulting in a total of 252 shipments (AEC 1972). The annual number of shipments of new fuel to the reference plant and the SMRs at the CRN Site are provided in Table 3-77. While the maximum number of fuel shipments for initial loading is 40, no reactor designs have been selected and the initial loading schemes are not known, the average annual number assumes the same number of fuel shipments over the 40-year lifetime of the SMRs or advanced nuclear reactors.

Table 3-77. Number of Truck Shipments of Unirradiated Fuel

Reactor Type	Number of Fuel Shipments		
	Initial Load[2]	Annual Reload[3]	Total
Reference LWR[1]	18[3]	6	252
SMRs or advanced nuclear reactors at the CRN Site	40 (maximum)	12 (assumed even loading over 40 years)	492
Normalized	N/A	15	600

[1]Source: AEC 1972

[2]Shipments of the initial core have been rounded up to the next highest whole number.

[3]The initial core load for the reference PWR in WASH-1238 was 100 MTU with 18 truck shipments (AEC, 1972).

N/A = Not Applicable

In the ESPA, TVA estimated that there would be 46 annual shipments of irradiated fuel from the CRN Site. As provided in Table 3-76, the normalized number of annual shipments is 137. The number of annual shipments of irradiated fuel from the reference reactor is 60 (AEC 1972).

The number of solid radioactive waste shipments from the CRN Site is based on a volume of 5,000 ft^3/yr. As shown in Table 3-76, the number of solid radioactive waste shipments from the CRN Site would be about 61 truck shipments per year normalized to 75 shipments per year.

As shown in Table 3-78, the sum of the number of yearly truck shipments of fuel and radioactive waste to and from the CRN Site is estimated to be 227 trucks per year, or less than one truck shipment per day. Table S-4 from 10 CFR 50.52 also states that the reference reactor would have less than one truck shipment per day. Therefore, the traffic density from the CRN Site would be comparable to the traffic density from the reference reactor.

The analyses for LWRs are presented in Section 3.20.

Table 3-78. CRN Site Comparisons to 10 CFR 51.52 Reference Conditions

Characteristic	Reference Reactor 10 CFR 51.52/WASH-1238[1]	CRN Site SMRs or Advanced Nuclear Reactors
Thermal Power Rating (MWt)	3800 MWt	2420 MWt
Fuel Form	Sintered uranium dioxide pellets	Sintered uranium dioxide pellets
U-235 Enrichment (%)	< 4	< 5
Fuel Rod Cladding	Zircaloy rods	Zircaloy rods
Average Fuel Irradiation (MWd per MTU)	≤ 33,000	≤ 51,000
Unirradiated Fuel		
Transport Mode	Truck	Truck
Irradiated Fuel		
Transport Mode	Truck, rail, or barge	Truck, rail, or barge
Decay time before shipment	> 5 years per contract with DOE	> 5 years per contract with DOE
Radioactive Waste		
Transport Mode	Truck or rail	Truck or rail
Waste Form	Solid	Solid
Packaged	Yes	Yes
Traffic Density (shipments)		
Unirradiated Fuel – Initial Loading	12	40
Unirradiated Fuel – Reload	15/year	12.3/year 15/year normalized
Irradiated Fuel	60/year	46/year 137/year – normalized
Radioactive Waste	46/year	61/year (75/year normalized)
Total	121/year	119.3/year (227 – normalized)
Trucks per day	< 1/day	< 1/day

[1]Source: AEC 1972

3.21.2 Environmental Consequences

3.21.2.1 Alternative A – No Action Alternative

Under this alternative, no completion or construction and operation of a Nuclear Technology Park would occur; therefore, there are no impacts.

3.21.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

The analysis below assumes the fuel cycles for SMRs and advanced non-LWRs are similar to the UFC cycle referenced in NUREG-1437, for the purposes of impact evaluations. Once TVA has selected the reactor technologies to be deployed at the CRN Site, subsequent NEPA analysis will specifically analyze any fuel cycle environmental impacts as appropriate.

3.21.2.2.1 Uranium Fuel Cycle

3.21.2.2.1.1 Land Use

Permanent land commitments are those that may not be released for use after plant shutdown and/or decommissioning. This limitation on land use is because decommissioning activities on the pertinent land may not remove sufficient radioactive material to meet the limits in 10 CFR 20, Subpart E, for release of land for unrestricted use. Temporary land commitments are for the life of the specific UFC plant (e.g., a mill, enrichment plant, or succeeding plants). Following completion of decommissioning, such land can be released for unrestricted use.

As provided in Table S-3 for the reference plant, the UFC disturbed land area and overburden requirements for the SMRs or advanced non-LWRs at the CRN Site are equated to an equivalently sized (in electrical power production) coal-fired power plant using strip-mined coal as a fuel and requiring the same area of disturbed land and overburden movement. The comparison shows that UFC land requirements for SMRs or advanced nuclear reactors at the CRN Site producing 800 MWe are equivalent to the coal mining land use requirements (disturbed land) for a coal-fired plant producing only approximately 88 MWe. Therefore, for equivalent energy production, the nuclear fuel cycle land use is approximately one-ninth that of coal.

Due to the recent increase in natural gas production in the U.S., the net electrical output associated with natural gas production was compared to the net electrical output from a Nuclear Technology Park at the CRN Site based on an equivalent area of disturbed land. It is estimated that natural gas production in Marcellus shale disturbs about 8.8 acres per well pad (cleared lands for pad and infrastructure). Each well pad contains on average two natural gas wells, and each well typically produces 10 million cubic feet (ft^3) of natural gas per day. Using conversion factors of 1,021 Btu per cubic foot of natural gas and an assumed power plant heat rate of 8,152 Btu per kilowatt-hour, the resulting net electrical output from natural gas production in the Marcellus shale is about 11.8 MWe/acre. For comparison, if the 21.6 acres of disturbed land required to support the fuel needs for an 800 MWe Nuclear Technology Park were dedicated to natural gas production, the land would only produce enough fuel for a gas fired plant producing approximately 255 MWe. Therefore, for equivalent energy production, the nuclear fuel cycle land use is approximately one-third that of natural gas.

If the quality and opportunity costs of the land are equivalent, then it is reasonable to state that land requirements for nuclear power are minor compared to coal-fired power plants and natural gas production. Therefore, it is concluded that the effect on land use to support the UFC for the Nuclear Technology Park is considered to be minor.

3.21.2.2.1.2 Water Use

Power stations supply electrical energy to the enrichment stage of the UFC. The primary water requirement of the UFC is waste heat removal from these power stations. Table S-3 of 10 CFR 51.51 provides a total water discharge (usage) within the UFC for the reference plant as 11,377 million gallons per year, less than four percent of the actual water used to cool the 1,000 MWe reference plant with once through cooling. Applying the 0.98 scaling factor, the water use within the UFC to support the Nuclear Technology Park is estimated to be approximately 11,149 million gallons per year. Therefore, the impact from the water used to manage power needs to support the Nuclear Technology Park are also minor assuming similar water sources to the reference plant.

According to Table S-3, the annual thermal discharge of power plants used within the UFC to support the 1,000 MWe reference plant would be approximately 4,063 billion Btu; this usage is less than five percent of the actual thermal discharge of the 1,000 MWe reference plant. The expected thermal effluent value to support the UFC for the Nuclear Technology Park would be approximately 3,982 billion Btu. Similarly, because the thermal effluent value for the proposed plants would be less than the thermal effluent value for the reference plant, the thermal discharge from the UFC for the Nuclear Technology Park would also be minor.

From 10 CFR 51.51, Table S-3 states that the consumptive water use of the UFC in support of the 1,000 MWe reference plant (i.e., water discharged to air from cooling towers) is two percent of the water consumption of the plant itself. Therefore, the water consumption from the UFC supporting the Nuclear Technology Park would have a minor effect with respect to water use.

3.21.2.2.1.3 Fossil Fuel Effects

Electrical energy and process heat would be consumed during various phases of the UFC. The electrical energy is often produced by combustion of fossil fuels (coal and/or natural gas) at conventional power plants. From 10 CFR 51.51, Table S-3, the electrical energy needs associated with the UFC associated with the reference plant are 323,000 MWh and represents less than five percent of the annual electrical power production of the reference plant. For the Nuclear Technology Park, the UFC electrical energy needs would be approximately 316,540 MWh, which is equivalent to 115,640 MT of coal or 132 million ft^3 of natural gas.

In NUREG-1437, Rev. 0, the NRC concludes that the effects of direct and indirect consumption of electric power for fuel cycle operations produced using fossil fuels are small and appropriate for the electric power being produced from uranium fuel by the reference plant. NUREG-1437, Rev. 1, does not provide any additional information that would alter this conclusion. Since the power output and UFC demands for the Nuclear Technology Park are less than those for the reference plant, the environmental effects from the combustion of fossil fuels associated with UFC operations would also be minor.

The NRC estimates that the carbon footprint of the UFC to support the 1,000 MWe reference plant for the 40-year plant life is about 17,000,000 MT of carbon dioxide (NRC 2011b). Scaling the 10 CFR 51.51 reference plant's UFC carbon footprint to obtain a UFC carbon footprint for the Nuclear Technology Park at the CRN Site, the carbon footprint for

40 years of UFC emissions would be approximately 16,660,000 MT. The average annual emission rate would then be approximately 416,000 MT. This rate compares to total annual emissions of 5,500,000,000 MT in 2011 for the entire U.S. Therefore, it is concluded that the carbon footprint associated with UFC operations would also be minor.

3.21.2.2.1.4 Chemical Effluents

According to 10 CFR 51.51, Table S-3, the gaseous effluents from the UFC supporting the reference plant are equivalent to the gaseous effluents from a 45 MWe coal power plant. Applying the 0.98 scaling factor to each of the gaseous effluents and summing them, the gaseous effluents from the UFC supporting the Nuclear Technology Park are equivalent to the gaseous effluents from a 44 MWe coal power plant. For an equivalent amount of energy produced with coal, the chemical effluents would be about 2.3 times greater. Therefore, it is concluded that the effects to the degradation of air quality from the power generation needed to support the UFC is minor.

Liquid chemical effluents produced during the UFC are associated with the fuel enrichment, fuel fabrication, and fuel reprocessing steps. While fuel reprocessing is not currently performed commercially in the U.S., the effluent amounts provided in 10 CFR 51.51, Table S-3, include potential reprocessing activities. Because the effluents at these quantities require only small amounts of dilution by the receiving bodies of water to achieve concentrations that are below established standards, the effects to the degradation of water quality from the power generation needed to support the UFC would be minor. Additionally, any liquid discharges into the navigable waters of the U.S. from power plants associated with UFC operations are subject to requirements and limitations set in NPDES permits issued by an appropriate federal, state, regional, local, or affected Native American tribal regulatory agency.

Tailings solutions and solids are generated during the milling process; however, these materials are not released in quantities that would be significantly different than currently used processes. The effect of all effluent waste streams (gaseous, liquid, and solid) associated with the UFC needs for the Nuclear Technology Park at the CRN Site are considered to be minor.

3.21.2.2.1.5 Radioactive Effluents for the UFC

From NUREG-1437, Rev. 1, Table 4.12.1.1-1, “Population Doses from Uranium Fuel Cycle Facilities Normalized to One Reference Reactor Year," the portion of dose commitment from radioactive gaseous effluents is 400 person-rem per year (person-rem/yr) and the portion of dose commitment from radioactive liquid effluents per year due to all UFC operations is 200 person-rem. Applying the 0.98 scaling factor for the Nuclear Technology Park, the dose commitment from radioactive gaseous and liquid effluents would be approximately 392 person-rem and 196 person-rem, respectively. Thus, the total 100-year environmental dose commitment from radioactive gaseous and liquid releases resulting from these portions of the UFC needed to support the Nuclear Technology Park is 588 person-rem/yr.

Currently, the radiological effects associated with Rn-222 and Tc-99 releases are not addressed in the reference plant data in 10 CFR 51.51, but they are accounted for in this PEIS for consistency with NUREGs. Most Rn-222 releases are from mining and milling operations and emissions from mill tailings, and most Tc-99 releases are from gaseous diffusion enrichment facilities. Although the gaseous diffusion plants in the U.S. have been shut down, the following assessment is based on the assumption that gaseous diffusion plants are in operation.

In Table 6.2 of NUREG-1437, Rev. 0, the NRC staff estimated the Rn-222 releases from mining plus milling and emanating from mill tailings required to support each year of operations of the 1,000 MWe reference plant to total 5,200 curies (Ci). The major risks from Rn-222 are bone and lung cancer, and there is a small risk from whole body exposure. The organ-specific dose weighting factors from 10 CFR Part 20 are applied to the bone and lung doses to estimate the 100-year dose commitment from Rn-222 to the whole body, which is estimated to be 140 person-rem for the reference plant. Using the 0.98 scaling factor, the Rn-222 releases from the UFC associated with Nuclear Technology Park are estimated to be 5,096 Ci and the estimated population dose commitment from mining, milling, and tailings before stabilization for each year of operation of the Nuclear Technology Park is estimated to be 136 person-rem.

In NUREG-1437, Rev. 0, the NRC staff also considered the potential health effects associated with the release of Tc-99 as part of UFC operations. It was found that the releases of Tc-99 are from chemical reprocessing of recycled UF_6 before it enters the isotope enrichment cascade. The annual Tc-99 releases (in Ci) from the reference plant and scaled releases from the Nuclear Technology Park are 0.012 Ci.

The major risks from Tc-99 are from exposure of the gastrointestinal tract and kidney; additionally, there is a small risk from whole-body exposure. Using the organ-specific dose weighting factors from 10 CFR 20, these individual organ risks were converted to a whole body 100-year dose commitment per year of operation: 100 person-rem for the reference plant and 98 person-rem for the Nuclear Technology Park.

Epidemiological studies have not consistently demonstrated adverse health effects in persons exposed to small (less than 10 rem) doses protracted over a period of many years (HPS 2019). However, a linear, no-threshold dose response relationship is used to describe the relationship between radiation dose and detriments such as cancer induction. This approach is accepted by the NRC as a conservative method for estimating health risks from radiation exposure, recognizing that the model may overestimate those risks. Based on this method, the risk to the public from radiation exposure using the nominal probability coefficient for total detriment can be estimated. This coefficient has the value of 570 fatal cancers, nonfatal cancers, and severe hereditary effects per 1,000,000 person-rem. The total whole body population doses (including Rn-222 and Tc 99) would be 840 person-rem/year for the 1,000 MWe reference plant and 822 person-rem/year for the Nuclear Technology Park. The estimated number of fatal cancers, nonfatal cancers, and severe hereditary effects would be less than one per year for both the 1,000 MWe reference plant and the new Nuclear Technology Park at the CRN Site, based on the conservative method described above.

Based on the information presented above, it is concluded that the environmental effect (population dose) from radioactive effluents from the UFC demands for the Nuclear Technology Park at the CRN Site would be minor. See Section 3.20.2 for further information related to the environmental consequences of radiological effluents.

3.21.2.2.1.6 Occupational Dose

As provided in Section 6.2.2.3 of NUREG-1437, Rev. 0, the annual occupational dose for the reference 1,000 MWe reactor attributable to all phases of the fuel cycle is 600 person-rem. The fuel cycle for the SMRs or advanced nuclear reactors would be similar to the fuel cycle for the reference plant. Individual occupational doses are maintained to meet the dose limits in 10 CFR Part 20, which is 5 rem/yr. Therefore, the environmental effects from this occupational dose are considered to be minor.

3.21.2.2.1.7 Summary

Using the evaluation process in NUREG-1437, Rev. 0 and Rev. 1, TVA examined the environmental effects of the UFC, including the dose from Rn-222 and Tc-99, as it relates to the operation of SMRs and advanced nuclear reactors at the CRN Site. Based on this evaluation, the environmental effects of the contributions to the UFC from the operation of SMRs or advanced nuclear reactors at the CRN Site are considered to be minor. Any site-specific impacts that are analyzed in the future that are expected to fall outside of the bounding analysis in this PEIS will be analyzed in subsequent NEPA analysis.

3.21.2.2.2 Radioactive Waste

Normal radioactive liquid and gaseous effluents would be controlled in accordance with 10 CFR 20. Therefore, the environmental effects associated with these radioactive waste streams are considered to be minor.

The CRN Site would enter into a contract to transport waste to either a licensed waste processing facility or a licensed low-level radioactive waste disposal facility. As discussed in Section 0, 10 CFR 51.52, Table S-4 addresses the environmental impacts from transportation of LLW. The assumed quantities (in Ci) of radioactive waste material generated are shown in 10 CFR 51.51, Table S-3, for the 1000 MWe reference plant, and for LLW disposal the NRC indicates in Table S-3 that no significant radioactive releases to the environment are expected (i.e., the environmental impact is considered to be minor). Additionally, if required, the impacts of construction and operation of onsite LLW storage facilities are considered to be minor. Therefore, environmental effects associated with solid radioactive waste management at the Nuclear Technology Park are considered to be minor.

3.21.2.2.3 Spent Fuel Storage

Environmental impacts from onsite spent fuel storage during the licensed life of existing LWRs have been studied extensively and are well understood. In the context of operating license renewal, the NRC provides descriptions of the storage of spent fuel during the licensed lifetime of reactor operations in NUREG-1437, Rev. 1. Radiological impacts are well within regulatory limits; thus, the radiological impacts of onsite storage during operations would be minimal. Onsite storage of spent fuel for advanced non-LWRs would also be required to meet the same regulatory limits. Therefore, the environmental effects associated with spent fuel storage during the life of the plant are considered to be minor.

In accordance with 10 CFR 51.23(b), the impact determination in NUREG-2157, "Generic Environmental Impact Statement for Contained Storage of Spent Nuclear Fuel" (NRC 2014a), regarding continued storage (i.e., the period following the term of the reactor operating license, reactor combined license, or ISFSI license) is incorporated into the Draft PEIS. The time frames analyzed in NUREG–2157 include the short-term time frame (i.e., 60 years beyond the licensed life of a reactor), the long-term time frame (i.e., an additional 100 years after the short-term time frame), and an indefinite time frame. The analysis in Section 4.20 of NUREG–2157 concludes that the potential impacts of spent fuel storage at the reactor site in both a spent fuel pool and in an onsite ISFSI would be minor during the short-term time frame. However, for the longer time frames for onsite storage, and for all time frames for away-from-reactor storage, Sections 4.20 and 5.20 of NUREG 2157 provide a range of potential impacts in some resource areas. These ranges reflect uncertainties that are inherent to analyzing environmental impacts on some resource areas over long time frames and are primarily driven by activities other than the continued storage of spent fuel at the reactor site. These uncertainties exist regardless of whether the impacts are analyzed generically or site specifically.

TVA is not considering off-site storage at this time. In the short-term time frame, which is the most likely time frame for the disposal of the fuel, the potential impacts of continued storage for onsite storage are minor and would, therefore, not be a significant contributor to the cumulative impacts for the CRN Site.

3.21.2.2.4 Transportation of Radioactive Materials

The environmental impacts of radioactive materials transportation were estimated using the RADTRAN 6.5 computer code. RADTRAN is a nationally accepted standard program and code for calculating the risks of transporting radioactive materials. RADTRAN was used in estimating the radiological doses and dose risks to populations and transportation workers resulting from incident-free transportation and to the general population from accident scenarios. For the analysis of incident-free transportation risks, the code used scenarios for persons who would share transportation routes with shipments, persons who live along the route of travel, and persons exposed at stops.

3.21.2.2.4.1 Transportation of Unirradiated Fuel

Table S-4 of 10 CFR 51.52 includes conditions related to radiological doses to transport workers and members of the public along transport routes. These doses, based on calculations in WASH-1238 (AEC 1972), are a function of the radiation dose rate emitted from the unirradiated fuel shipments, the number of exposed individuals and their locations relative to the shipment, the time of transit (including travel and stop times), and the number of shipments to which the individuals are exposed.

Calculation of worker and public doses associated with annual shipments of unirradiated fuel were performed using the WebTRAGIS 6.0 and RADTRAN computer codes. One of the key assumptions in WASH-1238 for the reference LWR unirradiated fuel shipments is that the radiation dose rate at 3 feet from the transport vehicle is 0.1 mrem/hour. This assumption is reasonable for the new plant technologies because the fuel materials would be low-dose rate enriched uranium and would be packaged similarly to the fuel analyzed in WASH-1238 (i.e., inside a metal container that provides sufficient radiation shielding).

For unirradiated fuel shipments, highway routes were analyzed using the routing computer code WebTRAGIS. The per trip dose values are combined with the average annual number of shipments of unirradiated fuel to calculate annual doses to the public and workers for comparison to Table S-4 dose values. The number of shipments per year is provided in Table 3-77. The incident free dose rates (in person-rem per shipment) were calculated by RADTRAN and are provided in Table 3-79. The dose rates ranged from 4.59E-03 person-rem/year for the transportation crew exposed at stops and 7.85E-03 person-rem/year for crew along the route to 5.81E-03 person-rem/year for the public in other vehicles along the transportation route.

Table 3-79. Total Shipment Cumulative Dose Summary

	Source		
	Unirradiated Fuel	**Radioactive Waste**	**Total**
Exposed Population			
Crew Dose	**(person-rem per year)**		
At Stops	4.59E-03	1.61	1.61
Along Route	7.85E-03	2.55	2.56
Total Crew Dose			**4.17**
Public Dose	**(person-rem per year)**		
At Stops			
Sharing Stops	2.15E-03	0.75	4.24
Residents	1.95E-04	0.102	0.102
Along Route			
Other Vehicles	5.81E-03	1.92	1.93
Residents	8.84E-04	0.328	0.329
Total Public Dose			**6.6**

3.21.2.2.4.2 Transportation of Irradiated Fuel

The analysis and associated environmental impacts of transporting spent fuel from the CRN Site to a spent fuel disposal facility will be deferred until a viable off-site location has been selected.

3.21.2.2.4.3 Transportation of Radioactive Waste

Incident-free transportation refers to transportation activities in which shipments reach their destination without releasing any radioactive cargo to the environment. Impacts from these shipments would be from the low levels of radiation that penetrate the radioactive waste shipping containers. Radiation doses could potentially occur to the following:

- Persons residing along the transportation corridors between the CRN Site and the potential repository
- Persons in vehicles passing a radioactive waste shipment
- Persons at vehicle stops for refueling, rest, and vehicle inspections
- Transportation crew workers

This analysis is based on shipment of radwaste by legal-weight trucks in either sea-land containers or high-integrity containers similar to those currently available. Each shipment is assumed to consist of a single shipping container from the CRN Site to Andrews, Texas.

The transportation route selected for a shipment determines the total potentially exposed population and the expected frequency of transportation-related accidents. For truck transportation, the route characteristics most important to the risk assessment include the total shipping distance between each origin-destination pair of sites and the population density along the route.

The population doses are calculated by multiplying the number of radioactive waste shipments per year by the per-shipment doses. The numbers of shipments per year are identified in Table 3-76. The incident-free dose rates (in person-rem per shipment) were calculated by RADTRAN and are provided in Table 3-79. The dose rates ranged from 1.61 person-rem/year for the transportation crew exposed at stops and 2.55 person-rem/year along the route to 1.92 person-rem/year for the public in other vehicles along the transportation route.

3.21.2.2.4.4 Comparison to 10 CFR 51.52 Table S-4

For an equal comparison to the reference reactor in 10 CFR 51.52 Table S-4, the number of shipments in Table 3-78 for the SMR or advanced nuclear reactor must be normalized. For each technology, the number of shipments is normalized based on net electric generation relative to the 1100 MWe and 80 percent capacity factor reference reactor analyzed in WASH-1238. Additionally, the unirradiated fuel shipments are adjusted to account for the initial core loading in the annual number of shipments for each reactor technology. The number of radioactive waste shipments is based on 3,800 ft^3 and 46 shipments per year from the reference reactor (from WASH-1238) or 82.6 ft^3 per shipment (2.34 cubic meters (m^3) per shipment). The resulting annual truck shipments normalized to the reference reactor are summarized in Table 3-78 (excluding transport of spent fuel). Annual doses provided in Table 3-79 are based on the normalized number of shipments.

Table 3-79 provides a total crew dose of 4.17 person-rem per reactor per year (excluding transport of spent fuel). While the estimate is more than the Table S-4 value, it is still considered small given the increased number of normalized shipments, and the greater assumed transportation distances (WASH-1238 uses 1,000 miles for unirradiated fuel shipments, 1,000 miles for irradiated fuel shipments, and 500 miles for radioactive waste shipments) (AEC 1972). The doses provided in Table 3-79 also assume the maximum dose rate for all shipment types, and the use of 30 minutes as the average time for a truck stop in the calculations.

Table 3-79 also provides a total public dose of 6.6 person-rem per reactor year (excluding transport of spent fuel). Onlookers are members of the public exposed to a shipping container for a short duration during periods when the transportation vehicle is stopped. While the estimate is more than the Table S-4 value, it is still considered small given the increased number of normalized shipments, the greater assumed transportation distances, and the increased populations along the transportation routes. Table S-4 does not provide a cumulative dose for the population exposed along the transportation routes for direct comparison.

3.21.2.2.4.5 Transportation Accident Analysis – Radiological Impacts

The reference reactor for 10 CFR 51.52 Table S-4 is an 1,100 MWe LWR with a capacity factor of 80 percent (1,100 MWe times 80 percent equals 880 MWe). The maximum generating output of the SMRs at the CRN Site as 800 MWe, and a station capacity factor of 90 percent (800 MWe times 90 percent equals 720 MWe) is conservatively assumed for this analysis. For the analysis below, the expected number of shipments is multiplied by the ratio, 1.22, to estimate the number of shipments normalized to the reference reactor used in Table S-4.

Transportation of Unirradiated Fuel

The following assumptions are made in this analysis of the transportation of unirradiated fuel:

- Unirradiated fuel would be transported to the CRN Site via truck in robust packages designed to protect the fuel from damage from dropping or puncture.
- The WASH-1238 analysis of postulated accidents during the transportation of unirradiated fuel found accident impacts to be negligible.
- As noted in NUREG-1815 (NRC 2006), accident frequencies are likely to be lower in the future than those used in the analysis in WASH-1238 because traffic accident, injury, and fatality rates have fallen since the initial analyses were performed.
- Advanced fuel behaves like fuel evaluated in the analyses provided in WASH-1238.
- Per NUREG-1815, there is no significant difference in the consequences of accidents severe enough to result in a release of unirradiated fuel particles to the environment between SMRs and previous-generation LWRs because the fuel form, cladding, and packaging are similar to those analyzed in WASH-1238.
- The fuel form, cladding, and packaging for the SMR designs considered in the PPE would be similar to the fuel form, cladding, and packaging for SMRs.

Based on this information, the dose impact from nuclides released from postulated accidents involving new fuel is assumed to be negligible when compared to dose from postulated irradiated fuel and radiation waste transportation accidents. Therefore, quantitative analysis of dose from new fuel accidents was not performed.

The radiological impacts from incident free transportation of unirradiated fuel were estimated using the WebTRAGIS 6.0 and RADTRAN 6.5 computer codes. The evaluation model assumes that unirradiated fuel is shipped from a fuel fabrication facility located in Richland, Washington, to the CRN Site. The fuel fabrication facility in Richland is the farthest fabrication facility in the U.S. from the CRN Site that is currently in operation; therefore, to maximize the transportation distance and potential impacts, it was used as a representative fuel fabrication facility for the purposes of the evaluation.

3.21.2.2.4.6 Transportation Accident Analysis – Non-Radiological Impacts

Non-radiological impacts associated with the postulated accidents are calculated for:

- Injuries and fatalities during transportation of unirradiated fuel
- Injuries and fatalities during transportation of radioactive waste

The non-radiological impacts from postulated accidents during transportation were evaluated using the WebTRAGIS code to define appropriate routing and the RADTRAN 6 code to calculate the non-radiological impacts (e.g., injuries and fatalities).

The non-radiological impacts were based on round-trip distances because the return of the empty truck is included in the evaluation. Therefore, the frequency (fatalities per reactor-year and injuries per reactor-year) was multiplied by two.

Transportation of Unirradiated Fuel

The evaluation model assumes that unirradiated fuel is shipped by truck from Richland, Washington, to the CRN Site. As shown in Table 3-77, the total number of lifetime shipments of unirradiated fuel for the CRN Site is postulated to be 492, and the average is 12.3 shipments per year. Multiplying by the ratio of 1.22, discussed above, the estimated number of shipments per year is 15 (i.e., 600 total shipments), normalized to the reference reactor used to estimate the parameters in 10 CFR 51.52 Table S-4.

The non-radiological fatality rates and injury rates normalized to the transportation rates for the reference reactor are provided in Table 3-80 and Table 3-81.

Table 3-80. CRN Site Model Non-Radiological Accident Analysis Results for Normalized Number of Shipments: Fatalities

	Fatalities per Shipment	Normalized Shipments Per Year	Fatalities per Year[1]	Fatalities per 100 Years
New Fuel	6.08E-05	15	1.82E-03	1.82E-01
Radioactive Waste	3.24E-05	75	4.86E-03	4.86E-01
Total	-	90	6.68E-03	6.68E-01

[1]The fatalities per year are calculated assuming a round trip for the truck. Therefore, the normalized number of shipments was doubled when calculating total route fatalities.

Table 3-81. CRN Site Model Non-Radiological Accident Analysis Results for Normalized Number of Shipments: Injuries

	Injuries per Shipment	Normalized Shipments Per Year	Injuries per Year[1]	Injuries per 10 Years
New Fuel	1.18E-03	15	3.54E-02	3.54E-01
Radioactive Waste	7.21E-04	75	1.08E-01	1.08E+00
Total	-	90	1.43E-01	1.43E+00

[1]The fatalities per year are calculated assuming a round trip for the truck. Therefore, the normalized number of shipments was doubled when calculating total route injuries.

Transportation of Radioactive Waste

The routing and accident parameters used to analyze non-radiological impacts of transporting radioactive waste were the same as those used to analyze the radiological impacts of transporting radioactive waste.

The annual volume of radioactive waste generated and shipped from the CRN Site would be 5,000 ft^3/yr. Table 3-76 shows the number of radioactive waste shipments from the CRN Site to be 61 shipments per year, and the number of shipments of radioactive waste (other than spent fuel) normalized to the reference reactor is 75 shipments per year.

The non-radiological fatality rates and injury rates normalized to the transportation rates for the reference reactor (excluding transport of spent fuel) are provided in Table 3-80 and Table 3-82.

Comparison to 10 CFR 51.52 Table S-4

For an equal comparison to the reference reactor in 10 CFR 51.52 Table S-4, the normalized number of shipments provided in the subsections above were used to determine the non-radiological environmental impacts due to transportation accidents. Table 3-80 and Table 3-82 indicate the fatal and non-fatal injury consequences, respectively, for unirradiated fuel and radioactive waste shipments based on the normalized numbers of shipments. The estimated number of fatal injuries is 6.68E-03 per reactor year for the CRN Site. The estimated number of non-fatal injuries is 1.43E-01 per reactor year (1.43 in 10 reactor years) for the CRN Site. The estimated numbers of fatal injuries and non-fatal injuries for the CRN Site are higher than the values for the reference reactor because the one-way shipping distances for unirradiated fuel and radioactive waste shipments are more than twice the distances assumed in the analyses for Table S-4 (WASH-1238). Considering these differences in the analyses, the impacts are comparable. Therefore, as the Table S-4 values are considered minor, the estimated numbers of fatal injuries and non-fatal injuries for the CRN Site are also minor.

3.21.2.2.4.7 Summary

A detailed analysis of the environmental impacts for the transportation of unirradiated fuel and radioactive waste transported to and from the CRN Site was performed in accordance with 10 CFR 51.52(b).

Reactors sited in the Nuclear Technology Park would have sufficient fuel pool storage capacity to enable a minimum cooling period of five years and sufficient storage capacity to permit irradiated fuel to cool sufficiently to meet the requirements of shipping casks available at the time the fuel is shipped.

In the analysis it was assumed that all shipments of unirradiated fuel and radioactive waste are by truck. The shipping weights would comply with federal, state, local, and tribal government restrictions as appropriate. The total number of shipments for the CRN Site (excluding transport of spent fuel) are outlined in Table 3-78, is 90 per year (normalized) which meets the Table S-4 requirement of less than one per day.

The radiological effects of incident-free conditions of transport (excluding transport of spent fuel) are summarized in Table 3-79. The values obtained from these analyses represent the impacts from incident-free transportation of radioactive materials to and from the CRN Site. The population doses to the transport crew and onlookers resulting from the new plant normalized to the reference reactor exceed Table S-4 values. However, these increases are reasonable given the different exposure parameters between WASH-1238 and the CRN Site RADTRAN model. Therefore, based on the analyses and above discussion, the environmental impacts of transportation of unirradiated fuel and radioactive waste are minor.

A detailed accident analysis of the environmental impacts for the transportation of unirradiated fuel and radioactive waste transported to and from the CRN Site was performed for LWRs in accordance with 10 CFR 51.52(b). As discussed above for incident free transportation, because the number of normalized shipments of radioactive waste are not significantly different from number of shipments from the reference reactor, the impacts from radiological accidents from the CRN Site are consistent with the minor impacts designation provided in 10 CFR 51.52, Table S4. The calculated dose risks are also minor. The non-radiological accident environmental impacts related to transportation of unirradiated fuel and radioactive waste are also consistent with the Table S-4 fatality and nonfatal injury rates. It is noted that this analysis does not account for future technology which may improve driver safety and further reduce accident rates.

Therefore, the overall corresponding impacts from accidents associated with the transportation of unirradiated fuel and radioactive waste to and from the Nuclear Technology Park at the CRN Site would be minor. The analysis and associated environmental impacts of transporting spent fuel from the CRN Site to a spent fuel disposal facility will be deferred until a viable off-site location has been selected.

3.21.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Alternative C is for one or more non-LWR advanced nuclear reactors at Area 2 on the CRN Site. The potential environmental consequences discussed for Alternative B are also applicable to Alternative C, since the evaluation applies to the entire CRN site and is for cumulative electrical output not to exceed 800 MWe. Therefore, the environmental impacts from uranium fuel cycle, radioactive wastes, spent fuel storage and accidents associated with the transportation of fuel and waste to and from the CRN Site under Alternative C are also minor.

3.21.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Alternative D is for one or more SMRs or advanced nuclear reactors at Area 1 and Area 2 on the CRN Site. The potential environmental consequences discussed for Alternative B are also applicable to Alternative D, since the evaluation applies to the entire CRN Site and is for cumulative electrical output not to exceed 800 MWe. Therefore, the environmental impacts from uranium fuel cycle, radioactive wastes, spent fuel storage and accidents associated with the transportation of fuel and waste to and from the CRN Site under Alternative D are also minor.

3.21.2.5 Summary of Impacts from Uranium Fuel Use

As summarized in Table 3-82, the impacts of uranium fuel use effects are minor. The combined environmental impacts from the UFC, the storage of spent fuel onsite, radioactive waste management, and the transportation of unirradiated fuel and radioactive waste are minor.

Table 3-82. Summary of Uranium Fuel Use Effects

Alternative	Project Element	Impact	Severity
Alternatives B, C, D	Uranium Fuel Cycle	Land Use.	Minor impacts. The UFC disturbed land area requirements for nuclear power are minor compared to coal-fired power plants and natural gas production.
		Water Use.	Minor impacts. The thermal discharge and water consumption from conventional power plants used to supply electricity for the UFC are minor.

Alternative	Project Element	Impact	Severity
		Fossil Fuel Use.	Minor impacts. The environmental effects from the combustion of fossil fuels associated with UFC operations and the overall carbon footprint for the UFC are minor.
		Chemical effluents / tailings from milling.	Minor impacts. The effect of all effluent waste streams (gaseous, liquid, and solid) associated with the UFC are minor.
		Radiological dose.	Minor impacts. The total population doses (including Rn-222 and Tc-99) from the UFC is conservatively estimated to be 822 person-rem/yr for the Nuclear Technology Park. The estimated number of fatal cancers, nonfatal cancers, and severe hereditary effects is less than one per year, based on the conservative linear no-threshold method.
	Radioactive Waste	Liquid waste generation.	Minor impacts. Liquid waste processing systems would be designed to maintain the radiation exposures of plant personnel ALARA. Discharges would be to the Reservoir and would be controlled and monitored to measure the activity released so that they remain within regulatory limits (10 CFR 20).
		Gaseous waste generation.	Minor impacts. Gaseous radioactive waste discharges would be controlled to the regulatory requirements of 10 CFR 20. Gaseous radioactive waste system equipment would be designed to ensure occupational exposures to plant personnel are ALARA.
		Solid waste generation.	Minor impacts. The Nuclear Technology Park would enter into a contract to transport waste to either a licensed waste processing facility or a licensed low-level radioactive waste disposal facility. No significant radioactive releases to the environment would be expected from the management of solid waste.

Alternative	Project Element	Impact	Severity
	Spent Fuel Storage	Radiological dose.	Minor impacts. The SMRs or advanced nuclear reactor designs considered for the CRN Site would require onsite spent fuel storage, in a spent fuel pool and/or ISFSI for dry cask storage, depending on the technology selected. Radiological impacts from onsite spent fuel storage would be maintained within regulatory limits. Ultimate disposal of irradiated fuel would be at a national waste repository.
	Transportation of Radioactive Materials	Radiological effects (dose).	Minor impacts. For normal conditions of transport, a total population dose of 10.1 person-rem per reactor year is conservatively estimated. The total crew (occupational) dose is conservatively estimated to be 19.1 person-rem per reactor year. These values are considered to be minor given the number of shipments estimated, transportation distances assumed, and increased population estimates. The population dose risk impact from accidents is small, much lower than the dose to the exposed population along the transportation route for normal conditions.
		Nonradiological effects (accidents during transport).	Minor impacts. Nonradiological effects from the transportation of fuel (new and spent) and other radiological wastes include traffic density, weight of the loaded truck or railcar, heat from the fuel cask, and transportation accidents. The NRC previously evaluated the environmental effects of transportation of fuel and waste for LWRs and found the impacts to be minor. The Nuclear Technology Park would have sufficient storage capacity to permit irradiated fuel to cool sufficiently to meet the requirements of shipping casks available at the time the fuel is shipped. Shipping weights would comply with federal, state, local, and tribal

Alternative	Project Element	Impact	Severity
			government restrictions as appropriate. The fatal and non-fatal injury consequences, respectively, for unirradiated fuel, and radioactive waste shipments are minor. The conservatively estimated number of fatal injuries associated with transportation accidents is slightly more than two fatal injuries in 100 reactor years.

3.22 Nuclear Plant Safety and Security

This section assesses the environmental impacts of postulated accidents involving proposed SMRs and advanced nuclear reactors, with a combined maximum net electrical output of no more than 800 MWe, at the CRN Site, and plant security including intentional destructive acts. It is divided into three subsections that address design basis accidents (DBAs), severe accidents, and plant security.

3.22.1 Affected Environment

The information provided in the following sections is based on the analysis in the ESPA for SMRs located at Area 1 of the Nuclear Technology Park at the CRN Site. For the purposes of this Draft PEIS, this analysis is used as a surrogate for SMRs and advanced non-LWRs located at Area 1 and/or Area 2, to evaluate potential impacts. Dose consequences associated with an accident occurring for a SMR or an advanced non-LWR at Area 2 are expected to be similar to those for an accident at Area 1 based on the close proximity of the locations. Additionally, this surrogate analysis assumed a 2-mile EPZ. The final EPZ has not yet been determined and will depend on the reactor technology selected. Detailed analyses for design basis accidents and severe accidents will be performed after any SMR and/or advanced non-LWR design has been selected for the Nuclear Technology Park at the CRN Site.

3.22.1.1 Design Basis Accidents

The potential consequences of postulated accidents are evaluated to demonstrate that SMRs and advanced nuclear reactors represented by a surrogate SMR based on a PPE approach could be constructed and operated at the CRN Site without undue risk to the health and safety of the public. As noted in Nuclear Energy Institute (NEI) 10-01, Industry Guideline for Developing a Plant Parameter Envelope (PPE) in Support of an Early Site Permit, Rev. 1 (NEI 2012) accident analyses model the time-dependent transport of radionuclides out of the reactor core through several pathways, each with different time-dependent removal mechanisms for radionuclides. Different reactor designs have different release pathways, and each pathway has different release rates and different radionuclide removal mechanisms. Therefore, the LWR vendor design that generated the largest post-accident dose was selected for use in the CRN Site-specific accident analysis. For the purposes of this Draft PEIS, it is assumed that the analysis for SMRs located at Area 1 is also representative or bounding for advanced non-LWRs, which are smaller and have lower power levels.

3.22.1.1.1 Selection of Accidents

Past PWR DBA analyses have shown that offsite doses due to a postulated loss-of-coolant accident (LOCA) are expected to more closely approach 10 CFR 50.34 (and 10 CFR 52.17) limits than other DBAs that may have a higher probability of occurrence but with resultant lower consequences. Therefore, the analysis evaluated one DBA involving consequences from a LOCA resulting from the single largest break size for the design with the largest power level per SMR unit of the designs being considered. The potential consequences of accidental releases from a DBA depend on the specific radionuclides released, the amount of each radionuclide released, and the meteorological conditions.

3.22.1.1.2 Evaluation Methodology

The LOCA source term (radionuclide activity released to the environment) selected for inclusion in the PPE is based upon vendor input and represents the design with the highest resulting doses at the EAB and the low population zone (LPZ) boundary from the SMR designs under consideration.

The PPE LOCA source term is based on a design that uses standard light water reactor fuel and assumes a core power level for a single unit at 800 MWt. The maximum average burnup assumed for the surrogate plant is 51 GWd/MTU. The methodology and analytical techniques used for development of the source term are similar to those used for large LWRs, and it is anticipated that comparable methodologies and techniques would be used in the development of the SMR accident source terms to be presented in the SMR design control documents.

Some of the baseline assumptions used to derive the source term include:

- Core melt is based on NRC RG 1.183 methodology and assumed design containment leakage with reduction after 24 hours
- Passive containment fission product removal processes

Doses for the LOCA are evaluated at the EAB and LPZ boundary. For environmental reviews, consequences are evaluated assuming realistic meteorological conditions. The evaluation uses the following parameters, as shown in Table 3-83:

- Short-term 50th percentile accident atmospheric dispersion factors (X/Qs) for the CRN Site
- Bounding vendor-provided LOCA doses
- X/Q values associated with the bounding vendor-provided LOCA doses

Doses are calculated based on the amount of activity released to the environment, the dispersion of activity during transport to the receptor (X/Q), the breathing rate at the receptor, and the applicable dose conversion factors. The only parameters that are site-specific are the X/Qs. Hence, it is reasonable to adjust the vendor LOCA doses for site-specific X/Q values.

For a given time step, the vendor dose is multiplied by the ratio of the site-specific X/Q to the vendor X/Q, as shown in the following equation:

$$Dose_{Site} = Dose_{Vendor}\left[\frac{(X/Q)_{Site}}{(X/Q)_{Vendor}}\right]$$

Table 3-83. CRN Site LOCA Doses

Location	Time (hours)	X/Q (sec/m^3) Site (50th %)	X/Q (sec/m^3) Vendor	*X/Q* Ratio (Site/Vendor)	Dose (rem TEDE) Vendor	Dose (rem TEDE) Site
EAB	0-2	5.58E-04	1.0E-03	0.56	4.4	2.4[1]
LPZ	0-8	4.27E-05	5.0E-04	0.085	4.4	0.38
	8-24	3.80E-05	3.0E-04	0.13	0.20	0.025
	24-96	2.94E-05	1.5E-04	0.20	0.05	0.0098
	96-720	2.04E-05	8.0E-05	0.26	0.06	0.015
				LPZ Total	4.8	0.43[1,2]

[1] Versus the 25 rem TEDE limit specific in 10 CFR 50.34 (and 10 CFR 52.17).
[2]Column total dose not equal sum of individual values due to rounding.

3.22.1.2 Severe Accidents

This section evaluates the potential environmental impacts of severe accidents at the CRN Site. Severe accidents are defined as accidents with substantial damage to the reactor core and degradation of containment systems. Subpart B of 10 CFR 52 requires applications for standard design certification to include information from the probabilistic risk assessment (PRA) of the design. The final design and PRA information was not available for the SMR and advanced nuclear reactor designs under consideration at the time of evaluation. Therefore, a reasonable, bounding estimate of the severe accident consequences for the PPE was made by evaluating the SMR design that represents the largest SMR considered for the CRN Site. This section uses preliminary PRA information for severe accidents for the largest SMR design, along with site-specific characteristics (e.g., meteorological, population, and land use data), to estimate the impacts of severe accidents. For the purposes of this Draft PEIS, it is assumed that the analysis for SMRs is also representative or bounding for advanced non-LWRs.

3.22.1.2.1 Severe Accident Evaluation Methodology

The MACCS2 computer code was developed specifically for the NRC to evaluate severe accidents at nuclear power plants. The NRC has approved MACCS2 analyses of environmental consequences for a new PWR design with passive safety features. The ratio of the thermal power rating of the previously analyzed PWR to the largest SMR considered for the CRN Site was used to estimate the source terms required for analysis of the impacts of severe accidents. Use of the largest SMR for the severe accident analysis is considered to provide representative accident consequences. The relative frequencies, source term chemical groups, and source term release fractions for the severe accident scenarios were calculated as part of the PRA for the SMR design with the maximum thermal output. This data was used together with the MACCS2 ATMOS module input files and an estimated core damage frequency (CDF) to approximate the consequences of severe accidents for the SMR.

The individual reactor considered for this analysis uses the maximum thermal power rating for a single reactor unit (800 MWt) from one of the potential SMR vendors, maximizing the severe accident consequences for an accident involving a single unit.

The CDF is a measure of the likelihood of severe accidents associated with reactor core damage. CDF is estimated using PRA modeling, which evaluates how changes to the reactor or auxiliary systems can change the severity of the accident. The vendor of the SMR considered in this analysis estimates the total CDF for the design to be approximately 4.65E-08 per reactor year (Ryr), which is lower than the CDF for traditional, large LWRs. Table 3-84 presents the relative frequency of each release category.

Table 3-84. Bounding CRN Site SMR Release Category Relative Frequencies

Release Category	Description	Relative Frequency (%)
IC	Intact Containment	91.9
BP	Containment Bypass	4.37
CFE	Early Containment Failure	3.11
CI	Containment Not Isolated	0.55
CFI	Intermediate Containment Failure	0.08
CFL	Late Containment Failure	0.000001
	Total	100

The SMR used in this analysis utilizes six severe accident sequences (i.e., release categories) as follows:

- Intact Containment (IC): Containment integrity is maintained throughout the accident. The release of radioactivity to the environment is due to nominal design leakage.
- Containment Bypass (BP): Radioactivity is released from the reactor coolant system to the environment via the secondary system or other interfacing system bypass. Containment failure occurs prior to the onset of core damage. This accident class contributes to the large, early release frequency (LERF).
- Containment Isolation Failure (CI): Radioactivity is released through a failure of the valves that close the penetrations between containment and the environment. Containment failure occurs prior to the onset of core damage. This accident class contributes to the LERF.
- Early Containment Failure (CFE): Radioactivity release occurs through a containment failure caused by some dynamic severe accident phenomenon after the onset of core damage but prior to core relocation. Such phenomena could

include hydrogen detonation, hydrogen diffusion flame, steam explosions, or vessel failures. This accident class contributes to the LERF.

- Intermediate Containment Failure (CFI): Radioactivity release occurs through a containment failure caused by some dynamic severe accident phenomenon after core relocation but before 24 hours have passed since initiation of the accident. Such phenomena could include hydrogen detonation / deflagration. This accident class contributes to large releases but does not occur early in the accident life cycle.
- Late Containment Failure (CFL): Radioactivity release occurs through a containment failure caused by some dynamic severe accident phenomenon more than 24 hours after initiation of the accident. Such phenomena could include the failure of containment heat removal. This accident class contributes to large releases but does not occur early in the accident life cycle.

The exposure pathways modeled include external exposure from the passing plume, external exposure from material deposited on the ground, inhalation of material in the passing plume or re-suspended from the ground, and ingestion of contaminated food and surface water. The MACCS2 code primarily addresses dose from the air pathway, but also calculates dose from surface runoff and deposition on surface water. The code also evaluates the extent of contamination. The analysis used site-specific meteorology and population data and included the ingestion pathway for the entire life cycle of the accident.

To assess human health impacts, TVA determined the collective dose, risk of early fatalities, and the risk of latent cancer fatalities from a severe accident for the population within a 50-mile radius. Economic costs were also determined, including the costs associated with short term relocation of people, decontamination of property and equipment, and interdiction of food supplies.

The MACCS2 calculations and accident frequency information are used to determine risk. The sum of the accident frequencies, the CDF, includes only internally initiated events. Risk is the product of frequency of an accident multiplied by the consequences of the accident. The consequence can be radiation dose, fatalities, economic cost or farmland that needs to be decontaminated. Dose-risk is the product of the collective dose times the accident frequency. Because the severe accident analysis addressed a suite of accidents (i.e., release categories), the individual risks are summed to provide a total risk (person-rem per Ryr). The same process was applied to estimating the risk of fatalities (fatalities per Ryr), the economic cost-risk (dollars per Ryr), and the risk of farmland decontamination (hectares per Ryr).

3.22.1.3 Plant Security

Licensee security programs and contingency plans deal with threats, thefts, and sabotage relating to nuclear facilities as part of the radioactive materials and activities that the NRC regulates (e.g., 10 CFR 73.55 for traditional LWRs licensed under 10 CFR part 50) in order to protect people and the environment. The NRC ensures safeguards and security by regulating licensees' security programs and contingency plans.

TVA has not yet developed site-specific security and contingency plans for the Nuclear Technology Park. However, TVA has in place detailed, sophisticated security measures to prevent physical intrusion into our nuclear plant sites by hostile forces seeking to gain access to nuclear reactors or other sensitive facilities or materials. These measures include, but are not limited to, intrusion detection and assessment systems, controlled access points, vehicle barrier systems, bullet and blast resistant enclosures and security personnel. TVA security personnel are trained and retrained to react to and repel hostile forces threatening TVA nuclear facilities. TVA's security measures and personnel are inspected and tested via force-on-force security exercises by the NRC. It is highly unlikely that a hostile force could successfully overcome these security measures and gain entry into sensitive facilities and even less likely that they could do this quickly enough to prevent operators from putting plant reactors into safe shutdown mode. TVA expects to follow the same approach for the Nuclear Technology Park in accordance with NRC regulations.

A security threat that is more frequently identified by members of the public or in the media are potential attacks using hijacked jet airliners, the method used on September 11, 2001, against the World Trade Center and the Pentagon. The likelihood of this now occurring is equally remote in light of today's heightened security awareness at airports and the Notice to Airmen (NOTAM) issued by the FAA, but this threat has been carefully studied for operating nuclear power plants. The NEI commissioned EPRI to conduct an impact analysis of a large jet airliner being purposefully crashed into sensitive nuclear facilities or containers including nuclear reactor containment buildings, used fuel storage ponds, used fuel dry storage facilities, and used fuel transportation containers (NEI 2012). Using conservative analyses, EPRI concluded that there would be no release of radionuclides from any of these facilities or containers because they are already designed to withstand potentially destructive events. The EPRI analysis used computer models to simulate a large commercial aircraft crashing into containment structures that were representative of all U.S. nuclear power containment types. The containment structures suffered some crushing and chipping at the maximum impact point but were not breached.

The NRC has amended its regulations to require applicants for new power reactors to perform a design-specific assessment of the effects on the facility of the impact of a large commercial aircraft under regulation 10 CFR 50.150, Aircraft Impact Assessment. TVA would ensure that each of the designs for the reactor technologies being considered for the CRN Site (SMRs and advanced non-LWRs) would follow the applicable requirements of 10 CFR 50.150 for AIA.

3.22.2 Environmental Consequences

3.22.2.1 Alternative A – No Action Alternative

Under this alternative, no completion or construction and operation of a Nuclear Technology Park would occur; therefore, there are no impacts.

3.22.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced Non-LWRs

3.22.2.2.1 Design Basis Accidents

Alternative B is for one or more advanced nuclear reactors at Area 1 on the CRN Site. There are no environmental criteria related to the potential consequences of DBAs. The calculated DBA doses shown in Table 3-83 are considerably smaller than the radiation dose limits of 10 CFR 50.67. Additionally, the site-specific analysis results demonstrate that the surrogate SMR DBA doses meet the site acceptance criteria of 10 CFR 50.34 (and 10 CFR 52.17). Therefore, the environmental consequences from DBAs at the CRN Site are of minor significance for any of the advanced nuclear reactor technologies being considered.

3.22.2.2.2 Severe Accidents

Alternative B is for one or more advanced nuclear reactors at Area 1 on the CRN Site. This subsection evaluates impacts of severe accidents from air, surface water, and groundwater pathways. The MACCS2 code was used to evaluate the doses from the air pathway and from water ingestion with site-specific data. MACCS2 does not model other surface water and groundwater dose pathways. These are analyzed qualitatively based on a comparison of doses from the atmospheric pathway for CRN Site to those of the existing fleet of U.S. nuclear reactors.

3.22.2.2.2.1 Air Pathways

The potential severe accidents for the SMR considered in this analysis were grouped into six accident classes (i.e., release categories) based on the similarity of their characteristics. The number and description of release categories is reactor design specific. Radionuclides that may be released are organized into groups having similar chemical characteristics. Each release category was assigned a set of characteristics representative of the chemical elements for that category. Each release category was analyzed with MACCS2 to calculate population dose, number of early and latent fatalities, economic cost, and the amount of farmland requiring decontamination. The analysis assumed that 99.5 percent of the population within the 2-mile EPZ of the CRN Site would be evacuated following declaration of a general emergency.

For each release category, risk was calculated by multiplying each consequence (population dose, fatalities, cost, and area of contaminated land) by the total CDF and the relative frequency for the release category. The sum of the long-term dose risk to the 50-mile population from atmospheric releases was calculated by MACCS2 for the 2-mile EPZ to be 7.71E-03 person-rem/Ryr (Table 3-86). As shown in Table 3-87 and Table 3-88, this 50-mile population risk is much lower than the risk estimated for (1) the five plants evaluated in NUREG-1150, *Severe Accident Risks: An Assessment for Five U.S. Nuclear Power Plants*, (NRC 1990) (2) the other current operating reactors in the U.S., (3) the recently licensed AP1000 reactors at the Vogtle site, and (4) the NRC Safety Goals (51 CFR 30028).

For an additional comparison, as reported in Section 3.20, Table 3-73, the calculated collective total body dose based on the PPE source term from normal operation at the CRN Site due to radioactive effluents (liquid and gaseous) is 6.8E+01 person-rem/Ryr. As previously described, dose risk is the total population dose rate (in person-rem/Ryr) multiplied by the frequency, and normal operation has a frequency of one. Therefore, the calculated population dose risk for normal operation is also 6.8E+01 person-rem/Ryr. Comparison of this value to the severe accident dose risk of 7.71E-03 person-rem/Ryr indicates that the calculated dose risk from severe accidents is far less than the calculated dose risk from normal operation.

The economic risk or costs (in dollars per Ryr) of a severe accident are also provided in Table 3-86. The total cost calculation considered consequences, such as evacuation costs, value of crops/milk contaminated and condemned, cost of property decontamination, and indirect costs resulting from loss of property use and incomes as a result of the accident. The economic risk is the total costs associated with the severe accident multiplied by the frequency of the accident. The calculated economic risk of a severe accident for the largest potential SMR at the CRN Site is 29.3 dollars/Ryr. The area of farmland requiring decontamination was calculated by MACCS2 for the 2-mile EPZ to be

1.69E-04 hectares/Ryr. These impacts are lower than those presented in the FEISs for recently approved reactor license applications, such as Vogtle (NRC 2008), and are therefore found to be acceptable.

Table 3-85. Environmental Impacts within a 50-Mile Radius for Severe Accidents at CRN Site

Release Category	Population Dose Risk (person-rem per Ryr)		Risk of Fatalities (fatalities per Ryr)		Economic Cost (dollars per Ryr)	Farmland Decontamination (hectares per Ryr)
	Water Ingestion	Total	Early	Latent		
Containment Bypass (BP)	1.01E-04	6.12E-03	1.77E-11	3.19E-06	2.42E+01	1.35E-04
Early Containment Failure (CFE)	1.55E-05	1.26E-03	0.00E+00	6.57E-07	4.50E+00	3.08E-05
Containment Isolation Failure (CI)	2.18E-06	2.54E-04	2.28E-12	1.97E-07	5.73E-01	3.86E-06
Intact Containment (IC)	1.94E-07	4.79E-05	0.00E+00	2.21E-08	2.53E-02	3.40E-10
Intermediate Containment Failure (CFI)	2.07E-07	3.84E-05	4.06E-15	2.18E-08	4.09E-02	2.81E-07
Late Containment Failure (CFL)	4.50E-11	1.52E-07	0.00E+00	8.25E-11	6.05E-04	3.90E-09
Total	**1.19E-04**	**7.71E-03**	**2.00E-11**	**4.09E-06**	**2.93E+01**	**1.69E-04**

Table 3-86. Comparison of Environmental Risks for the PPE with Risks for Current-Generation Reactors at Five Sites Evaluated in NUREG−1150 and NRC Safety Goals

Reactor Facility	Core Damage Frequency (/Ryr)	50-mile Population Dose Risk (Person-rem/Ryr)	Fatalities (/Ryr)		Average Individual Fatality Risk (/Ryr)	
			Early	Latent	Early	Latent Cancer
Grand Gulf[1]	4.0E-06	5E+01	8E-09	9E-04	3E-11	3E-10
Peach Bottom[1]	4.5E-06	7E+02	2E-08	5E-03	5E-11	4E-10
Sequoyah[1]	5.7E-05	1E+03	3E-05	1E-02	1E-08	1E-08
Surry[1]	4.0E-05	5E+02	2E-06	5E-03	2E-08	2E-09
Zion[1]	3.4E-04	5E+03	4E-05	2E-02	9E-09	1E-08
PPE at the CRN Site[2]	4.7E-08	8E-03	2E-11	4E-06	1E-13	9E-12
NRC Safety Goals[3]	N/A	N/A	N/A	N/A	4E-07	2E-06

[1]Risks were calculated using the MACCS2 code and presented in NUREG-1150.
[2]Risks were calculated with MACCS2 code using CRN Site site-specific input.
[3]Provided by the NRC in the Safety Goal Policy Statement (51 FR 30028).

Note:
N/A = Not Applicable

Table 3-87. Comparison of Environmental Risks from Severe Accidents for PPE with Risks for New Nuclear Plants and Current Nuclear Power Plants Undergoing Operating License Renewal Review

	Core Damage Frequency (per year)	50-mile Population Dose Risk (person-rem/Ryr)
Current Reactor Maximum[1]	2.4E-04	6.9E+01
Current Reactor Mean[1]	3.1E-05	1.5E+01
Current Reactor Median[1]	2.5E-05	1.3E+01
Current Reactor Minimum[1]	1.9E-06	3.4E+01
AP1000 Reactor at Vogtle site[2]	2.4E-07	2.8E-02
PPE at the CRN Site[3]	4.7E-08	7.7E-03

[1]Based on MACCS2 calculations for over 70 current plants at over 40 sites (NUREG-2168).
[2]NUREG-1872 (FEIS for Vogtle ESP)
[3]Calculated with MACCS2 code using CRN Site-specific input

3.22.2.2.2.2 Surface Water Pathways

People can be exposed to radiation when airborne radioactivity is deposited onto surface water. The exposure pathways can include drinking the water, aquatic food, swimming, and shoreline pathways. Surface water bodies within 50 miles of the CRN Site include the Reservoir and other smaller bodies of water.

The NRC examined the aquatic food, swimming, and shoreline pathways in NUREG-0769, *Final Environmental Impact Statement Related to the Operation of Enrico Fermi Atomic Power Plant, Unit No. 2,* and demonstrated that the dose from the aquatic food pathway was more than ten times the dose from the combined swimming and shoreline doses. The examination concluded that the uninterdicted aquatic food pathway was the principal pathway of exposure and the swimming and shoreline pathways were not significant. The NRC also evaluated doses from the aquatic food pathway for nuclear power plants discharging to various bodies of water in NUREG-1437, Rev. 0. NUREG-1437, Subsection 5.3.3.3.3 concluded that the risk associated with the aquatic food pathway is small relative to the atmospheric pathway for most sites, including small and large river sites. The CRN Site is a good approximation of the generic small river site examined in the NUREG-0440, *Liquid Pathway Generic Study: Impacts of Accidental Radioactive Releases to the Hydrosphere from Floating and Land-based Nuclear Power Plants* (i.e., the source of the NUREG-1437 analysis).

MACCS2 was used to calculate the dose from drinking water pathway for surface water sources. The sum of the severe accident dose risk to the 50-mile population from drinking water was calculated by MACCS2 for the 2-mile EPZ to be 1.19E-04 person-rem/Ryr (Table 3-85). The total drinking water dose risk is very small in comparison to the total dose risk for the atmospheric pathways. This dose risk is also lower than the dose risk from the drinking water pathway presented in the FEIS for recently approved reactor license applications, such as Vogtle (NUREG-1872), and are therefore found to be acceptable.

3.22.2.2.2.3 Groundwater Pathways

People could receive a dose from groundwater pathways. Radioactivity released during an accident can enter groundwater that serves as a source of drinking water or move through an aquifer that eventually discharges to surface water. The MACCS2 code does not calculate the dose from groundwater pathways. NUREG-1437, Rev. 0, evaluated the groundwater pathway dose, based on the analysis in NUREG-0440. NUREG-0440 analyzed a core meltdown that contaminated groundwater and subsequently contaminated surface water. NUREG-0440 did not analyze direct groundwater drinking at small river sites because of the limited number of potable groundwater wells. Therefore, Subsection 5.3.3.4.1 of NUREG-1437, Rev. 0, concludes that the dose from the groundwater pathway for small river sites is considered to be “minor or nonexistent.” As stated previously, the CRN Site is a good approximation of the generic small river site examined in NUREG-0440.

3.22.2.2.2.4 Health Risks

Based on the total calculated dose risk from the SMR at the CRN Site considered in this analysis, the risk of early fatalities to the 50-mile population was calculated to be 2.00E-11 fatalities/Ryr and the risk of latent cancer fatalities to the 50-mile population was calculated by MACCS2 for the 2-mile EPZ to be 4.09E-06 fatalities/Ryr. These fatality risks are lower than the fatality risks presented in the FEIS for recently approved reactor license applications. For Vogtle, in NUREG-1872, fatality risks are reported as1.9E-10 early fatalities/Ryr and 1.9E-05 latent fatalities/Ryr. While these risks are site-specific and dependent on local meteorology and regional populations, CRN Site risks are considered comparable to other facilities.

In addition, the MACCS2 computer code estimated the average individual fatality risks to be 1.27E-13 per Ryr from early fatalities within about one mile of CRN Site and 9.12E-12 per year from latent cancer fatalities within 10 miles. These risks are well below the safety goals for the average individual early fatality and latent cancer fatality risks set by the NRC in the Safety Goal Policy Statement (51 FR 30028) − less than 0.1 percent of risk resulting from other accidents. As indicated in NUREG-2168, Environmental Impact Statement for an ESP at the PSEG Site, Final Report (NRC 2015), the individual risk of a prompt fatality from all other accidents to which members of the U.S. population are generally exposed is about 4E-04 per year, and the sum of cancer fatality risks resulting from all other causes for an individual is taken to be the cancer fatality rate in the U.S., which is about 2E-03 per year. The risks estimated for the CRN Site are much less than one-tenth of one percent of these everyday public risks.

3.22.2.2.2.5 Conclusions

These estimates of the environmental impacts of severe accidents are considered to be bounding for the SMRs or advanced nuclear reactors under consideration for the CRN Site. Also, as provided in Table 3-86 and Table 3-87, the 50-mile population dose risks and the population fatality risks are less than those calculated for other operating reactors or new reactors currently under construction and the individual fatality risks are several orders of magnitude below the NRC Safety Goals.

Based on the discussions in the subsections above, these environmental impacts are concluded to be minor.

3.22.2.2.3 Plant Security

TVA's implementation of detailed, sophisticated security measures at the CRN Site in accordance with NRC regulations, similar to those implemented at TVA's other nuclear facilities, would help prevent physical intrusion by hostile forces seeking to gain access to nuclear reactors or materials. These robust security measures would help prevent release of radioactive material as set forth in NRC regulations.

Furthermore, TVA would ensure that each of the designs for the reactor technologies being considered for the CRN Site (SMRs and advanced non-LWRs) would follow the applicable requirements of 10 CFR 50.150 for AIA.

In conclusion, under Alternative B (including Alternatives B1 and B2), the implementation of nuclear security measures and AIA are considered to have a minor and beneficial environmental impact as they prevent release of radionuclides by adversary force attacks.

3.22.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced Non-LWRs

Alternative C is for one or more advanced non-LWRs at Area 2 on the CRN Site. The potential environmental consequences discussed for Alternative B are also applicable to Alternative C, since the evaluation applies to the entire CRN site and is for a surrogate SMR that is considered to be representative or conservative. Therefore, the environmental consequences from DBAs and severe accidents would also be minor for Alternative C. Similarly, the implementation of nuclear security measures and AIA under Alternative C are similar to those under Alternative B and are considered to have a beneficial environmental impact as they prevent release of radionuclides by adversary force attacks.

3.22.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced Non-LWRs

Alternative D is for one or more advanced nuclear reactors at Area 1 and Area 2 on the CRN Site. The potential environmental consequences discussed for Alternative B are also applicable to Alternative D, since the evaluation applies to the entire CRN site and is for a surrogate SMR that is considered to be representative or conservative. Therefore, the environmental consequences from DBAs and severe accidents would also be minor for Alternative D. Similarly, the implementation of nuclear security measures and AIA under Alternative D are similar to those under Alternative B and are considered to have a beneficial environmental impact as they prevent release of radionuclides by adversary force attacks.

3.22.2.5 Summary of Impacts to Nuclear Plant Safety and Security

As summarized in Table 3-88, the impacts associated with DBAs, severe accidents, and plant security are considered to be minor. There are no specific environmental criteria related to the potential consequences of DBAs or severe accidents. However, the calculated DBA doses are considerably smaller than the radiation dose limits of 10 CFR 50.67 and meet the site acceptance criteria of 10 CFR 50.34 (and 10 CFR 52.17). Additionally, for severe accidents, the 50-mile population dose risks and the population fatality risks are less than those calculated for other operating reactors or new reactors currently under construction and the individual fatality risks are several orders of magnitude below the NRC Safety Goals. Therefore, the environmental consequences from DBAs and severe accidents at the CRN Site are considered to be minor. In addition, impacts from plant security include the implementation of nuclear safety measures and the requirements of 10 CFR 50.150, which are considered to have a beneficial environmental impact by preventing the release of radionuclides by adversary forces. Finally, 10 CFR 100.20(b) requires TVA to evaluate the nature and proximity of human-related hazards to establish site parameters for use in determining whether a plant design can accommodate commonly occurring hazards and whether the risk of other hazards is very low. The acceptability of a site depends on establishing that (1) an accident at a nearby facility will not result in radiological consequences that exceed the dose guideline in 10 CFR 50.34; (2) the accident poses no undue risk because it is sufficiently unlikely to occur; or (3) the nuclear power station can be designed so its safety will not be affected by the accident. Therefore, the impacts associated with plant safety and security are minor. Any site-specific impacts that are analyzed in the future that are expected to fall outside of the bounding analysis in this PEIS will be analyzed in subsequent NEPA analysis.

Table 3-88. Summary of Impacts Associated with Nuclear Plant Safety and Security

Alternative	Project Phase	Impact	Severity
Design Basis and Severe Accidents			
Alternatives B, C, D	Operation	Potential for radiological releases resulting from DBAs or severe accidents.	Minor impacts. Conservative or bounding analyses show that radiological dose to the public resulting from a postulate DBA meet regulatory limits. For severe accidents, the calculated dose risk from atmospheric pathways is far less than the calculated dose risk

Alternative	Project Phase	Impact	Severity
			from normal operation. Additionally, the total drinking water dose risk is very small in comparison to the total dose risk for the atmospheric pathways. For the CRN Site, dose from groundwater pathways is also considered to be negligible. For severe accidents, the conservatively calculated doses and associated estimates of early fatalities or latent cancer fatalities would be several orders of magnitude below the NRC Safety Goals.
		Economic impacts of a severe accident.	Minor impacts. The economic impacts of a severe accident include evacuation costs, lost value of contaminated crops/milk, cost of property decontamination, and indirect costs resulting from loss of property use and incomes. The calculated economic risk of a severe accident at the CRN Site is 29.3 dollars/Ryr and the area of farmland requiring decontamination for the 2-mile EPZ is 1.69E-04 hectares/Ryr. These impacts are lower than those presented in the FEISs for recently approved nuclear reactors.
Nuclear Plant Safety and Security			
Alternatives, B, C, D	Operation	Prevention of release of radionuclides resulting from nearby hazards or an adversarial force.	Minor (beneficial impacts). The implementation of nuclear safety measures and the requirements of 10 CFR 50.150 and 10 CFR 100.20 are considered to have a beneficial environmental impact by preventing the release of radionuclides resulting from nearby hazards or an adversarial force.

3.23 Decommissioning

3.23.1 Affected Environment

3.23.1.1 Decommissioning Regulations

The NRC requires that a nuclear facility be decommissioned per NRC regulations after cessation of operations by safely removing the facility from service and reducing residual radioactivity to a level that permits release of the property for unrestricted use and termination of the license or release of the property under restricted conditions and termination of the license. NRC regulation 10 CFR 50.82, Termination of License specifies the actions that the NRC and licensee must take to decommission a nuclear power facility. The requirements for release of a nuclear power facility for unrestricted use is specified in 10 CFR 50.83, Release of Part of a Power Reactor Facility or Site for Unrestricted Use. The radiological criteria to be met for license termination are specified in 10 CFR 20, Subpart E. The NRC provides guidance to implement the rules in NUREGs in identifying specific methods for meeting the requirements. NRC regulations require the licensee to submit a post-shutdown decommissioning activities report (PSDAR) to the NRC and any affected States no later than two years after the date of permanent cessation of operation. The PSDAR includes:

- A description of site conditions
- The planned decommissioning activities
- A description of the methods used to ensure protection of workers and the public against radiation hazards
- A description of the planned final radiation survey
- An updated cost estimate
- A comparison of the cost estimate with funds set aside for decommissioning
- A plan for ensuring the availability of adequate funds for completing the project

Guidance and methods to evaluate the environment impacts during decommissioning of a facility are provided in NUREG-0586, Supplement 1, Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Regarding the Decommissioning Nuclear Power Reactors, issued in 2002 (NRC 2002). This document supplements the Final Generic Environment Impact Statement on Decommissioning a Nuclear Facility, issued in 1998 (NUREG-0586) (NRC 1998). Detailed analysis of decommissioning alternatives and plans are not required by the NRC until after a decision has been made to cease operation. Therefore, the evaluation addresses only general environmental impacts of decommissioning.

For the purposes of the evaluating the environmental impacts of decommissioning the various reactor designs considered by this Draft PEIS, the decommissioning process and requirements for LWRs as described in NUREG-0586 are considered bounding of SMRs and advanced non-LWR reactor technologies under consideration by this Draft PEIS. Note that the construction of the selected reactors for the Nuclear Technology Park may be staggered and would likely over a period of 20 years or more. Therefore, decommissioning of the reactors would likely not occur concurrently.

3.23.1.2 Decommissioning Strategies

The three NRC approved strategies of decommissioning nuclear power facilities are:

1. **DECON**. A method of decommissioning in which structures, systems, and components that contain radioactive contamination are removed from a site and safely disposed at a commercially operated LLW disposal facility or decontaminated to a level that permits the site to be released for unrestricted use shortly after it ceases operation.

   The DECON option calls for the prompt removal of radioactive material at the end of the plant life. Under DECON, all fuel assemblies, nuclear source material, radioactive fission and corrosion products, and all other radioactive and contaminated materials above NRC-restricted release levels are removed from the plant. The reactor pressure vessel and internal components would be removed along with removal and demolition of the remaining systems, structures, and components with contamination control employed as required. This is the most expensive of the three options, primarily due to price escalation for disposal of LLW.

2. **SAFSTOR.** A method of decommissioning in which a nuclear facility is placed and maintained in a condition that allows the facility to be safely stored and subsequently decontaminated (deferred decontamination) to levels that permit release for unrestricted use.

   SAFSTOR is a deferred decontamination strategy that takes advantage of the natural dissipation (decay) of radiation. After all fuel assemblies, nuclear source material, radioactive liquid, and solid wastes are removed from the plant, the remaining physical structure would then be secured and mothballed. Monitoring systems would be used throughout the dormancy period and a full-time security force would be maintained. The facility would be decontaminated to NRC-unrestricted release levels after a period of up to 60 years, and the site would be released for unrestricted use. Although this option makes the site unavailable for alternate uses for an extended period, worker and public doses would be much smaller than under DECON, as would the need for radioactive waste disposal.

3. **ENTOMB.** A method of decommissioning in which radioactive contaminants are encased in a structurally long-lived material, such as concrete. The entombed structure is maintained, and surveillance is continued until the entombed radioactive waste decays to a level permitting termination of the license and unrestricted release of the property. During the entombment period, the licensee maintains the license previously issued by the NRC.

   This option reduces worker and public doses, but most power reactors would have radionuclides in concentrations exceeding the limits for unrestricted use even after 100 years. The NRC staff position is that entombment should be used as a last resort for the decommissioning of power reactor facilities, with the expectation that this method would be selected only under unique decommissioning circumstances. The ENTOMB method has not been used in the U.S. and is not envisioned for decommissioning of the Nuclear Technology Park at the CRN Site.

The strategy for decommissioning of the Nuclear Technology Park at the CRN Site (DECON or SAFSTOR or combination) does not have to be identified until PSDARs are issued for each selected reactor technology.

3.23.1.3 Decommissioning Phases

Reactors might be licensed and constructed in the Nuclear Technology Park over a period of 20+ years. to achieve aspirations of net-zero carbon emissions by 2050. Each reactor would have its own licensing timeframe, so it is expected that reactors would be decommissioned on a staggered basis over a number of years. Nevertheless, each plant to be decommissioned would follow NRC's four phase decommissioning process as described below.

Phase 1 is administrative and involves preparations to shut-down the facility and begin the decommissioning process. Activities include planning for decommissioning, determining the decommissioning option, physical changes to the facility, changes to the organization (i.e., destaffing, employee retention program, hiring decommissioning contractors), and determining licensing basis change. The PSDAR may be submitted prior to shutdown, which allows immediate decommissioning following certification of the permanent shutdown and removal of fuel. Phase 1 typically occurs 1 ½ to 2 ½ years before planned shutdown.

Phase 2 is the transition from operation to decommissioning. Fuel would be transferred from the reactor into the spent fuel pool. Isolation and stabilization of all unnecessary structures, systems, and components are conducted during this phase. There is benefit for chemical decontamination of the primary system and establishment of a nuclear island. Phase 2 lasts about ½ to 1 ½ years.

Phase 3 consists of the decontamination and dismantlement of the facility. Activities include maintaining and emptying spent fuel when the fuel is transferred to spent fuel storage, removing the nuclear steam supply system (NSSS) and reactor pressure vessel (RPV) internals, decontaminating buildings and components, segmenting and removing radioactive components, removing large components, and LLW packaging, transportation, and vendor processing/disposal. Phase 3 can take between 3 ½ to 10 years.

Phase 4 is license termination. Activities include final site characterization, final radiation survey for final license termination plan submitted at least 2 years before termination, and final site survey.

3.23.1.4 Decommissioning Environmental Standards

10 CFR 50.82, Termination of License, paragraph (a)(6)(ii) states that the licensee must not permit any decommissioning activity that "result in significant environmental impact not previously reviewed". 10 CFR 50.82, paragraph (a)(4) states that "Prior to or within 2 years following permanent cessation of operation, the licensee shall submit a PSDAR to the NRC, and a copy to the affected State(s)." The PSDAR must contain a description of the planned decommissioning activities along with a schedule for their accomplishment, a discussion that provides the reasons for concluding that the environmental impacts associated with site-specific decommissioning activities would be bounded by appropriate previously issued EISs, and a site-specific decommissioning cost estimate, including the projected cost of managing irradiated fuel".

The list of environmental items in NUREG-0586, Generic Environmental Impact Statement on Decommissioning of Nuclear Facilities, Supplement 1 issued in 2002 considers the technological advances in decommissioning to evaluate environmental impacts during decommissioning of nuclear power light water reactors. NUREG-0586 requires a full interdisciplinary analysis of all appropriate natural and human environmental resource factors.

3.23.2 Environmental Consequences

3.23.2.1 Alternative A – No Action Alternative

Under this alternative, construction, operation, or decommissioning of a Nuclear Technology Park would occur; therefore, there would be no impacts from decommissioning.

3.23.2.2 Alternative B – Nuclear Technology Park at Area 1 with SMRs and/or Advanced non-LWRs

Under Alternative B, the environmental impacts of decommissioning would be minor for all environmental resources. The air quality, water quality, and ecological impacts of decommissioning are expected to be substantially smaller than those experienced during facility construction or operation because the level of activity and the releases to the environment are expected to be smaller. Adverse socioeconomic impacts of decommissioning could result from the demands on, and contributions to, the community by the workers employed to decommission the facility and from reduction in the operations workforce.

The NRC identified in SECY-11-0181, Decommissioning Funding Assurance for Small Modular Nuclear Reactors, differences between potential SMR designs, such as those included in consideration for Alternative B, and previously licensed reactor designs that could impact decommissioning strategies (NRC 2011a). These differences include:

- Reduced size and quantity of components and equipment to be disposed
- Reduced area to be decontaminated (depending on the number of modules)
- Possible difficulty with accessibility for decontamination because of the small size of the components
- Possible difficulties related to the decommissioning of modules while other modules are in operation

The projected physical facility inventories associated with advanced nuclear reactor designs are expected to be less than those for currently operating nuclear reactors due to advances in technology, the smaller size reactor facility footprints anticipated to be sited at the Nuclear Technology Park, and simplified maintenance regimes for advanced nuclear reactors. Based on this comparison, the general environmental impacts identified in NUREG-0586 are bounding for any advanced nuclear reactor facility constructed and operated in the Nuclear Technology Park.

Therefore, the impacts associated with decommissioning would be minor. Further environmental reviews would be conducted at the time the PSDAR is submitted to refine the impact analysis associated with the specific reactor technology chosen for the Nuclear Technology Park.

3.23.2.3 Alternative C – Nuclear Technology Park at Area 2 with Advanced non-LWRs

As discussed in Section 3.22.1, the decommissioning process and requirements for traditional LWRs as described in NUREG-0586 are considered bounding of SMRs and advanced non-LWR technologies. Therefore, under Alternative C the environmental impacts of decommissioning non-LWR advanced nuclear reactors at Area 2 would be similar to those described under Alternative B and would be minor. Because advanced non-LWRs consist of a range of technologies with different existing and proposed nuclear fuel types, it is expected that additional NRC reviews would be conducted during the licensing process for non-LWR designs selected for construction and operation in the Nuclear Technology Park, to evaluate appropriate potential decommissioning strategies. Further environmental reviews would be conducted at the time the PSDAR is submitted to refine the impact analysis associated with decommissioning of the specific reactor technology chosen for the Nuclear Technology Park.

3.23.2.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2 with SMRs and/or Advanced non-LWRs

Under Alternative D, the environmental impacts of decommissioning would be similar to those described for Alternative B and C. Therefore, the impacts associated with Alternative D due to decommissioning would also be minor.

3.23.2.5 Summary of Impacts from Decommissioning

A decommissioning plan relative to each potential reactor deployed at the CRN Site would be developed for approval by the NRC, with appropriate environmental reviews conducted prior to TVA preparation to decommission any potential plant in the future. For the purpose of evaluating future environmental impacts associated with decommissioning, LWRs as described in NUREG-0586 are considered bounding of the SMR and advanced non-LWR Reactor technologies that are being considered for the Nuclear Technology Park.

Environmental issues associated with decommissioning were analyzed in the Generic Environmental Impact Statement for License Renewal of Nuclear Power Plants, NUREG-1437 (NRC 1996). The potential environmental impacts of decommissioning are minor as shown in Table 3-89. Further environmental reviews would be conducted at the time a decommissioning plan is proposed.

Table 3-89. Summary of Impacts from Decommissioning

Alternative	Project Phase	Impact	Severity
Alternatives B, C, D	Decommissioning	Potential impacts to air quality, water quality, ecological resources, socioeconomics, and other resource areas as defined in NUREG-0586.	Minor impacts. Impacts of decommissioning are expected to be substantially smaller than those experienced during facility construction or operation because the level of activity and the releases to the environment are expected to be smaller. Also, per in general, as stated in NUREG-0586, decommissioning generally results in positive environmental impacts.

3.24 Unavoidable Adverse Environmental Impacts

Unavoidable adverse impacts are the effects of the proposed action on natural and human resources that would remain after mitigation measures or BMPs have been applied. Mitigation measures and BMPs are typically implemented to reduce a potential impact to a level that would be below the threshold of significance as defined by the CEQ and the courts. Impacts associated with the construction and operation of a Nuclear Technology Park at the CRN Site have the potential to cause unavoidable adverse effects to several natural and human environmental resources. TVA would reduce the potential for adverse effects to the extent practicable during the planning process. In addition, TVA would implement mitigation measures (Section 2.8) to further reduce potential adverse effects to certain environmental resources. Chapter 3 discusses in detail the potential impacts from construction and operation of the proposed Nuclear Technology Park at the CRN Site and presents mitigation and controls intended to lessen the adverse impacts. Unavoidable adverse impacts associated with construction and operation activities to each resource evaluated in the EIS where applicable are discussed below.

3.24.1 Unavoidable Adverse Impacts During Construction

Under Alternatives B, C, and D, most unavoidable adverse impacts from construction are attributable to activities involving land disturbance from preparing the CRN site such as vegetation clearing, excavation, grading, filling wetlands, filling or culverting intermittent streams and waterways, adding impervious surfaces, upgrading of onsite and offsite access routes and construction of new routes, and installation of intake and discharge structures.

It is estimated that depending on the alternative selected, up to approximately 632.9 acres of the CRN Site would be affected by construction activities, including approximately 553.9 acres that would be permanently covered by the facility or otherwise developed and approximately 79.0 acres that would be used temporarily as laydown during construction would result in an unavoidable adverse impact to terrestrial resources. Approximately 240 acres within Area 1 were previously disturbed during the CRBRP project as described in Section 2.4.1.1 and shown in Figure 3-22. The terrestrial communities mainly affected by the current proposed action include mixed evergreen-deciduous, deciduous, evergreen forest, woody wetlands, and herbaceous vegetation. Unavoidable adverse impacts on aquatic ecology would include physical alteration of habitat from in-filling of streams and ponds, associated alteration of adjacent riparian zones, placement of cofferdams, installation of new or replacement culverts and localized dredging activities, installation of shoreline stabilization measures, and ensuing localized changes in water quality. A total of 0.69 acres of nearshore underwater habitat is expected to be impacted by construction activities in the Reservoir. Impacts to streams would result in direct alteration and loss of aquatic habitat and associated riparian zones. These impacts would result from installation of the water intake structure, discharge piping, and improvements at the BTA. These habitat alterations would result in impacts to localized species composition and wildlife habitat for the lands immediately affected. However, due to the abundant habitat of similar quality within the vicinity of the project sites, the overall impact to is considered minor.

Forest and herbaceous vegetation that may offer some suitable summer roosting and/or foraging habitat to state- and federally listed bats would be removed under the action alternatives. In addition, proposed actions would occur in the vicinity of a transitional roosting cave used by federally listed gray bats. Depending on the duration between previous bat surveys and site-specific design, additional presence/absence surveys may be required prior to construction activities. Where feasible, tree removal would occur in winter to minimize impacts to roosting bats. Consultation with the USFWS under Section 7 of the

ESA would occur when specific designs have been selected and scope of the project has been refined. By implementing minimization measures such as winter tree removal and any additional conservation measures that may result from the Section 7 consultation, substantial impacts to state- and federally listed bats are not anticipated.

Unavoidable impacts to surface waters include the elimination of up to seven perennial streams (1,775 linear feet), six intermittent streams (2,655 linear feet), 13 ephemeral stream (3,931 linear feet), two small ponds (0.9 acre) within the CRN Project Area. Up to 9,050 lineal feet of shoreline would also be affected by the installation of shoreline stabilization and restoration measures. Additionally, there is anticipated to be local and temporary increase in sediments in water from increased erosion and construction stormwater runoff, and discharge of excavation dewatering. Unavoidable impacts associated with underwater excavation would result in minor localized changes in flow patterns along the reservoir bottom due to differences in bottom contours at the edges of the excavation zone, as well as temporary suspension of sediments during excavation. Unavoidable adverse impacts to wetlands include the permanent disturbance of 14.7 acres of 46 wetlands on the CRN Project Area, approximately 6.56 acres of wetlands would be permanently altered. These impacts overall are minor to moderate and would be mitigated through adherence to permit requirements and the provision of appropriate compensatory mitigative measures, if needed. Temporary impacts to water quality from runoff during construction could impact nearby receiving water bodies but would be reduced with application of appropriate BMPs.

Unavoidable localized increases in air emissions, noise, and visual discord would also occur during construction activities. Activities associated with the use of construction equipment may result in varying amounts of fugitive dust, emissions of pollutants and GHGs from land-disturbing activities, and noise that may potentially impact onsite workers, users of adjacent recreational lands and water bodies, and residents located across the reservoir, and visual discord from construction equipment. Workers would use appropriate protection and adhere to safety standards designed to minimize worker-related injuries. Emissions from onsite construction activities and equipment are minimized through implementation of BMPs including proper maintenance of construction equipment and vehicles. Overall, these impacts would be minor to moderate.

During the peak of construction, traffic generation would be substantial during key morning and afternoon commute times on principal access routes surrounding the CRN Site. However, with proposed roadway improvements at TN 58 and Bear Creek Road and along Bear Creek Road leading into the CRN Site, traffic impacts during construction would be minor, and the LOS metrics would be improved at most key intersections with the exception of TN 95 at Bear Creek Road. At this location, where the LOS is currently rated LOS F, traffic delays would worsen during construction due to heavy volumes during the peak hour associated with ORR and additional traffic using the TN 95 Access. This additional traffic would also increase noise and fugitive dust in areas proximate to these roads, potentially affecting sensitive noise receptors along the routes. Emissions from construction equipment are minimized through implementation of BMPs including proper maintenance of construction equipment and vehicles and dust suppression measures.

Construction could impact up to six of the 13 identified potentially eligible archaeological sites within or partially within the CRN Project Area, resulting in unavoidable adverse impacts to historic and cultural resources. Once specific project plans are available, TVA would undertake steps required in the PA between TVA, the TN SHPO, and federally recognized tribes including additional investigations, determination of NRHP eligibility status, and appropriate mitigation.

In the context of the availability of regional resources that are similar to those unavoidably adversely affected by the project, coupled with the application of appropriate BMPs, the adherence to permit requirements, and the temporary nature of construction activities, unavoidable adverse impacts of construction activities would range from minor to moderate.

3.24.2 Unavoidable Adverse Impacts During Operation

Operations of the Nuclear Technology Park would create an unavoidable adverse impact on air quality and GHG emissions. Operations would increase gaseous and particulate emissions from auxiliary systems (auxiliary boilers, diesel generators, gas turbines, and emergency equipment) and cooling towers. Visual impact from the cooling towers and associated plumes would, under certain conditions, result in an unavoidable adverse impact on visual aesthetics for the surrounding area. The scenic integrity would drop from moderate to low. These impacts would be minor to moderate and would be minimized through implementation of BMPs and adherence to parameters of the respective permits.

Potential unavoidable impacts associated with nonradiological public health and safety include general occupation health risks, occupational illnesses, and etiological agents from thermal discharges to the Reservoir. Radiological unavoidable impacts include the possibility of exposure from radon-222 and technetium-99 releases, which can cause bone and lung cancer and gastrointestinal tract and kidney complications respectively. However, these impacts would be reduced by adherence to NRC and OSHA safety standards.

Operation of the Nuclear Technology Park would contribute to unavoidable adverse impacts related to the uranium fuel cycle, transportation of fuels and wastes, and storage of spent fuel. Impacts include liquid and gases radioactive waste leakages and transportation of and permanent land commitments for storage of solid radioactive waste. All sources of radioactive waste and the transportation and storage of spent fuel would comply with NRC requirements.

The unavoidable adverse impacts of operating a Nuclear Technology Park at the CRN Site would range from minor to moderate.

3.25 Relationship of Short-Term Uses and Long-Term Productivity

NEPA requires a discussion of the relationship between short-term uses of the environment versus the maintenance and enhancement of long-term environmental productivity. This Draft PEIS focuses on the analyses of environmental impacts associated with the construction and operation of a Nuclear Technology Park at the CRN Site, as well as infrastructure improvements in associated offsite areas. These activities are considered short-term uses of the environment for the purposes of this section. In contrast, the long-term productivity is considered to be that which occurs beyond the conclusion of decommissioning the Nuclear Technology Park and associated infrastructure. This section includes an evaluation of the extent that the short-term uses preclude any options for future long-term use of the project site.

The uses of the human environment associated with the proposed action include unavoidable adverse impacts to resources associated with both construction and operation of the Nuclear Technology Park, as described above. Impacts which would cease or be reversed following plant decommissioning are considered short-term, because they would be restored to a state which supports long-term productivity following decommissioning. These include impacts to resources such as air quality, terrestrial ecology, aquatic ecology, noise, visual resources, and socioeconomic resources. The long-term productivity of those resources that can be restored following decommissioning would not be considered long-term. Impacts which cannot be reversed or would continue past decommissioning of the Nuclear Technology Park, may be considered long-term. These include impacts to resources such as land use, water resources, and impacts to historic properties. Long-term management of radioactive waste from operations and decommissioning and management of irradiated fuel that must be safeguarded and isolated for extended durations and therefore, represents a long-term commitment of resources long after decommissioning.

The short-term use of some resources and long-term use of others, and irreversible and irretrievable commitment of depletable resources would be offset by the benefit of the demonstration of nuclear technology capabilities. This benefit would be considered short-term, occurring during the operating life of the Nuclear Technology Park. This benefit would be much larger than the productivity of any other uses of those resources during the operational life of the Nuclear Technology Park. The Nuclear Technology Park would continue to have long-term benefits even after decommissioning, as plant structures and site infrastructure may be repurposed to other productive uses which could continue to support economic activity. Lastly, the operation of the Nuclear Technology Park would serve as a demonstration of nuclear technology as a viable option for electric power production at other sites, even after all of the reactors in the Nuclear Technology Park have been decommissioned.

3.26 Irreversible and Irretrievable Commitments of Resources

The term irreversible commitments of resources describes environmental resources that are potentially changed by the construction or operation of the proposed project that could not be restored to their prior state by practical means at some later time. Irreversible commitments generally occur to nonrenewable resources such as minerals or cultural resources and to those resources that are renewable only over long timespans, such as soil productivity. A resource commitment is considered irretrievable when the use or consumption is neither renewable nor recoverable for the use until reclamation is successfully applied. Irretrievable commitments generally apply to the loss of production, harvest, or other natural resources and are not necessarily irreversible. For example, the construction of a road through a forest would be an irretrievable commitment of the productivity of timber within the road ROW as long as the road remains. Mining of ore is an irreversible commitment of a resource as the ore cannot be restored once it is removed and used.

3.26.1 Irreversible Commitments of Resources

Commitment of land including permanently filled wetlands and streams, for the construction and operation of the Nuclear Technology Park and associated offsite areas would be largely unavailable for other uses. Permanent disturbances to wetlands, surface waters, and archaeological sites would be irreversible. Similarly, impacts to nonmobile biota during construction would also be irreversible. Consumptive water uses during construction and during operation of the Nuclear Technology Park would be irreversibly lost from Watts Bar Reservoir. Operation of the SMRs at the CRN Site generates radioactive, hazardous, and nonhazardous waste requiring disposal. These waste streams are to be treated at permitted facilities or disposed in permitted landfills. Land committed to the disposal of such wastes would have an irreversible impact on their use as it would be committed for that use with few other purposes.

3.26.2 Irretrievable Commitments of Resources

Irretrievable commitments of resources resulting from construction and maintenance of a Nuclear Technology Park at the CRN Site would be similar to those of any major construction project. Actual commitment of construction resources would depend on the potential reactor designs selected by TVA. It is anticipated that some metals, concrete, and other materials used in the construction of the Nuclear Technology Park would become contaminated or irradiated over the life of the facility operations. Much of that material cannot be reused or recycled. However, while the expected use of construction materials associated with construction of a Nuclear Technology Park are irretrievable, it is not detrimental to the availability of these resources. Additionally, nonrenewable energy in the form of fuels and electricity during construction, and operation of the Nuclear Technology Park. Ancillary (e.g., vehicles and equipment) usage, and power supplied for plant operations would be supplied from the overall TVA electrical grid which includes coal and gas-fired generation. However, the total amount consumed during construction and operation is very small compared to overall usage in the U.S.

Operation of the Nuclear Technology Park also requires the irretrievable commitment of uranium ore. The amount of uranium ore and existing highly enriched uranium in the U.S. and Russia that could be processed into fuel are available in sufficient quantities, so that the irreversible commitment during the operational life of the Nuclear Technology Park would be negligible.

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4.1 NEPA Project Management

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Education:	B.S., Geology
Project Role:	Geology and Soils (Geographic Project Setting and Geology and Physiography)
Experience:	21 Years in geotechnical subsurface investigations and reporting for commercial infrastructure, transportation (roads and bridges), and nuclear safety related/NQA-1 site subsurface investigations (ESPA and COLA), 4 Years in industrial mineral and precious metal mineral exploration and mining

Name:	**Robin Ledford**
Education:	B.S. and M.S., Biological Science
Project Role:	Wetlands
Experience:	19 years of experience in wetland delineations, 404/401 permitting, and environmental reviews

Name:	**Chris Mausert-Mooney**
Education:	B.S., Biology
Project Role:	Technical Review
Experience:	11 years of experience in botany, threatened and endangered species monitoring/surveys, and wetland delineations

Name:	**Valentina Montaldo Falero**
Education:	M.S. (Laurea), Geology; Ph.D., Geology (Seismology)
Project Role:	Geology and Soils (Seismicity)
Experience:	21 years of experience in seismic hazard assessment for critical facilities

Name:	**Chelsey Nieman, Ph.D**
Education:	Ph.D, Fisheries and Wildlife
Project Role:	Aquatic Ecology
Experience:	7 years of experience in freshwater ecology

Name:	**Rebecca Porath, CWB**
Education:	M.S. and B.S., Wildlife and Fisheries Sciences
Project Role:	Terrestrial Ecology, Endangered and Threatened Species
Experience:	22 years in environmental planning, NEPA analysis and documentation, ecological studies, and preparation of technical documents

Name:	**Konrad Quast, Ph.D**
Education:	B.S. and Ph.D, Hydrology and Water Resources
Project Role:	Water Resources (Groundwater)
Experience:	20 years in hydrogeologic and environmental geochemical data analysis, interpretation, and preparation of technical reports

Name:	**Natalie Reiss**
Education:	B.A., Biology
Project Role:	Transportation, Visual Resources, Noise, Socioeconomics (Economics and Income and Community Characteristics), Environmental Justice
Experience:	7 years of experience in NEPA analysis and documentation

Name:	**Kurt Sichelstiel**
Education:	B.A., Geology
Project Role:	Water Resources (Groundwater)
Experience:	40 years of experience

Name:	**Randy Shuler, Ph.D, LSRP**
Education:	B.S., Biology; B.S., Biochemistry; Ph.D, Biochemistry and Molecular Biology
Project Role:	Nonradiological Public Health and Safety
Experience:	30 years of experience

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Name:	**Jeff Prendergast, PE**
Education:	B.S., Mechanical Engineering
Project Role:	Principle Project Manager
Experience:	13 years' experience leading nuclear design projects

Name:	**Stephen Murphy, PE**
Education:	B.S., Mechanical Engineering
Project Role:	Deputy Project Manager
Experience:	7 years' experience leading nuclear design projects

Name:	**Kenneth Snell, JD, PE**
Education:	B.S., Chemical Engineering; B.A., Environmental Studies; J.D. Law
Project Role:	Sr. Project Quality Control Specialist
Experience:	35 years' experience in environmental permitting, compliance, and controls

Name:	**Mike Launi, PE, MBA**
Education:	M.E. and B.S., Nuclear Engineering; MBA
Project Role:	Technical Licensing Expert
Experience:	40 years' experience in nuclear licensing

Name:	**Erwin Prater, PhD, MBA, CCM, CFA**
Education:	B.A., Geography/Mathematics; M.S. and Ph.D, Atmospheric Science; MBA
Project Role:	Meteorology & Climate Change
Experience:	30 years' experience in air quality modeling, accidental release modeling, and consulting

Name:	**David Gennardo, PE**
Education:	B.S. and M.S., Nuclear Engineering
Project Role:	Radiological Dose & Waste, Nuclear Plant Safety
Experience:	11 years' experience in nuclear licensing activities, radiological studies, and safe shutdown analyses

Name:	**Shannon McEwen-Barbas**
Education:	B.A., History and Environmental Studies; M.A., Geography; M.S., Environmental Science and Policy
Project Role:	Land Use, Demographics
Experience:	7 years' experience in GIS, demographic, and statistical analysis

Name:	**Constantine Petropoulos, PE, MBA**
Education:	B.S. and M.S., Structural Engineering
Project Role:	Nuclear Plant Security
Experience:	40 years' experience in engineering, design, construction, and betterment of nuclear power plants

Name:	**Bob Charles, MBA**
Education:	B.S., Electrical Engineering; MBA
Project Role:	Decommissioning
Experience:	48 years' experience in nuclear, fossil, and solar power plants

Name:	**Matthew Heerman, PE**
Education:	B.S., Chemical Engineering
Project Role:	Water Quality
Experience:	14 years' experience in engineering of water and waste treatment systems

Name:	**David Helm, PE**
Education:	B.A., Economics; B.S., Chemical Engineering; M.S., Environmental Engineering
Project Role:	Air Quality
Experience:	More than 20 years' experience in environmental compliance, engineering and permitting

CHAPTER 5 – LITERATURE CITED

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Appendix A – Plant Parameter Envelope (PPE)

APPENDIX A

SITE CHARACTERISTICS AND PLANT PARAMETER ENVELOPE VALUES CONSIDERED IN THE ENVIRONMENTAL REVIEW OF THE EARLY SITE PERMIT APPLICATION

The early site permit (ESP) site characteristics and plant parameter envelope (PPE) values are from Tables 3.1-1 and 3.1-2 of the applicant's Early Site Permit Application (Revision 2): Part 3, Environmental Report, unless otherwise specified. These characteristics and parameters were used by the Nuclear Regulatory Commission (NRC) staff in its independent evaluation of the environmental impacts of the surrogate reactors and are tabulated in Tables I-1 and I-2 of the FEIS as well as below. Any mention of figures or tables in Tables I-1 or I-2 refer to figures or tables in the Environmental Report. In some cases, as noted, the staff substituted values based on its own analysis.

Table A.1. Clinch River Nuclear Environmental Site Characteristics

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
9. Unit Vent/Airborne Effluent Release Point				
9.1 Atmospheric Dispersion (X/Q) (Accident)				
9.1.1 0-2 hr @ EAB	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases in the limiting two-hour interval.	Site	5.58E-04 s/m^3	7.1
9.1.2 0-8 hr @ low population zone (LPZ)	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases in the first eight hours.	Site	4.27E-05s/m^3	7.1
9.1.3 8-24 hr @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between hours 8 and 24 after the accident.	Site	3.80E-05 s/m^3	7.1
9.1.4 1-4 day @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between the first day and the fourth day after the accident.	Site	2.94E-05 s/m^3	7.1
9.1.5 4-30 day @ LPZ	The atmospheric dispersion coefficients used in the design safety analysis to estimate dose consequences of accident airborne releases between day four until the end of the first 30 days after the accident.	Site	2.04E-05 s/m^3	7.1
9.3 Calculated Dose Consequences				
9.3.1 Normal	The design radiological dose consequences due to airborne releases from normal operation of the plant.	Site	10 CFR Part 20, 10 CFR Part 50 Appendix I	5.4[b], 7.2[b]
9.3.2 Post-Accident	The design radiological dose consequences due to airborne releases from postulated accidents.	Site	10 CFR 52.17(a)(1)(ix), 10 CFR 100.20	5.4[b], 7.2[b]

(a) The numbering of the PPE listing is not meant to be sequential and was compiled from, and is consistent with, the list developed by industry and refined for this early site permit application.
(b) Information used in the development of the impacts described in the section, but not referenced specifically in the text.

Table A.2. Clinch River Nuclear Site-Related Design Parameters

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
1. Structure				
1.1 Building Characteristics				
1.1.1 Height (w/o Stack and Cooling Towers)	The height from finished grade to the top of the tallest power-block structure, excluding cooling towers (excludes stairway towers, elevator, etc.).	Rx	160 ft	2.5.2, 3.1, 4.4, 5.8
1.1.2 Foundation Embedment	The depth from finished grade to the bottom of the basemat or the most deeply embedded power-block structure (excavation depth is the same elevation as embedment depth).	Rx	138 ft	3.1
3. Normal Plant Heat Sink				
3.1 Condenser				
3.1.2 Condenser/Heat Exchanger Duty	Design value for the waste heat rejected to the circulating water system across the condensers.	Eng	5593 MBTU/hr for site	3.4
3.2 Non-Safety Related Service Water Systems				
3.2.3 Miscellaneous Plant Water Uses Intake	The maximum, and normal, water intake of the plant neglecting cooling-tower makeup, potable/sanitary water users, and liquid radwaste treatment.	Eng	Maximum: 5,100 gpm; normal: 1,345 gpm See Figure 3.3-1	3.4
3.2.4 Miscellaneous Plant Water Uses Discharge	The maximum, and normal, water discharge of the plant neglecting cooling-tower makeup, potable/sanitary water users, and liquid radwaste treatment.	Eng	Maximum: 4,200 gpm; normal: 445 gpm See Figure 3.3-1	3.4
3.3 Mechanical Draft Cooling Towers				
3.3.1 Acreage	The land required for cooling towers, including support facilities such as equipment sheds, basins, canals, or shoreline buffer areas.	Eng	See Figure 3.1-1	3.4, 5.3
3.3.3 Blowdown Constituents and Concentrations	The maximum expected concentrations for anticipated constituents in the cooling-water systems blowdown to the receiving waterbody.	Eng	Table 3.6-1 (values for site)	3.6
3.3.4 Blowdown Flow Rate	The normal (and maximum) flow rate of the blowdown stream from the cooling-water systems to the receiving waterbody for closed system designs.	Eng	Maximum: (2 COC) 12,800 gpm, Expected: (4 COC) 4270 gpm See Figure 3.3-1	3.4

Table A.2. (cont'd)

PPE Section[a]	Definition	Parameter Type	PPE Value	ER Section
3.3.5 Blowdown Temperature	The maximum expected blowdown temperature at the point of discharge to the receiving waterbody.	Eng	90 F	3.4
3.3.6 Cycles of Concentration	The ratio of total dissolved solids in the cooling-water blowdown streams to the total dissolved solids in the makeup water streams.	Eng	Maximum: 4; minimum: 2	3.4, 5.3
3.3.7 Evaporation Rate	The expected (and maximum) rate at which water is lost by evaporation from the cooling-water systems.	Eng	12,800 gpm (expected and maximum) -values for site	3.4
3.3.8 Height	The vertical height above finished grade of mechanical draft cooling towers associated with the cooling-water systems.	Eng	65 ft	3.4, 5.3, 5.8
3.3.9 Makeup Flow Rate	The expected (and maximum) rate of removal of water from a natural source to replace water losses from closed cooling-water system.	Eng	17,078 gpm (expected), 25,608 gpm (maximum)	3.4
3.3.10 Noise	The maximum expected sound level produced by operation of cooling towers, measured at 1,000 ft from the noise source.	Eng	<70 dba	5.3, 5.8, 9.3
3.3.11 Cooling-Tower Temperature Range	The temperature difference between the cooling water entering and leaving the towers.	Eng	18 F	3.4
3.3.12 Cooling-Water Flow Rate	The total cooling-water flow rate through the condenser/heat exchangers.	Eng	755,000 gpm	3.4, 5.3
3.3.14 Maximum Consumption of Raw Water	The expected maximum short-term consumptive use of water by the cooling-water systems (evaporation and drift losses).	Eng	12,808 gpm	3.4
3.3.16 Stored Water Volume	The quantity of water stored in cooling-water system impoundments, basins, tanks and/or ponds.	Eng	5 million gal	3.4
3.3.17 Drift	Rate of water lost from the tower as liquid droplets entrained in the vapor exhaust air stream.	Eng	8 gpm	3.4
5. Potable Water/Sanitary Waste System				
5.1 Discharge to Site Water Bodies				
5.1.1 Flow Rate (Potable/Sanitary Normal)	The expected (normal) effluent flow rate from the potable/sanitary system to the receiving waterbody.	Rx	50 gpm	3.4, 3.6, 5.5
5.1.2 Flow Rate (Potable/Sanitary Maximum)	The maximum effluent flow rate from the potable/sanitary system to the receiving waterbody.	Rx	100 gpm	3.4, 3.6, 5.5

Table A.2. (cont'd)

PPE Section[(a)]	Definition	Parameter Type	PPE Value	ER Section
9.5 Source Term				
9.5.1 Gaseous (Normal)	The expected annual activity, by radionuclide, contained in routine plant airborne effluent streams, excluding tritium.	Rx	Table 3.5-3	3.5
10. Liquid Radwaste System				
10.2 Release Point				
10.2.1 Flow Rate	The discharge (including minimum dilution flow, if any) flow rate of liquid potentially radioactive effluent streams from plant systems to the receiving waterbody.	Eng	900 gpm - expected normal and maximum -	3.4
10.3 Source Term				
10.3.1 Liquid	The annual activity, by radionuclide, contained in routine plant liquid effluent streams, excluding tritium.	Rx	Table 3.5-1 ([value per site)	3.5
11. Solid Radwaste System				
11.2 Solid Radwaste				
11.2.1 Activity	The annual activity, by radionuclide, contained in solid radioactive wastes generated during routine plant operations.	Rx	Table 3.5-5 (site value)	3.5
11.2.3 Volume	The expected volume of solid radioactive wastes generated during routine plant operations.	Rx	5,000 cubic ft/yr (site value)	3.5, 3.8, 5.7, 7.4
13. Auxiliary Boiler System				
13.1 Exhaust Elevation	The height above finished plant grade at which the flue gas effluents are released to the environment.	Eng	Plant Grade	3.6
13.2 Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the auxiliary boilers.	Eng	Table 3.6-2	3.6
14. Standby Power System				
14.1 Diesel				
14.1.2 Diesel Exhaust Elevation	The elevation above finished grade of the release point for standby diesel exhaust releases.	Eng	25 ft	3.6
14.1.3 Diesel Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby diesel generators.	Eng	Table 3.6-3 (value per site)	3.6

Table A.2. (cont'd)

PPE Section[(a)]	Definition	Parameter Type	PPE Value	ER Section
14.2 Gas Turbine				
14.2.2 Gas-Turbine Exhaust Elevation	The elevation above finished grade of the release point for standby gas turbine exhaust releases.	Eng	50 ft	3.6
14.2.3 Gas-Turbine Flue Gas Effluents	The expected combustion products and anticipated quantities released to the environment due to operation of the emergency standby gas-turbine generators.	Eng	Table 3.6-4	3.6
15. Plant Layout Considerations				
15.1 Access Routes				
15.1.1 Heavy-Haul Routes	The land usage required for permanent heavy-haul routes to support normal operations and refueling.	Eng	5 ac	3.9
15.2 Acreage to Support Plant Operations	The land area required to provide space for plant facilities.	Eng	See Figure 3.1-1	3.7
16. Plant Operations Considerations				
16.1 Megawatts Thermal	The thermal power generated by one unit (may be the total of several modules). Specify both core thermal power and reactor coolant pump (RCP) thermal power if there are RCPs in the design. The total thermal power for the site.	Rx	800 MW(t) (core for single unit), 805 MW(t) (core for single unit + RCP), 2,420 MW(t) total for site	5.7, 7.4
16.2 Plant Design Life	The operational life for which the plant is designed.	Rx	60 years	3.2
16.3 Plant Population				
16.3.1 Operation	The estimated number of total permanent staff to support operations of the plant.	Eng	500 (value per site)	3.10,5.8, 9.3
16.3.2 Refueling/Major Maintenance	The estimated additional number of temporary staff required to conduct refueling and major maintenance activities.	Eng	1,000	5.8, 9.3
16.4 Station Capacity Factor	The percentage of time that a plant is capable of providing power to the grid.	Eng	Maximum: 98%; minimum: 90%	5.7, 7.4
16.6 Megawatts Electrical (at 100% power with 85ºF circulating water)	Best estimate of MW(e) generator output.	Eng	800 MW(e) (value for site)	3.2, 5.7, 5.9, 7.4, 9.4, 10.1

Table A.2. (cont'd)

PPE Section[(a)]	Definition	Parameter Type	PPE Value	ER Section
17. Construction				
17.2 Acreage				
17.2.1 Laydown Areas	The land area required to provide space for construction support facilities. Provide a list of what buildings and/or areas and the associated acreage for each.	Eng	See Figure 3.1-1	3.7
17.3 Construction				
17.3.1 Noise	The maximum expected sound level due to construction activities, measured at 50 ft from the noise source.	Eng	101 dB at 50 ft	3.9
17.4 Plant Population				
17.4.1 Construction	Maximum number of people onsite during construction.	Eng	2,200 (value per site)	3.10
18. Miscellaneous Items				
18.0.1 Fuel Characteristics	What is the form of the reactor fuel and the burnup (GWd/MTU)	Rx	UO_2, 51 GWD/MTU	5.7, 7.4
18.0.2 Fuel assemblies	Provide the number of fuel assemblies per core and the weight (in MTU) of each assembly.	Rx	Number of fuel assemblies: 96 weight of each assembly: 0.304 MTU	3.8, 5.7, 7.4
18.0.4 Refueling	Provide the refueling frequency, average number of assemblies per refueling, and fuel pool capacity (in fuel assemblies).	Rx	Frequency: 2 years, assemblies per refueling: 96, capacity: up to 1,800 fuel assemblies[(b)]	3.8, 5.7, 5.8
18.0.5 Irradiated fuel transportation	Provide the weight of irradiated fuel per spent fuel shipping cask (MTU).	Rx	21.2 MTU	5.7
18.1 Maximum Fuel Enrichment	Concentration (weight percent fraction) of U-235 in the fuel uranium.	Rx	<5% U-235	3.2, 5.7, 7.4
18.2 Maximum Average Assembly Burnup	Maximum assembly average burnup at end of assembly life.	Rx	51 GWD/MTU	3.2, 5.7, 7.4
18.3 Peak fuel rod exposure at end of life	Peak fuel rod exposure at end of life.	Rx	62 GWD/MTU	3.2
18.7 Clad Material	Fuel rod clad material.	Rx	Zirc Alloy (Zircaloy)	5.7

(a) The numbering of the PPE listing is not meant to be sequential and was compiled from, and is consistent with, the list developed by industry and refined for this early site permit application.
(b) The fuel pool capacity PPE value was set by the NRC based on information provided by TVA (TVA 2018-TN5830).
Notes: RX = Reactor Parameter; Eng = Owner Engineered Parameter; COC = Cycles of Concentration.

Appendix B – Notice of Intent (NOI)

to assemble a report on current screening and vetting procedures, information sharing practices, and recommendations to improve these activities, to include an evaluation of the usefulness of the DS–5535. The Department is aware of these requirements, and is committed to evaluating and improving the utility of the DS–5535 accordingly.

Methodology

Department of State consular officers at visa-adjudicating posts worldwide will ask the additional questions to resolve an applicant's identity or to vet for terrorism, national security-related, or other visa ineligibilities when the consular officer determines that the circumstances of a visa applicant, a review of a visa application, or responses in a visa interview indicate a need for greater scrutiny. The additional questions may be sent electronically to the applicant or be presented orally or in writing at the time of the interview.

Julie M. Stufft,

Acting Deputy Assistant Secretary, Bureau of Consular Affairs, Department of State.

[FR Doc. 2021–02413 Filed 2–4–21; 8:45 am]

BILLING CODE 4710–06–P

DEPARTMENT OF STATE

[Public Notice: 11347]

Proposal To Extend and Amend Cultural Property Agreement Between the United States and Egypt

AGENCY: Department of State.

ACTION: Public notice.

SUMMARY: Proposal to extend and amend the *Memorandum of Understanding Concerning the Imposition of Import Restrictions on Categories of Archaeological Material of the Arab Republic of Egypt.*

FOR FURTHER INFORMATION CONTACT: Catherine Foster, Cultural Heritage Center, Bureau of Educational and Cultural Affairs: 202–632–6301; *culprop@state.gov;* include ''Egypt'' in the subject line.

SUPPLEMENTARY INFORMATION: Pursuant to the authority vested in the Assistant Secretary of State for Educational and Cultural Affairs, and pursuant to 19 U.S.C. 2602(f)(1), an extension and amendment of the *Memorandum of Understanding Concerning the Imposition of Import Restrictions on Categories of Archaeological Material of the Arab Republic of Egypt* is hereby proposed.

A copy of the Memorandum of Understanding, the Designated List of categories of material restricted from import into the United States, and related information can be found at the Cultural Heritage Center website: *http://culturalheritage.state.gov.*

Allison R. Davis,

Executive Director CPAC, Bureau of Educational and Cultural Affairs, Department of State.

[FR Doc. 2021–02369 Filed 2–4–21; 8:45 am]

BILLING CODE 4710–05–P

DEPARTMENT OF STATE

[Public Notice: 11346]

Notice of Receipt of Request From the Government of the Republic of Albania Under Article 9 of the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property

AGENCY: Department of State.

ACTION: Notice.

SUMMARY: Notice of receipt of request from Albania for cultural property protection.

FOR FURTHER INFORMATION CONTACT: Chelsea Freeland, Cultural Heritage Center, Bureau of Educational and Cultural Affairs: 202–632–6301; *culprop@state.gov;* include ''Albania'' in the subject line.

SUPPLEMENTARY INFORMATION: The Government of the Republic of Albania made a request to the Government of the United States on November 9, 2020, under Article 9 of the 1970 UNESCO *Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property.* Albania's request seeks U.S. import restrictions on archaeological and ethnological material representing Albania's cultural patrimony. Pursuant to the authority vested in the Assistant Secretary of State for Educational and Cultural Affairs, and pursuant to 19 U.S.C. 2602(f)(1), notification of the request is hereby published. A public summary of Albania's request and information about U.S. implementation of the 1970 UNESCO Convention will be available at the Cultural Heritage Center website: *http://culturalheritage.state.gov.*

Allison R. Davis,

Executive Director CPAC, Bureau of Educational and Cultural Affairs, Department of State.

[FR Doc. 2021–02368 Filed 2–4–21; 8:45 am]

BILLING CODE 4710–05–P

TENNESSEE VALLEY AUTHORITY

Programmatic Environmental Impact Statement—Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

AGENCY: Tennessee Valley Authority.

ACTION: Notice of intent.

SUMMARY: The Tennessee Valley Authority (TVA) intends to prepare a Programmatic Environmental Impact Statement (PEIS) to address the potential environmental effects associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at the Clinch River Nuclear (CRN) Site in Oak Ridge, Roane County, Tennessee. The park would contain one or more advanced nuclear reactors with a cumulative electrical output not to exceed 800 megawatts electric (MWe). TVA plans to evaluate a variety of alternatives including a no-action alternative. Public comments are invited to identify other potential alternatives, information, and analysis relevant to the proposed action.

DATES: The public scoping period begins with the publication of this Notice in the **Federal Register** and comments on the scope of the PEIS must be received or postmarked by March 19, 2021. To accommodate social distancing guidelines and public health recommendations related to the COVID–19 pandemic, TVA will host a virtual open house on March 1, 2021 from 6:00–8:00 p.m. EST. Visit *https://www.tva.com/nepa* to obtain more information.

ADDRESSES: Comments may be submitted in writing to J. Taylor Cates, NEPA Specialist, 1101 Market Street, BR 2C–C, Chattanooga, TN 37402. Comments may also be submitted online at: *https://www.tva.com/nepa* or by email to *nepa@tva.gov.* Due to COVID–19 teleworking restrictions, electronic submission of comments is encouraged to ensure timely review and consideration.

FOR FURTHER INFORMATION CONTACT: Other related questions should be sent to Tennessee Valley Authority, J. Taylor Cates, NEPA Specialist, 1101 Market Street, BR 2C–C, Chattanooga, TN, 37402, 423–751–2732, or *jtcates@tva.gov.*

SUPPLEMENTARY INFORMATION: This notice is provided in accordance with the Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) at 40 CFR parts 1500–1508 and Section 106 of the National Historic

Preservation Act (NHPA), and its implementing regulations (36 CFR part 800). The PEIS will be prepared consistent with the 2020 CEQ regulations for implementing NEPA at 40 CFR parts 1500–1508 (85 FR 43304–43376, Jul. 16, 2020).

TVA Power System

TVA is a corporate agency and instrumentality of the United States created by and existing pursuant to the TVA Act of 1933 (16 U.S.C. part 831), to, among other things, foster the social and economic welfare of the people of the Tennessee Valley region and promote the proper use and conservation of the Valley's natural resources. TVA generates and distributes electricity for business customers and local power distributors, serving more than 10 million people in parts of seven southeastern states. TVA is fully self-financed without Federal appropriations and funds operations through electricity sales and power system bond financing. In addition to operating and investing its revenues in its electric system, TVA provides flood control, navigation and land management for the Tennessee River system, and assists local power companies and state and local governments with economic development and job creation.

Dependable electrical capacity on the TVA power system is about 33,000 MWe. TVA's current generating assets include one pumped-storage facility, one diesel generator site, three nuclear plants, five coal plants, nine combustion turbine plants, eight combined cycle plants, 14 solar energy sites, 29 hydroelectric dams, and several small renewable generating facilities. A portion of delivered power is obtained through long-term power purchase agreements. About 13 percent of TVA's annual generation is from hydro; 14 percent is from coal; 27 percent is from natural gas; 41 percent is from nuclear; and the remainder is from wind, solar, and energy efficiency programs. TVA transmits electricity from these facilities over almost 16,000 miles of transmission lines. Like other utility systems, TVA has power interchange agreements with utilities surrounding the Tennessee Valley region, and buys and sells power on an economic basis almost daily.

Background

The CRN Site is in Oak Ridge, Roane County, Tennessee, on 935 acres of TVA-managed land on the Clinch River arm of the Watts Bar Reservoir. The site is located adjacent to the U.S. Department of Energy's (DOE) Oak Ridge Reservation, a roughly 33,500 acre reservation with defense, research, and environmental cleanup missions.

In May 2016, TVA submitted an application to the Nuclear Regulatory Commission (NRC) for an Early Site Permit (ESP) at the CRN Site for two or more new nuclear power units demonstrating Small Modular Reactors (SMR) technology with a total combined nuclear generating capacity not to exceed 800 MWe. SMRs provide the benefits of nuclear power in situations where large units, generally considered units with approximate electrical output exceeding 1000 MWe, are not appropriate or practical because of various constraints (*i.e.* local transmission system, limited physical space or water availability, constraints on the availability of capital for construction and operation, proximity to population centers, etc.). A NRC ESP provides early resolution of site safety and environmental issues, which in turn provides predictability and stability in any subsequent NRC licensing process.

The NRC prepared and released a Final EIS in April 2019 to assess the environmental aspects of their action, to decide whether or not to issue an ESP to TVA for the CRN Site. Following the NRC ESP Final EIS determination, the NRC issued the ESP to TVA in December 2019. The ESP provides NRC approval of the CRN site for considering new nuclear power units demonstrating SMR technology; the ESP does not authorize TVA to construct or operate a nuclear facility. TVA must apply for and receive additional licenses from the NRC prior to initiating construction or operation of advanced nuclear reactors at the CRN Site.

Project Purpose and Need

In June 2019, TVA released the Final 2019 Integrated Resource Plan (IRP) and the associated IRP Final EIS. The IRP identified the various resources that TVA intends to pursue to meet the energy needs of the Valley over the 20-year planning period in accordance with TVA's mission. The 2019 IRP recommends that TVA continue to evaluate emerging nuclear technologies, including SMRs, as part of technology innovation efforts aimed at developing future electricity generation capabilities.

TVA's purpose and need for the CRN Advanced Nuclear Reactor Technology Park is two-fold. First is to evaluate and demonstrate the feasibility of deploying advanced nuclear reactors to support TVA's mission of providing safe, clean, reliable, and low-cost energy to the Tennessee Valley. Second is to evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities.

TVA will consider the potential environmental effects associated with the proposed construction, operation, and decommissioning of one or more advanced nuclear reactors, with a cumulative electrical output not to exceed 800 MWe at the CRN Site. In addition to producing energy, advanced reactors could support a low carbon future, including demonstration of technologies such as microgrids, grid resiliency, waste heat energy storage for grid support, and the production of isotopes of hydrogen and other elements.

Preliminary Proposed Action and Alternatives

The PEIS will address a range of alternatives for construction, operation, and decommissioning of an advanced nuclear reactor technology park at the CRN Site. Action alternatives include construction of light water reactor (LWR) alternatives and/or non-LWR alternatives at the CRN Site. There are two areas within the 935-acre CRN Site that are best suitable for development; these are designated as Area 1 and Area 2. Therefore, TVA plans to evaluate four discrete alternatives (A–D) for these proposed actions including the No-Action Alternative (A) and an advanced nuclear reactor technology park at Area 1 (B); at Area 2 (C); at Area 1 and Area 2 (D). Two additional alternatives E and F were considered but eliminated.

Anticipated Environmental Impacts

The PEIS will include a detailed evaluation of all environmental, social, and economic impacts associated with implementation of the proposed action. Resource areas to be addressed in the PEIS include, but are not limited to: Air quality; aquatics; botany; climate change; cultural resources; emergency planning; floodplains; geology and groundwater; hydrothermal; land use; navigation; noise and vibration; radiological safety; soil erosion and surface water; socioeconomics and environmental justice; threatened and endangered species; transportation; visual; waste; water use; wetlands; and wildlife. Measures to avoid, minimize, and mitigate adverse effects will be identified and evaluated in the PEIS.

Anticipated Permits and Other Authorizations

TVA anticipates consulting on the required authorities including, but not limited to: The Endangered Species Act; Bald and Golden Eagle Protection Act; Rare Species Protection and Conservation Act; National Historic

Preservation Act; Clean Air Act; and Federal Clean Water Act.

TVA anticipates seeking required permits or authorizations, from the following governmental entities: The Nuclear Regulatory Commission; Federal Aviation Administration; U.S. Department of Transportation; Tennessee Department of Transportation; U.S. Army Corps of Engineers; U.S. Coast Guard; U.S. Environmental Protection Agency; Tennessee Department of Environment and Conservation; U.S. Fish and Wildlife Service; the City of Oak Ridge; Tennessee State Historic Preservation Officer; Tribal Historic Preservation Officers; and Texas Department of State Health Services, Radiation Control Program, Radiation Safety Licensing Branch. This is not an exhaustive list, other permits or authorizations may be sought as required or appropriate.

Public Participation and Scoping Process

TVA seeks comment and participation from all interested parties for the proposed action, including, but not limited, to assisting TVA in determining the scope of issues for analysis in the PEIS. Information about this project is available at *https://www.tva.com/nepa,* which includes a link to an online public comment page. TVA invites the public to identify other potential alternatives, information, and analysis relevant to the proposed action. Comments must be received or postmarked no later than March 19, 2021. Federal, state, local agencies, and Native American Tribes are also invited to provide comments. Please note that any comments received, including names and addresses, will become part of the project administrative record and will be available for public inspection.

To accommodate social distancing guidelines and public health recommendations related to the COVID–19 pandemic, TVA will host a virtual open house during the scoping period. The virtual open house will be held on March 1, 2021, from 6:00–8:00 p.m. EST. Visit *https://www.tva.com/nepa* to obtain more information about the virtual open house. Additional open house details will be available on the project site by February 17, 2021.

PEIS Preparation and Schedule

TVA will consider comments received during the scoping period and develop a scoping report, which will be published at *https://www.tva.com/nepa.* The scoping report will summarize public and agency comments that were received and identify the projected schedule for completing the PEIS process. Following completion of the CRN Site environmental analysis, TVA will post a Draft PEIS for public review and comment on the project web page. TVA anticipates holding a public open house, which may be virtual, after releasing the Draft PEIS. Open house details will be posted on TVA's website in conjunction with the Draft PEIS. TVA expects to release the Draft PEIS in the Fall of 2021.

TVA will consider the substantive comments received on the Draft PEIS, financial assessments, engineering evaluations, risk evaluations, and other applicable evaluations in the Final PEIS before selecting one or more alternatives. TVA projects completing a Final PEIS in Spring 2022. Subsequently, a final determination on proceeding with the CRN Site will be documented in a Record of Decision.

Authority: 40 CFR 1501.9.

Rebecca Tolene,

Vice President, Environment.

[FR Doc. 2021–02144 Filed 2–4–21; 8:45 am]

BILLING CODE P

DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

Notice of Final Federal Agency Actions on Proposed Highway in California

AGENCY: Federal Highway Administration (FHWA), Department of Transportation (DOT).

ACTION: Notice of Limitation on Claims for Judicial Review of Actions by the California Department of Transportation (Caltrans).

SUMMARY: The FHWA, on behalf of Caltrans, is issuing this notice to announce actions taken by Caltrans that are final. The actions relate to a proposed highway project, I–10 Blythe Pavement Rehabilitation Project in the County of Riverside, State of California. Those actions grant licenses, permits, and approvals for the project.

DATES: By this notice, the FHWA, on behalf of Caltrans, is advising the public of final agency actions subject to 23 U.S.C. 139(*l*)(1). A claim seeking judicial review of the Federal agency actions on the highway project will be barred unless the claim is filed on or before July 6, 2021. If the Federal law that authorizes judicial review of a claim provides a time period of less than 150 days for filing such claim, then that shorter time period still applies.

FOR FURTHER INFORMATION CONTACT: For Caltrans: Antonia Toledo, Senior Environmental Planner, California Department of Transportation-District 8, 464 W 4th Street, MS–820, San Bernardino, CA 92401. Office Hours: 8:00 a.m.—5:00 p.m., Pacific Standard Time, telephone, (909) 501–5741 or email *Antonia.Toledo@dot.ca.gov.* For FHWA, contact David Tedrick at (916) 498–5024 or email *david.tedrick@dot.gov.*

SUPPLEMENTARY INFORMATION: Effective July 1, 2007, the FHWA assigned, and Caltrans assumed, environmental responsibilities for this project pursuant to 23 U.S.C. 327. Notice is hereby given that Caltrans has taken final agency actions subject to 23 U.S.C. 139(*l*)(1) by issuing licenses, permits, and approvals for the following highway project in the State of California: rehabilitation of the existing asphalt concrete (AC) pavement on Interstate 10 from Post Mile (PM) R134.0 to PM R156.5 in the County of Riverside. Rehabilitation Activities include removal and replacement of existing inside and outside shoulders, guardrails, rumble strips, drainage inlets, and dikes, and installation of oversized drains. The project will also involve upgrades to ramp facilities for ADA compliance, installation of two temporary detour lanes in the existing median, extension of existing rock slope protection at bridge locations, and hydroseeding the median for erosion control and vegetation restoration. The primary purpose of this project is to restore and extend the life of existing pavement for a minimum of forty years, enhance trip reliability, and consequently minimize expenditures associated with future maintenance. The actions by the Federal agencies, and the laws under which such actions were taken, are described in the Final Environmental Assessment (FEA)/ Finding of No Significant Impact (FONSI) for the project, approved on July 27, 2020, and in other documents in Caltrans' project records. The FEA, FONSI and other project records are available by contacting Caltrans at the addresses provided above.

This notice applies to all Federal agency decisions as of the issuance date of this notice and all laws under which such actions were taken, including but not limited to:

1. Council on Environmental Quality (CEQ) regulations
2. National Environmental Policy Act of 1969, as amended, 42 U.S.C 4331(b)(2)
3. Federal Highway Act of 1970, U.S.C 772
4. Federal Clean Air Act of 1977 and 1987
5. Clean Water Act of 1977 and 1987
6. Federal Water Pollution Control Act of 1972
7. Safe Drinking Water Act of 1944, as amended
8. Executive Order 11988, Floodplain

Appendix C – Scoping Report

Document Type: PEIS – Administrative Record
Index Field: Scoping Report
Project Name: Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park
Project Number: 2020-17

CLINCH RIVER NUCLEAR SITE ADVANCED NUCLEAR REACTOR TECHNOLOGY PARK PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT SCOPING REPORT

Prepared by:
TENNESSEE VALLEY AUTHORITY
Knoxville, Tennessee

June 2021

To request further information, contact:
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Table of Contents

Abbreviations and Acronyms

CEC	Categorical Exclusion Checklist
CRBRP	Clinch River Breeder Reactor Plant
CRN	Clinch River Nuclear
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESP	Early Site Permit
ESPA	Early Site Permit Application
EO	Executive Order
FEIS	Final Environmental Impact Statement
IRP	Integrated Resource Plan
kV	kilovolt
LWR	Light Water Reactor
MDCTs	Mechanical Draft Cooling Towers
MWe	megawatts electric
MWt	megawatts thermal
NEPA	National Environmental Policy Act
NOI	Notice of Intent
NRC	Nuclear Regulatory Commission
PPE	Plant Parameter Envelope
PEIS	Programmatic Environmental Impact Statement
PMC	Project Management Corporation
SMR	Small Modular Reactor
TDEC	Tennessee Department of Environment and Conservation
TL	Transmission Line
TN	Tennessee
TVA	Tennessee Valley Authority
TWRA	Tennessee Wildlife Resource Agency

1.0 Introduction

The Tennessee Valley Authority (TVA) is beginning the preparation of a Programmatic Environmental Impact Statement (PEIS) pursuant to the National Environmental Policy Act (NEPA) to assess the potential environmental impacts associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at the TVA Clinch River Nuclear (CRN) Site. TVA's project goal is to demonstrate new nuclear technology through the construction and operation of one or more advanced nuclear reactors at the CRN Site as shown in the CRN Project Site Layout in Figure 1. The CRN Site provides opportunity to evaluate and demonstrate the feasibility of deploying advanced nuclear reactors and to evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities.

This CRN Site Advanced Nuclear Reactor Technology Park Scoping Report (herein Scoping Report) describes the internal and public scoping for relevant issues relating to the CRN project and outreach conducted by TVA to notify the public. The Scoping Report also documents the input submitted to TVA by the public, organizations, and intergovernmental entities during the public scoping period.

1.1 Background

The CRN Site comprises 935 acres of TVA managed land in the city of Oak Ridge, Roane County, TN, which is adjacent to the U.S. Department of Energy's (DOE) approximately 33,000-acre Oak Ridge Reservation. In May 2016, TVA submitted an application to the NRC for an Early Site Permit (ESP) at the CRN Site for two or more new nuclear power units demonstrating small modular reactor (SMR) technology, with a total combined nuclear generating capacity not to exceed 800 megawatts electric (MWe). SMRs provide the benefits of nuclear power in situations where large nuclear power units (generally considered single units with approximate electrical output exceeding 1000 MWe), are not practical because of various constraints which may include transmission system limitations, limited physical space or water availability, proximity to population centers, constraints on the availability of capital for construction and operation, or other factors.

The ESP established early resolution of site safety and environmental issues, which provides predictability and stability in the NRC licensing process. In April 2019, the NRC prepared and released a Final Environmental Impact Statement (NRC ESP FEIS) to assess the environmental aspects of whether or not to issue an ESP to TVA. Following the NRC ESP FEIS determination in December 2019, the NRC issued an ESP to TVA. The ESP provides NRC approval of the suitability of the CRN Site for new nuclear power units, but does not authorize TVA to construct or operate a nuclear facility. The ESP is valid until December 2039. Prior to initiating construction or operation of advanced nuclear reactors at the CRN Site, TVA must apply for and receive additional licenses from the NRC.

In June 2019, TVA released the Final 2019 Integrated Resource Plan (IRP) and the associated IRP Final EIS. Among other things, the IRP identified the various generating resources that TVA intends to pursue to meet the energy needs of the Tennessee River Valley (the Valley) over it's the 20-year planning period. The 2019 IRP recommends that TVA continue to evaluate emerging nuclear technologies, including SMRs, as part of technology innovation efforts aimed at developing future electricity generation capabilities.

1.2 Purpose and Need

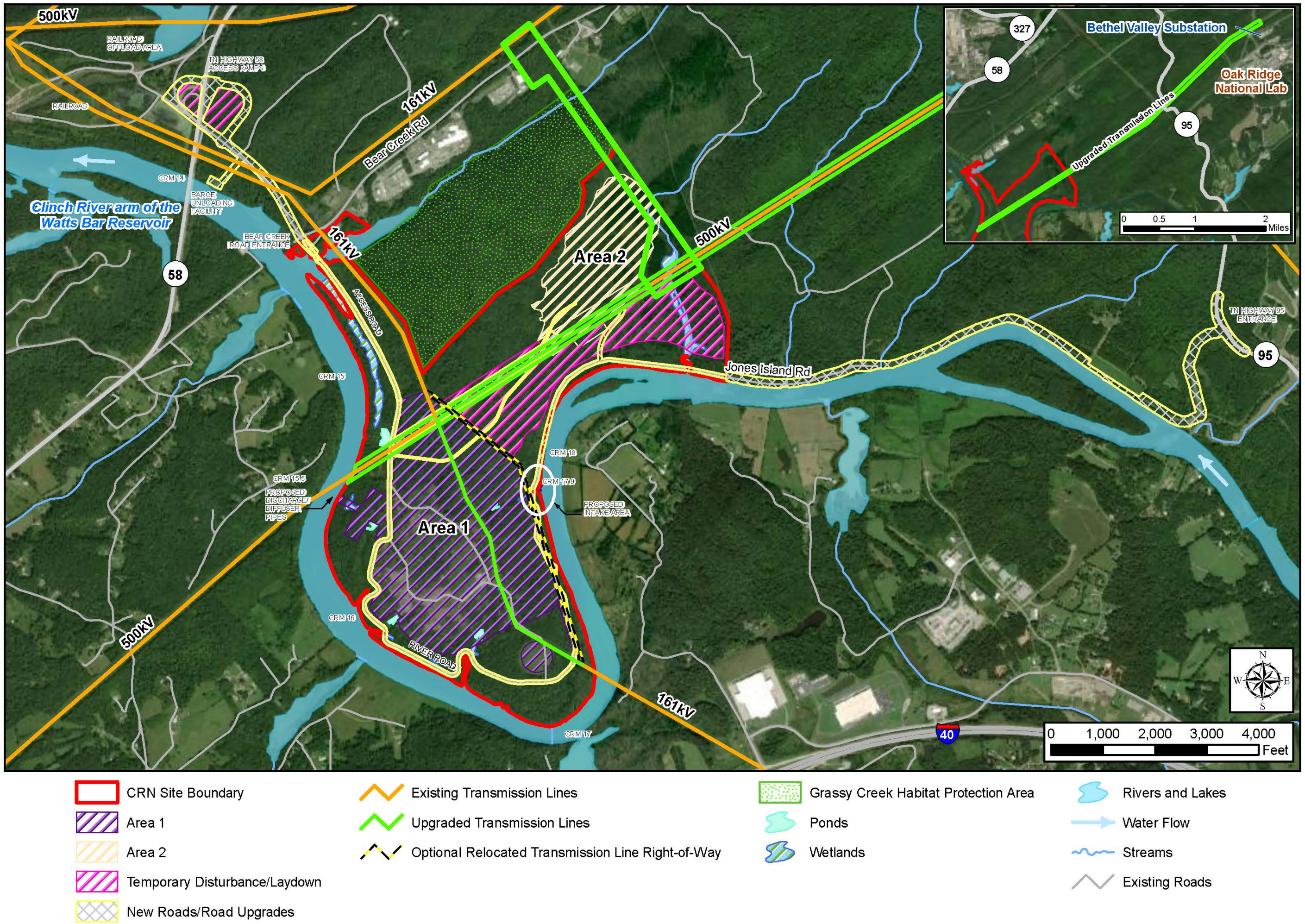
TVA's purpose and need for the CRN Site Advanced Nuclear Reactor Technology Park includes:

- Evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities. Evaluate and demonstrate the feasibility of deploying and operating advanced nuclear reactors to support TVA's mission of providing safe, increasingly clean, reliable, and low-cost energy to the Valley.

- Support TVA's 2019 Integrated Resource Plan (IRP) by continuing to evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities. The 2019 IRP identified the various resources such as emerging nuclear technologies, which TVA intends to pursue to meet the energy needs of the Valley over the next 20-year planning period, in accordance with TVA's mission.

- Consider a new nuclear technology park at the CRN Site to support TVA's innovation mission as another way to serve the people of the Valley.

These advanced reactors at the associated Advanced Nuclear Reactor Technology Park could support innovation towards a low carbon future for the Valley, including demonstration of technologies such as microgrids, grid resiliency, waste heat energy storage for grid support, and the intentional production of valuable isotopes.



Proposed CRN Project Site

Figure 1. Proposed CRN Project Site Layout

1.3 Related Documents and Environmental Reviews

The following environmental reviews were prepared for actions related to the CRN Site:

- *Clinch River Breeder Reactor Plant (CRBRP) Environmental Report, prepared by Project Management Corporation (PMC), Volume I & II, 1982*. The CRN Site was selected as the location for construction of a liquid metal fast breeder reactor in 1972. Site preparation for the CRBRP began in 1982 and disturbed approximately 240 acres. CRBRP site preparation activities included leveling a ridge that originally reached 880 feet above mean sea level (msl) to 780 msl and excavation of an approximately 24 -acre area to a depth of as much as 100 feet, resulting in excavation of approximately three million cubic yards of earth and rock. Structures installed at the CRBRP site included a cement crane pad, quality control test laboratory, construction shops, concrete batch plants, and sediment ponds. An approximately 6,450 foot long 8-inch water line from the DOE's Bear Creek Filtration Plant was also installed at the CRBRP site. The CRBRP project was terminated in 1983.
- *Clinch River Breeder Reactor Plant DOE/TVA/PMC Site Redress Planning Task Force Report, DOE, TVA, and PMC, January 1984*. The CRBRP site redress plans included measures to stabilize the CRBRP site such as reseeding of grass, planting of trees, mulching cleared areas, installation of straw bales in shallow ditches, installation of small berms of riprap in larger ditches, installation of culverts to direct water from steep slopes, and modification of the holding ponds for long-term stability. Portable buildings and structures were removed from the CRBRP site with the exception of the crane pad and meteorological tower. The approximately 6,450 foot long 8-inch water line was terminated at a hydrant and left in place. The 80-foot by 80-foot crane pad was left in place. The excavated area was partially backfilled in a manner to sustain site drainage. Rock bolts within the excavated area were left in place. Level areas of the CRBRP site were graded and compacted.
- *Clinch River Nuclear Site Early Site Permit Application, Environmental Report, Part 3 May 2016 (ESPA ER)*. The ER was prepared and submitted as part of the TVA application for an ESP for the CRN Site in Oak Ridge, Roane County, Tennessee. TVA prepared this ER to analyze the environmental effects of construction, operation, and decommissioning of two or more SMRs at the CRN Site having a maximum electrical output not to exceed 800 MWe. The application used four potential advanced reactor technologies to develop a bounding analysis of the potential engineering, safety, and environmental impacts. The NRC used this ER to develop an EIS to meet the requirements of NEPA for the NRC to consider the environmental effects of the issuance of an ESP.
- *Final Environmental Impact Statement for an Early Site Permit at the Clinch River Nuclear Site, April 2019 (NRC ESP FEIS)*. NRC issued the NRC ESP FEIS in response to the TVA application for an ESP for new nuclear power units demonstrating SMR technology in Oak Ridge, Roane County, Tennessee. The NRC EIS evaluated the proposed action and the potential impacts on the environment associated with NRC's decision regarding whether or not to issue an ESP. After considering the environmental aspects of the proposed action before the NRC, NRC staff recommended approving the TVA ESPA.
- *Early Site Permit Issuance, December 2019*. The NRC issued Early Site Permit No. ESP-006 to TVA for the CRN Site.

Other minor actions at the CRN Site that qualified as Categorical Exclusions include the following Categorical Exclusion Checklists (CECs) completed by TVA:

- *Clinch River SMR Project Met Tower Road Culvert Installation – CEC 24366, May 2011*
- *Clinch River Site Meteorological Tower – CEC 23403, June 2011*
- *Clinch River Site Characterization – CEC 23595, November 2012*
- *Clinch River Small Modular Reactor (SMR) Site Meteorological Tower Removal – CEC 28783, August 2013*
- *Portable Bridge Installation at the Clinch River Nuclear CRN Site – CEC 40907, August 2019*

2.0 Alternatives

2.1 Alternatives Carried Forward for Analysis

The CRN PEIS will address a range of alternatives for construction, operation, and decommissioning of an advanced nuclear reactor technology park at the CRN Site. Action alternatives include construction of light water reactor (LWR) and/or non-LWR alternatives at the CRN Site. There are two areas within the 935-acre CRN Site that are best suited for development; these are designated as Area 1 and Area 2. TVA plans to evaluate four discrete alternatives (A-D) for these proposed actions within Area 1 and Area 2, including: the No Action Alternative (A); an advanced nuclear reactor technology park at Area 1 (B); at Area 2 (C); and at Area 1 and Area 2 (D). Two additional alternatives E and F were considered but eliminated.

2.1.1 Alternative A – No Action Alternative

Under the No Action Alternative, TVA would not apply for a NRC license, construct, operate, maintain, or potentially decommission advanced nuclear reactors at the CRN Site. The CRN Site would remain relatively unused and would continue to be managed in accordance with the Watts Bar Reservoir Land Management Plan. TVA would continue to meet the obligations of the NRC ESP. TVA would continue to adhere to the Clinch River Site Maintenance Plan including routine inspections and maintenance. TVA would also continue routine maintenance of the TLs and rights-of-way that traverse the CRN Site. In addition, the Tennessee Wildlife Resource Agency's (TWRA's) permit for use of TVA land for controlled hunting could be reinstated. Under the No Action Alternative, TVA would not have access to the energy-generating capacity of the advanced nuclear reactors and would not be able to meet the project purpose and need.

2.1.2 Alternative B – Nuclear Technology Park at Area 1

To meet the purpose and need, the project proposes an array of activities including the construction, operation, maintenance, and potential decommissioning of one or more advanced reactors at Area 1 on the CRN Site (Figure 1). Specific designs have not been selected. The plans include evaluating the environmental impacts for the potential uses of the CRN Site for up to approximately 60 years using a plant parameter envelope (PPE) approach. Options to be considered under this alternative include:

- Alternative B1 – Construction and operation of one or more LWRs at Area 1.
- Alternative B2 – Construction and operation of one or more LWRs and/or other advanced nuclear reactors at Area 1.

Under Alternative B, there would be no construction at Area 2.

2.1.3 Alternative C – Nuclear Technology Park at Area 2

To meet the purpose and need, the project proposes an array of activities including the construction, operation, maintenance, and potential decommissioning one or more non-LWR advanced nuclear reactor(s) at Area 2 on the CRN Site (Figure 1). Specific designs have not been selected. The plans include evaluating the environmental impacts for the potential uses of the CRN Site for up to approximately 60 years, deploying one or more advanced nuclear reactors using a PPE approach. The reactor(s) would be constructed and operated on Area 2 shown on Figure 1. Under Alternative B, there would be no construction at Area 1.

2.1.4 Alternative D – Nuclear Technology Park at Area 1 and Area 2

To meet the purpose and need, the project proposes an array of activities including the construction, operation, maintenance, and potential decommissioning of one or more LWR and/or non-LWR advanced nuclear reactor(s) at Area 1 and Area 2 on the CRN Site (Figure 1). Specific designs have not been selected. The plans include evaluating the environmental impacts for the potential uses of the CRN Site for up to approximately 60 years using a PPE approach.

2.2 Alternatives Considered but Eliminated from Further Discussion

TVA considered multiple options for construction, operation, and decommissioning of an advanced nuclear reactor technology park at the CRN Site. This section identifies alternatives that TVA considered but omitted from detailed analysis, because they did not meet the purpose and need of TVA's proposed action or were otherwise unreasonable.

2.2.1 Alternative E – Construction of SMRs at Alternative Sites

In the ESPA ER, TVA considered three alternative sites in detail for construction of SMRs; these included the Oak Ridge Reservation Site 2, Oak Ridge Reservation Site 8, and Redstone Arsenal Site 12. TVA's ESPA ER described (1) the TVA region of interest for identification of alternative plant sites, (2) the methods used by TVA to select the proposed site and alternative sites, and (3) generic issues that are consistent among the alternative sites. The ESPA ER also compares the environmental impacts at the CRN Site to those at the alternative sites. The ESPA ER and NRC ESP FEIS qualitatively determined that none of the alternative sites are obviously superior to the proposed CRN Site. The NRC ESP FEIS recommended that an ESP should be issued for the CRN Site in Oak Ridge, Roane County, Tennessee and NRC subsequently issued an ESP to TVA for the CRN Site.

2.2.2 Alternative F – Construction of Alternative Energy

Construction of other generation systems (i.e. solar, coal, etc.) would not meet the purpose and need of this project as stated in Section 1.2. TVA considered other technologies in the 2019 Final IRP which are being considered for other locations in the TVA system and are evaluated under separate analyses, as appropriate.

3.0 Environmental Review Process

The NEPA review process helps federal agencies make decisions based on an understanding of a proposed action's potential impacts. NEPA also requires that federal agencies provide opportunities for public involvement in the agency decision-making process. Finally, NEPA requires federal agencies conduct scoping to engage important stakeholders in the early identification of concerns, potential impacts, relevant effects of past actions and possible alternative actions.

TVA will consider input obtained from the public, stakeholders, resource and permitting agencies, and other interested parties during the public scoping period when developing the

Draft PEIS. Publication of the Draft PEIS will include a 45-day public review and comment period, during which TVA will conduct a public meeting. TVA will consider all comments and edits submitted on the Draft PEIS, make appropriate revisions in response, and publish a Final PEIS. After a period of at least 30 days, TVA will make a final decision on which action alternative will be captured in a Record of Decision (ROD) to be published in the Federal Register.

In addition to agency and public input, the PEIS will also address specific requirements associated with a number of federal laws such as National Historic Preservation Act, Endangered Species Act, Clean Water Act, and Clean Air Act, and would satisfy the requirements of pertinent executive actions, including Executive Order (EO) 11988 (Floodplains Management), EO 11990 (Protection of Wetlands), EO 12898 (Environmental Justice), EO 13112 as amended by 13751 (Invasive Species), EO 13990 Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, EO 14008 Tackling the Climate Crisis at Home and Abroad, and other applicable EOs.

At the time of publication of this report, TVA estimates that the Draft PEIS will be published in the late fall of 2021, the Final PEIS will be published in late spring of 2022, and the ROD could be signed by the summer of 2022.

3.1 Scoping Period Public Outreach

As noted, public scoping was initiated with the publication of the NOI to prepare a PEIS in the Federal Register on February 5, 2021 (Appendix A). Additionally, TVA posted a public notice about the scoping period and information regarding the PEIS on the TVA website (www.tva.com/nepa). A public scoping period was held between February 2 and March 19, 2021. To facilitate awareness of this opportunity, in addition to posting the NOI in the Federal Register and TVA website, TVA contacted local, state, and federal government agencies, local power companies, and direct serve customers and sent a media advisory to news outlets across the TVA service area. A public notice advertisement was also placed in the *Roane County News*, *Knoxville News Sentinel*, *News-Herald*, *Oak Ridger*, *Courier News* and on the TVA website (Appendix A).

TVA encouraged the public to comment on the scope of the PEIS, alternatives under consideration, and environmental issues that need to be addressed. TVA invited the public to submit formal comments via email (nepa@tva.gov), the TVA webpage (www.tva.com/nepa), or by mail. TVA's webpage also provided a link for submission of comments. In addition to the webpage, TVA provided a "virtual meeting room", accessible through the www.tva.com/nepa website, which provides for virtual public engagement. The virtual meeting room provided access to project information in the form of presentation displays and links to project documentation, maps, graphics, and TVA's CRN project webpage. The virtual meeting room also provided information on the scheduled virtual scoping meeting, links for submitting scoping comments, and a scoping meeting registration link.

As part of Scoping, TVA hosted a live virtual scoping webinar on March 1, 2021 to gather input from the public and stakeholders. The public was invited to attend this virtual meeting and submit formal comments. At the live virtual scoping webinar, TVA provided a presentation outlining the CRN Site history, the proposed project description, project schedule, and NEPA regulatory framework as well as site layouts and a drone video tour of the site. A total of 98 individuals, both members of the general public and representatives of a variety of organizations registered for the meeting. Among those registered, 69 were not affiliated with TVA and 58 attended the question and answer session following the presentation.

3.2 Summary of Scoping Feedback

TVA received a wide variety of comments and opinions regarding the construction, operation, and decommissioning of an advanced nuclear reactor technology park at the CRN Site and will consider this input in developing its Draft PEIS.

TVA received 45 comment submissions from members of the pubic, local government, and state and federal agencies. The submissions consisted of:

- One submission from a federal agency, U.S. Environmental Protection Agency
- Three submissions from state agencies, Tennessee Department of Environment and Conservation (TDEC) Division of Water Resources, TDEC Division of Air Pollution Control, and Tennessee Department of Transportation
- One submission from a local government, Roane County Environmental Review Board
- Fourteen submissions from organizations including the Sierra Club, Savannah River Site Watch, Tennessee Environmental Council, Bellefonte Efficiency & Sustainability Team of the Blue Ridge Environmental Defense League, Nuclear Information and Resource Service, Coalition for A Nuclear Free Great Lakes, and Erwin Citizens Awareness Network, Inc.
- Twenty-seven submissions from members of the public unaffiliated with organizations

All comments submitted are included in Appendix B.

The 45 comment submissions were reviewed to identify specific issues of concern by each commenter and were grouped in general categories for identification and review. In total, 128 separate comments were identified. In order of number of comments received, the issues raised by commenters included the following:

1. *Energy Alternatives* – Preferences regarding use of renewable energy alternatives such as wind and solar instead of nuclear energy power or other nuclear technologies (19 comments)

2. *Nuclear Safety* – Potential risks associated with nuclear accidents, waste storage, weapons, and potential for radiation exposure (16 comments)

3. *Nuclear Waste* – Concerns regarding the production, storage, and disposal of nuclear waste (16 comments)

4. *Use of the CRN Site/Alternative Locations* – Concerns regarding removal of forested areas within the CRN Site and consideration of existing brownfield sites in the area or decommissioned TVA facilities for the proposed advanced nuclear technology park rather than disturbance of the CRN site (11 comments)

5. *Water Quality and Flooding/Weather Risks* – Potential risks to water quality in the Clinch River arm of Watts Bar Reservoir from coolant water returned to the river, water elevations in relation to the facility's intake, groundwater contamination, and risks to floodplains due to flooding or extreme weather events (11 comments)

6. *Environmental and Community Impacts* – Concerns regarding potential impacts to the human and natural environment, including destruction of existing habitats on the CRN Site (9 comments)

7. *TVA Oversight* – Concerns regarding past and present management of TVA nuclear and fossil fuel facilities (9 comments)

8. *Project Cost* – Concerns regarding project cost (8 comments)

9. *Specific Project-Related Questions* – Questions regarding nuclear technology and vendors (6 comments)

10. *Project Support* – Support for the CRN project (5 comments)

11. *Support for the No Action Alternative* – Support for the No Action Alternative (4 comments)

12. *Scoping Period/Project Schedule* – Concerns regarding pace of project and request for extension of the scoping comment period by six months (4 comments)

13. *Nuclear Fuel Production* – Concerns regarding the environmental and health effects related to processing nuclear fuel that would be used by advanced reactors and the source for the materials used in processing (3 comments)

14. *Air Quality* – Air permitting considerations for the project advised by TDEC (2 comments)

15. *Transportation* – Coordination with TDOT regarding potential roadway improvements at State Road 58 and Bear Creek Road and consideration of existing bicycle lanes on State Road 58 bridge as a part of the impact analysis requested by Roane County *(2 comments)*

16. *Economic Feasibility* – EPA request to include evaluation of economic feasibly of LWR and non-LWR modular type reactors to encompass environmental costs (1 comment)

17. *Cumulative Effects* – Roane County request to consider Kairos Power project in the cumulative effects analysis (1 comment)

18. *Earthquakes* – Consideration of earthquake tremors (1 comment)

3.3 Issues to be Addressed

Based on TVA's internal scoping and input gathered from the public scoping process, the anticipated major issues to be addressed in this PEIS include:

- *Geology and Soils* – Regional geology and soils at the CRN Site will be identified and any limitations related to construction and operation will be evaluated. Impacts to prime farmland soils will be quantified. The seismic history of the region will be identified, and evaluation of plant design and plant shut down in the event of an earthquake will be presented.
- *Surface Water Resources* – TVA will describe the quality of surface water resources, including the Clinch River arm of the Watts Bar Reservoir, and will analyze the extent to which each development alternative would affect water quality directly or indirectly.
- *Groundwater Resources* – TVA will use data obtained from studies conducted by TVA to describe existing groundwater conditions in the vicinity and will analyze the extent to which each development alternative would affect groundwater quality.

- *Floodplains and Wetlands* – Wetlands and floodplains within the CRN Site will be identified and impacts will be quantified. The effects of each of the development alternatives on jurisdictional wetlands and floodplains will be evaluated.
- *Biological Resources* (vegetation, wildlife, and aquatic life) – Community types within the CRN Site will be described. Significant natural features, including rare species habitat, important wildlife habitat, or locally uncommon natural community types will be identified. TVA will evaluate the effect of each alternative on terrestrial and aquatic ecosystems.
- *Threatened and Endangered Species* – Federally or state-listed as threatened or endangered plants and animals known to exist in the vicinity of the CRN Site will be identified. The effects of each development alternative on endangered, threatened, and rare species in need of management will be evaluated.
- *Recreational and Managed Areas* – Natural areas, parks, and other managed areas within the vicinity of the alternatives will be identified and potential impacts associated with the proposed alternatives will be addressed.
- *Climatology and Meteorology* – An extensive discussion of the meteorology and climatology within the region of the CRN Site will be presented, including regional climatology, local meteorology, severe weather, and how each would affect routine and accidental airborne radioactive releases.
- *Air Quality and Climate Change* – Air quality considerations including attainment status, and regional air quality information will be presented. Impacts to air quality from activities associated with each of the alternatives will be evaluated. The impact of emissions from each of the alternatives on climate change will be addressed.
- *Transportation* – The existing roadway network in the vicinity of the CRN Site, including physical road characteristics (number of lanes, shoulders, and posted speed limit) and existing traffic characteristics will be identified. The effect of construction and operational traffic to the CRN Site will be evaluated, including the potential for improvements to site access from local highways.
- *Visual Resources* – The aesthetic setting of the CRN Site will be described and an analysis of changes to scenic attractiveness and scenic integrity associated with each of the alternatives will be completed.
- *Noise* – Noise emissions and impacts associated with the construction phase equipment use and plant operations will be assessed to determine the potential noise effects of each alternative on sensitive receptors.
- *Socioeconomics and Environmental Justice* – Demographic and community characteristics within the vicinity the CRN Site will be evaluated. Special attention will be given to identification of potential low-income and minority populations to evaluate the potential for disproportionate adverse impacts in accordance with EO 12898 and EO 13990. Economic effects associated with the construction and operational workforce associated with each alternative will also be evaluated. TVA will also evaluate existing local services including educational, emergency, water, and wastewater to determine adequate supply and effects associated with each alternative.
- *Land Use* – Land uses within the proposed project sites and within the vicinity (5-mile radius) will be identified. Permanent and temporary direct and indirect impacts to land use associated with each of the alternatives will be evaluated.
- *Cultural Resources* – TVA will characterize archaeological and historic resources within the Area of Potential Effect of the CRN Site. TVA also will discuss any known sites listed on or eligible for the National Register of Historic Places. The potential effects of each alternative on historic and archaeological resources will be evaluated. The cultural

resources analysis and recommendations will be reviewed through formal consultation with the Tennessee State Historic Preservation Officer and interested tribes, the results of which will also be provided. TVA will consider cultural and historic resources, up to and including the Manhattan Project National Historic Park.

- *Local Government Revenues* – The current sources and level of local government revenues will be identified. The effects associated with construction and ultimate development of each alternative will be evaluated.
- *Solid and Hazardous Waste* – Current practices regarding hazardous materials/waste management near the CRN Site will be identified. In addition, TVA will identify any impacts from waste generation during construction and operation. Operational measures (waste management practices) will be incorporated into the assessment of impacts.
- *Nonradiological Public Health and Safety* – TVA will evaluate nonradiological public health and safety regulations and identify safety programs adopted by TVA to minimize incidents.
- *Radiological Effects* – The potential for radiological dose exposure to the public from normal operational releases via probable pathways to individuals, populations, and biota near the CRN Site will be assessed.
- *Uranium Fuel Use Effects* – TVA will evaluate the potential for environmental effects from radioactive waste, spent fuel storage, and transportation of radioactive materials resulting from operations of the nuclear facilities at the CRN Site.
- *Nuclear Plant Safety and Security* – TVA will evaluate the environmental impacts of postulated accidents involving radioactive materials at the CRN Site and plant security including intentional destructive acts.
- *Decommissioning* – TVA will describe the process for decontamination and decommissioning, which will occur at the end of the CRN Site's operating life, to ensure nuclear units are safely removed from service and the site is made safe for restricted use.

The potential direct and indirect impacts of each resource will be assessed in the PEIS. Mitigation measures designed to minimize impacts, will be identified as appropriate. In addition, the PEIS will include an analysis of the cumulative impacts associated with each alternative. A cumulative impact analysis considers the potential impact to the environment that may result from the incremental impact of the project when added to other past, present, and reasonably foreseeable future actions (40 C.F.R. § 1508.7). These past, present, and reasonably foreseeable future actions will include, but are not limited to, the other potential development actions that are connected to the development of an advanced nuclear technology park at the CRN Site. The methodology for performing such analysis is set forth in the Council on Environmental Quality's *Considering Cumulative Effects under NEPA*.

Appendix A

Federal Register Notice and Newspaper Notices

to assemble a report on current screening and vetting procedures, information sharing practices, and recommendations to improve these activities, to include an evaluation of the usefulness of the DS–5535. The Department is aware of these requirements, and is committed to evaluating and improving the utility of the DS–5535 accordingly.

Methodology

Department of State consular officers at visa-adjudicating posts worldwide will ask the additional questions to resolve an applicant's identity or to vet for terrorism, national security-related, or other visa ineligibilities when the consular officer determines that the circumstances of a visa applicant, a review of a visa application, or responses in a visa interview indicate a need for greater scrutiny. The additional questions may be sent electronically to the applicant or be presented orally or in writing at the time of the interview.

Julie M. Stufft,

Acting Deputy Assistant Secretary, Bureau of Consular Affairs, Department of State.

[FR Doc. 2021–02413 Filed 2–4–21; 8:45 am]

BILLING CODE 4710–06–P

DEPARTMENT OF STATE

[Public Notice: 11347]

Proposal To Extend and Amend Cultural Property Agreement Between the United States and Egypt

AGENCY: Department of State.

ACTION: Public notice.

SUMMARY: Proposal to extend and amend the *Memorandum of Understanding Concerning the Imposition of Import Restrictions on Categories of Archaeological Material of the Arab Republic of Egypt.*

FOR FURTHER INFORMATION CONTACT: Catherine Foster, Cultural Heritage Center, Bureau of Educational and Cultural Affairs: 202–632–6301; *culprop@state.gov;* include ''Egypt'' in the subject line.

SUPPLEMENTARY INFORMATION: Pursuant to the authority vested in the Assistant Secretary of State for Educational and Cultural Affairs, and pursuant to 19 U.S.C. 2602(f)(1), an extension and amendment of the *Memorandum of Understanding Concerning the Imposition of Import Restrictions on Categories of Archaeological Material of the Arab Republic of Egypt* is hereby proposed.

A copy of the Memorandum of Understanding, the Designated List of categories of material restricted from import into the United States, and related information can be found at the Cultural Heritage Center website: *http://culturalheritage.state.gov.*

Allison R. Davis,

Executive Director CPAC, Bureau of Educational and Cultural Affairs, Department of State.

[FR Doc. 2021–02369 Filed 2–4–21; 8:45 am]

BILLING CODE 4710–05–P

DEPARTMENT OF STATE

[Public Notice: 11346]

Notice of Receipt of Request From the Government of the Republic of Albania Under Article 9 of the 1970 UNESCO Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property

AGENCY: Department of State.

ACTION: Notice.

SUMMARY: Notice of receipt of request from Albania for cultural property protection.

FOR FURTHER INFORMATION CONTACT: Chelsea Freeland, Cultural Heritage Center, Bureau of Educational and Cultural Affairs: 202–632–6301; *culprop@state.gov;* include ''Albania'' in the subject line.

SUPPLEMENTARY INFORMATION: The Government of the Republic of Albania made a request to the Government of the United States on November 9, 2020, under Article 9 of the 1970 UNESCO *Convention on the Means of Prohibiting and Preventing the Illicit Import, Export and Transfer of Ownership of Cultural Property.* Albania's request seeks U.S. import restrictions on archaeological and ethnological material representing Albania's cultural patrimony. Pursuant to the authority vested in the Assistant Secretary of State for Educational and Cultural Affairs, and pursuant to 19 U.S.C. 2602(f)(1), notification of the request is hereby published. A public summary of Albania's request and information about U.S. implementation of the 1970 UNESCO Convention will be available at the Cultural Heritage Center website: *http://culturalheritage.state.gov.*

Allison R. Davis,

Executive Director CPAC, Bureau of Educational and Cultural Affairs, Department of State.

[FR Doc. 2021–02368 Filed 2–4–21; 8:45 am]

BILLING CODE 4710–05–P

TENNESSEE VALLEY AUTHORITY

Programmatic Environmental Impact Statement—Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

AGENCY: Tennessee Valley Authority.

ACTION: Notice of intent.

SUMMARY: The Tennessee Valley Authority (TVA) intends to prepare a Programmatic Environmental Impact Statement (PEIS) to address the potential environmental effects associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at the Clinch River Nuclear (CRN) Site in Oak Ridge, Roane County, Tennessee. The park would contain one or more advanced nuclear reactors with a cumulative electrical output not to exceed 800 megawatts electric (MWe). TVA plans to evaluate a variety of alternatives including a no-action alternative. Public comments are invited to identify other potential alternatives, information, and analysis relevant to the proposed action.

DATES: The public scoping period begins with the publication of this Notice in the **Federal Register** and comments on the scope of the PEIS must be received or postmarked by March 19, 2021. To accommodate social distancing guidelines and public health recommendations related to the COVID–19 pandemic, TVA will host a virtual open house on March 1, 2021 from 6:00–8:00 p.m. EST. Visit *https://www.tva.com/nepa* to obtain more information.

ADDRESSES: Comments may be submitted in writing to J. Taylor Cates, NEPA Specialist, 1101 Market Street, BR 2C–C, Chattanooga, TN 37402. Comments may also be submitted online at: *https://www.tva.com/nepa* or by email to *nepa@tva.gov.* Due to COVID–19 teleworking restrictions, electronic submission of comments is encouraged to ensure timely review and consideration.

FOR FURTHER INFORMATION CONTACT: Other related questions should be sent to Tennessee Valley Authority, J. Taylor Cates, NEPA Specialist, 1101 Market Street, BR 2C–C, Chattanooga, TN, 37402, 423–751–2732, or *jtcates@tva.gov.*

SUPPLEMENTARY INFORMATION: This notice is provided in accordance with the Council on Environmental Quality's (CEQ) regulations for implementing the National Environmental Policy Act (NEPA) at 40 CFR parts 1500–1508 and Section 106 of the National Historic

Preservation Act (NHPA), and its implementing regulations (36 CFR part 800). The PEIS will be prepared consistent with the 2020 CEQ regulations for implementing NEPA at 40 CFR parts 1500–1508 (85 FR 43304–43376, Jul. 16, 2020).

TVA Power System

TVA is a corporate agency and instrumentality of the United States created by and existing pursuant to the TVA Act of 1933 (16 U.S.C. part 831), to, among other things, foster the social and economic welfare of the people of the Tennessee Valley region and promote the proper use and conservation of the Valley's natural resources. TVA generates and distributes electricity for business customers and local power distributors, serving more than 10 million people in parts of seven southeastern states. TVA is fully self-financed without Federal appropriations and funds operations through electricity sales and power system bond financing. In addition to operating and investing its revenues in its electric system, TVA provides flood control, navigation and land management for the Tennessee River system, and assists local power companies and state and local governments with economic development and job creation.

Dependable electrical capacity on the TVA power system is about 33,000 MWe. TVA's current generating assets include one pumped-storage facility, one diesel generator site, three nuclear plants, five coal plants, nine combustion turbine plants, eight combined cycle plants, 14 solar energy sites, 29 hydroelectric dams, and several small renewable generating facilities. A portion of delivered power is obtained through long-term power purchase agreements. About 13 percent of TVA's annual generation is from hydro; 14 percent is from coal; 27 percent is from natural gas; 41 percent is from nuclear; and the remainder is from wind, solar, and energy efficiency programs. TVA transmits electricity from these facilities over almost 16,000 miles of transmission lines. Like other utility systems, TVA has power interchange agreements with utilities surrounding the Tennessee Valley region, and buys and sells power on an economic basis almost daily.

Background

The CRN Site is in Oak Ridge, Roane County, Tennessee, on 935 acres of TVA-managed land on the Clinch River arm of the Watts Bar Reservoir. The site is located adjacent to the U.S. Department of Energy's (DOE) Oak Ridge Reservation, a roughly 33,500 acre reservation with defense, research, and environmental cleanup missions.

In May 2016, TVA submitted an application to the Nuclear Regulatory Commission (NRC) for an Early Site Permit (ESP) at the CRN Site for two or more new nuclear power units demonstrating Small Modular Reactors (SMR) technology with a total combined nuclear generating capacity not to exceed 800 MWe. SMRs provide the benefits of nuclear power in situations where large units, generally considered units with approximate electrical output exceeding 1000 MWe, are not appropriate or practical because of various constraints (*i.e.* local transmission system, limited physical space or water availability, constraints on the availability of capital for construction and operation, proximity to population centers, etc.). A NRC ESP provides early resolution of site safety and environmental issues, which in turn provides predictability and stability in any subsequent NRC licensing process.

The NRC prepared and released a Final EIS in April 2019 to assess the environmental aspects of their action, to decide whether or not to issue an ESP to TVA for the CRN Site. Following the NRC ESP Final EIS determination, the NRC issued the ESP to TVA in December 2019. The ESP provides NRC approval of the CRN site for considering new nuclear power units demonstrating SMR technology; the ESP does not authorize TVA to construct or operate a nuclear facility. TVA must apply for and receive additional licenses from the NRC prior to initiating construction or operation of advanced nuclear reactors at the CRN Site.

Project Purpose and Need

In June 2019, TVA released the Final 2019 Integrated Resource Plan (IRP) and the associated IRP Final EIS. The IRP identified the various resources that TVA intends to pursue to meet the energy needs of the Valley over the 20-year planning period in accordance with TVA's mission. The 2019 IRP recommends that TVA continue to evaluate emerging nuclear technologies, including SMRs, as part of technology innovation efforts aimed at developing future electricity generation capabilities.

TVA's purpose and need for the CRN Advanced Nuclear Reactor Technology Park is two-fold. First is to evaluate and demonstrate the feasibility of deploying advanced nuclear reactors to support TVA's mission of providing safe, clean, reliable, and low-cost energy to the Tennessee Valley. Second is to evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities.

TVA will consider the potential environmental effects associated with the proposed construction, operation, and decommissioning of one or more advanced nuclear reactors, with a cumulative electrical output not to exceed 800 MWe at the CRN Site. In addition to producing energy, advanced reactors could support a low carbon future, including demonstration of technologies such as microgrids, grid resiliency, waste heat energy storage for grid support, and the production of isotopes of hydrogen and other elements.

Preliminary Proposed Action and Alternatives

The PEIS will address a range of alternatives for construction, operation, and decommissioning of an advanced nuclear reactor technology park at the CRN Site. Action alternatives include construction of light water reactor (LWR) alternatives and/or non-LWR alternatives at the CRN Site. There are two areas within the 935-acre CRN Site that are best suitable for development; these are designated as Area 1 and Area 2. Therefore, TVA plans to evaluate four discrete alternatives (A–D) for these proposed actions including the No-Action Alternative (A) and an advanced nuclear reactor technology park at Area 1 (B); at Area 2 (C); at Area 1 and Area 2 (D). Two additional alternatives E and F were considered but eliminated.

Anticipated Environmental Impacts

The PEIS will include a detailed evaluation of all environmental, social, and economic impacts associated with implementation of the proposed action. Resource areas to be addressed in the PEIS include, but are not limited to: Air quality; aquatics; botany; climate change; cultural resources; emergency planning; floodplains; geology and groundwater; hydrothermal; land use; navigation; noise and vibration; radiological safety; soil erosion and surface water; socioeconomics and environmental justice; threatened and endangered species; transportation; visual; waste; water use; wetlands; and wildlife. Measures to avoid, minimize, and mitigate adverse effects will be identified and evaluated in the PEIS.

Anticipated Permits and Other Authorizations

TVA anticipates consulting on the required authorities including, but not limited to: The Endangered Species Act; Bald and Golden Eagle Protection Act; Rare Species Protection and Conservation Act; National Historic

Preservation Act; Clean Air Act; and Federal Clean Water Act.

TVA anticipates seeking required permits or authorizations, from the following governmental entities: The Nuclear Regulatory Commission; Federal Aviation Administration; U.S. Department of Transportation; Tennessee Department of Transportation; U.S. Army Corps of Engineers; U.S. Coast Guard; U.S. Environmental Protection Agency; Tennessee Department of Environment and Conservation; U.S. Fish and Wildlife Service; the City of Oak Ridge; Tennessee State Historic Preservation Officer; Tribal Historic Preservation Officers; and Texas Department of State Health Services, Radiation Control Program, Radiation Safety Licensing Branch. This is not an exhaustive list, other permits or authorizations may be sought as required or appropriate.

Public Participation and Scoping Process

TVA seeks comment and participation from all interested parties for the proposed action, including, but not limited, to assisting TVA in determining the scope of issues for analysis in the PEIS. Information about this project is available at *https://www.tva.com/nepa,* which includes a link to an online public comment page. TVA invites the public to identify other potential alternatives, information, and analysis relevant to the proposed action. Comments must be received or postmarked no later than March 19, 2021. Federal, state, local agencies, and Native American Tribes are also invited to provide comments. Please note that any comments received, including names and addresses, will become part of the project administrative record and will be available for public inspection.

To accommodate social distancing guidelines and public health recommendations related to the COVID–19 pandemic, TVA will host a virtual open house during the scoping period. The virtual open house will be held on March 1, 2021, from 6:00–8:00 p.m. EST. Visit *https://www.tva.com/nepa* to obtain more information about the virtual open house. Additional open house details will be available on the project site by February 17, 2021.

PEIS Preparation and Schedule

TVA will consider comments received during the scoping period and develop a scoping report, which will be published at *https://www.tva.com/nepa.* The scoping report will summarize public and agency comments that were received and identify the projected schedule for completing the PEIS process. Following completion of the CRN Site environmental analysis, TVA will post a Draft PEIS for public review and comment on the project web page. TVA anticipates holding a public open house, which may be virtual, after releasing the Draft PEIS. Open house details will be posted on TVA's website in conjunction with the Draft PEIS. TVA expects to release the Draft PEIS in the Fall of 2021.

TVA will consider the substantive comments received on the Draft PEIS, financial assessments, engineering evaluations, risk evaluations, and other applicable evaluations in the Final PEIS before selecting one or more alternatives. TVA projects completing a Final PEIS in Spring 2022. Subsequently, a final determination on proceeding with the CRN Site will be documented in a Record of Decision.

Authority: 40 CFR 1501.9.

Rebecca Tolene,

Vice President, Environment.

[FR Doc. 2021–02144 Filed 2–4–21; 8:45 am]

BILLING CODE P

DEPARTMENT OF TRANSPORTATION

Federal Highway Administration

Notice of Final Federal Agency Actions on Proposed Highway in California

AGENCY: Federal Highway Administration (FHWA), Department of Transportation (DOT).

ACTION: Notice of Limitation on Claims for Judicial Review of Actions by the California Department of Transportation (Caltrans).

SUMMARY: The FHWA, on behalf of Caltrans, is issuing this notice to announce actions taken by Caltrans that are final. The actions relate to a proposed highway project, I–10 Blythe Pavement Rehabilitation Project in the County of Riverside, State of California. Those actions grant licenses, permits, and approvals for the project.

DATES: By this notice, the FHWA, on behalf of Caltrans, is advising the public of final agency actions subject to 23 U.S.C. 139(*l*)(1). A claim seeking judicial review of the Federal agency actions on the highway project will be barred unless the claim is filed on or before July 6, 2021. If the Federal law that authorizes judicial review of a claim provides a time period of less than 150 days for filing such claim, then that shorter time period still applies.

FOR FURTHER INFORMATION CONTACT: For Caltrans: Antonia Toledo, Senior Environmental Planner, California Department of Transportation-District 8, 464 W 4th Street, MS–820, San Bernardino, CA 92401. Office Hours: 8:00 a.m.—5:00 p.m., Pacific Standard Time, telephone, (909) 501–5741 or email *Antonia.Toledo@dot.ca.gov.* For FHWA, contact David Tedrick at (916) 498–5024 or email *david.tedrick@dot.gov.*

SUPPLEMENTARY INFORMATION: Effective July 1, 2007, the FHWA assigned, and Caltrans assumed, environmental responsibilities for this project pursuant to 23 U.S.C. 327. Notice is hereby given that Caltrans has taken final agency actions subject to 23 U.S.C. 139(*l*)(1) by issuing licenses, permits, and approvals for the following highway project in the State of California: rehabilitation of the existing asphalt concrete (AC) pavement on Interstate 10 from Post Mile (PM) R134.0 to PM R156.5 in the County of Riverside. Rehabilitation Activities include removal and replacement of existing inside and outside shoulders, guardrails, rumble strips, drainage inlets, and dikes, and installation of oversized drains. The project will also involve upgrades to ramp facilities for ADA compliance, installation of two temporary detour lanes in the existing median, extension of existing rock slope protection at bridge locations, and hydroseeding the median for erosion control and vegetation restoration. The primary purpose of this project is to restore and extend the life of existing pavement for a minimum of forty years, enhance trip reliability, and consequently minimize expenditures associated with future maintenance. The actions by the Federal agencies, and the laws under which such actions were taken, are described in the Final Environmental Assessment (FEA)/Finding of No Significant Impact (FONSI) for the project, approved on July 27, 2020, and in other documents in Caltrans' project records. The FEA, FONSI and other project records are available by contacting Caltrans at the addresses provided above.

This notice applies to all Federal agency decisions as of the issuance date of this notice and all laws under which such actions were taken, including but not limited to:

1. Council on Environmental Quality (CEQ) regulations
2. National Environmental Policy Act of 1969, as amended, 42 U.S.C 4331(b)(2)
3. Federal Highway Act of 1970, U.S.C 772
4. Federal Clean Air Act of 1977 and 1987
5. Clean Water Act of 1977 and 1987
6. Federal Water Pollution Control Act of 1972
7. Safe Drinking Water Act of 1944, as amended
8. Executive Order 11988, Floodplain

ACHS, CHS earn Tennessee Pathways certification for programs

On Feb. 2, the Tennessee Department of Education announced 159 Pathways in 94 high schools, and 51 districts have earned the Tennessee Pathways Certification for creating regional post-secondary opportunities.

This more than doubles the number of certified pathways in Tennessee, bringing the total to 281 in 136 high schools and 69 districts.

In Anderson County, the 2020 Tennessee Certified Pathways are:

- Anderson County High School/Early Childhood Education Careers (Pre-K-4);
- Clinton High School/Early Childhood Education Careers (Pre-K-4);
- Anderson County High School/Coding.

Tennessee Pathways is structured around three key elements shown to increase seamless enrollment and success in postsecondary programs:

- High-quality college and career advisement throughout K-12;
- Rigorous early postsecondary and work-based learning opportunities in high school;
- Seamless vertical alignment between K-12, postsecondary programs, and career opportunities as a result of effective partnerships among school districts, higher education institutions, employers, and community organizations .

Launched in 2019 in partnership with the Tennessee Board of Regents, the Tennessee Pathways Certification sets clear expectations for alignment, advisement, and partnerships that define strong education-to-career pathways.

Beyond establishing standards for program quality and design, the certification elevates and celebrates innovative and exemplary pathways in the state.

"Tennessee is committed to building strong college and career pathways statewide," said Commissioner Penny Schwinn. "Students benefit from having exposure to high-quality career pathways, and these pathways will serve to enhance our state's future success and outcomes.

"We are proud to have more than doubled the number of Certified Pathways and this tremendous growth speaks to our districts, communities, and partners' shared values of strong education-to-career pathways. The department is proud to support every district across all regions working to further develop, enhance, and grow these opportunities."

All schools serving grades 9-12 in Tennessee were eligible to apply and each pathway was evaluated through a rigorous application process in which schools detailed their postsecondary and employer partnerships, early college and career experiences, and structures for providing students with impactful career advisement.

Despite the challenges of the COVID-19 pandemic, districts submitted 188 total applications for the Tennessee Pathways certification, representing every region of the state, 108 high schools, and 57 districts during the 2019-20 application cycle.

PHOTO SUBMITTER | COURIER NEWS

From left, Clinton High School band students who auditioned for the East Tennessee School Band and Orchestra Association Jazz Clinic are, from left: Ethan Yonce, Sara Boundy, Kate Boundy, and Alexander Erick. Not pictured: Austin Saltkill and Trey Meredith.

Clinton band students honored

On Saturday, Jan. 31, six Clinton High School band students auditioned and placed in the East Tennessee School Band and Orchestra Association Jazz Clinic.

This is an honor band that selects the best students grades 9-12 in the area of jazz.

The following students were selected for this years clinic: Junior Alexander Erick, Second Chair Alto Saxophone Red Band; senior Kate Boundy, First Chair Tenor Saxophone White Band; freshman Trey Meredith, Second Chair Alto Saxophone White Band; freshman Sara Boundy, First Chair Piano; freshman Ethan Yonce, First Chair Guitar; and senior Austin Saltkill made First Alternate on Drum Set.

Sell your unwanted items in the Classifieds. Call (865) 457-2515 Today.

COLLEGE BRIEFS

Austin Peay Dean's List announced

Austin Peay State University recognized more 2,000 students who were named to the Dean's List for academic achievement during the Fall 2020 semester. From Anderson County are:

Franklin Dodson and Audra Jones of Oak Ridge.

To qualify for the Dean's List, students must earn a semester GPA of 3.5 or greater.

Bradshaw, Sparks earn degrees

Berry College in Rome, Ga., recently announced its newest class of graduates. The following local students were Fall 2020 graduates:

Elizabeth Bradshaw of Oak Ridge earned a BS degree in economics.

Dara Sparks of Clinton earned a BA degree in English.

UC names Dean's, President's lists

In recognition of academic performance, the Office of the Vice President for Academic Affairs at University of the Cumberlands has announced the students named to the Dean's List and President's List for the fall 2020 semester.

To be eligible for the Dean's List, students must be enrolled in at least 12 credit hours (a full course load), maintain a minimum cumulative grade point average of 3.50. To be eligible for the President;s List, students must maintain an cumulative grade point average of 4.0, receive an "A" grade in UC Engage.

Of the Cumberlands students named to the Dean's List for fall 2020 from Anderson County are:

Jordan Comer of Oak Ridge, Molly Ferguson of Lake City, Madison Sickau of Norris, and Alec Williams of Clinton.

Anderson County students named to the fall 2020 President's List are:

Lauren Guthrie of Oak Ridge, and Alison McIntosh of Rocky Top.

Public Notice

TVA

Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Notice of Intent to Prepare a Programmatic Environmental Impact Statement

TVA has released a Notice of Intent (NOI) to prepare a Programmatic Environmental Impact Statement (PEIS) to address the potential environmental effects associated with the construction, operation and decommissioning of an advanced nuclear reactor technology park at TVA's 935-acre Clinch River Nuclear (CRN) Site in Oak Ridge, Roane County, Tennessee. The park would contain one or more advanced nuclear reactors with a cumulative electrical output not to exceed 800 megawatts electric (MWe). Public comments are invited to identify other potential alternatives, information and analysis relevant to the proposed action.

This project supports TVA's 2019 Integrated Resource Plan by continuing to evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities. This project would evaluate and demonstrate the feasibility of deploying advanced nuclear reactors to support TVA's mission of providing safe, clean, reliable and low-cost energy to the Tennessee Valley. The consideration of a new nuclear facility at the CRN Site supports TVA's mission statement and is another way to assess how to serve the people of the Tennessee Valley.

The PEIS will address a range of alternatives for construction, operation and decommissioning of an advanced nuclear reactor technology park at the CRN Site. Action alternatives include construction of light-water reactor (LWR) alternatives and/or non-LWR alternatives at the CRN Site. There are two areas within the CRN Site that are best suitable for development; these are designated as Area 1 and Area 2. Therefore, TVA plans to evaluate four discrete alternatives (A-D) for these proposed actions, including the No-Action Alternative (A) and an advanced nuclear reactor technology park at Area 1 (B); at Area 2 (C); at Area 1 and Area 2 (D). Two additional alternatives, E and F, were considered but eliminated.

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Chattanooga, TN 37402

Learning about Black History all year long

By Martha Deaderick

"We have to seek the truth to see it and to talk about it—even if it's uncomfortable. And then we have to act." Mary Ellen Flannery.

Last year, before the pandemic, a small group of Roane Countians met at the Greenwood School in Kingston to learn about some uncomfortable truths in our past. The class consisted of about eight people, mostly members of the NAACP and evenly divided between Blacks and Whites. We used a text by an historian of Vanderbilt University, Dr. Carrie Russell, "Reckoning with a Violent and Lawless Past." We read of the event in Erwin, TN in 1918, where an argument with a Black man and some Whites escalated into a mob attack threatening the entire Black community. This resulted in all the Black families being chased out of town. For decades, Erwin remained all White.

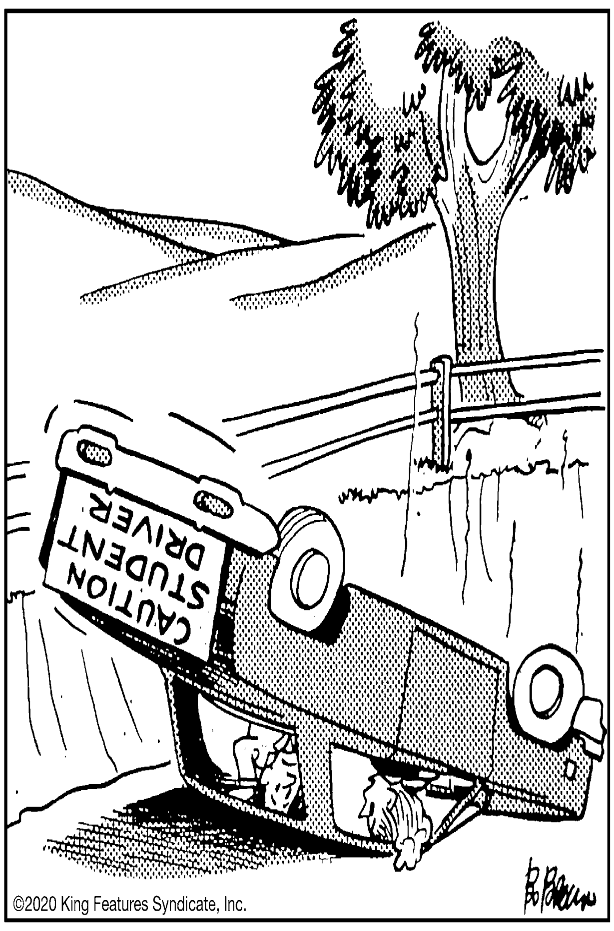
Using video documentaries, articles and books, the group learned how, after Reconstruction, Black Americans lost their farms, businesses and homes as they were forced out of communities by violence and threats. We compared our memories of growing up and knowing about the "sundown towns" and of our experiences in Roane County when it was racially segregated. These memories were especially vivid as our meeting classroom was in the former "Colored School" of Kingston.

An 1888 article in the "Chattanooga Times" recounted a rumored lynching of Jack Jones, who was accused of attacking a White woman in Roane County. His body was never found.

The group hopes that they may bring back to Roane County a monument to Mr. Jones, which is now on display at the National Memorial to Peace and Justice in Montgomery, Alabama. Communities that show they are willing to confront these difficult histories are able to return these to their own counties for display there. The group hopes to visit the national memorial in person once Covid restrictions are removed and vaccinations are more available.

The opinions expressed in this column do not reflect the views of this newspaper.

LAFF-A-DAY



"I did something wrong, didn't I?"

LICK SKILLET

From Page 4A

brought up to believe in "Truth, Justice and the American Way!" Our fictional heroes, such as Superman, Wonder Woman and so many others taught us these fundamental values. So did our Sunday schools and churches. Almost all of our parents taught us that we were not to lie, nor cheat. From every playground and schoolyard could be heard the insistent utterance that we play by the rules. And any infraction immediately provoked the cry of "No Fair!" And poor losers weren't asked to play anymore.

But now?

How times have changed. And the most changed of all are the ministers of certain of our churches. It seems that so-called Evangelical preachers have decided that they no longer want to be society's spoilsports. Instead they want to be the good time Charlies; the go-along to get along echo chambers for the propagators of the big lies; lies proclaimed with proud abandon by people who at one time had reputations as truth tellers.

How these fellows can stand at a pulpit in a structure supposedly dedicated to Jesus Christ's teachings and beliefs while in front of them lies a copy of the Holy Bible containing a printed version of those teachings and beliefs, and spout the propaganda they do is beyond belief. One is reminded of Marvin Miller's query of President Truman as to whether he thought President Nixon had ever read the Constitution: to which the answer was to the effect that he didn't know if Nixon had read it or not, but if he had he hadn't understood it.

Well, we have the same thought as to these so-called Evangelical preachers. We wonder if they have ever read the Holy Bible, especially the New Testament? And, we hazard the opinion that if they have read the New Testament, especially Christ's own teachings set out therein, they most assuredly didn't understand any of it. For if they did, they would not be preaching the very things that our Lord decried, nor avoiding preaching the very things that our Lord praised, such as loving thy neighbor as thyself.

But no. They would rather tread the paths of the Liar in Chief, for that is what it now takes for this crowd that wants to rule over us. Lie, Lie, Lie.

And, of course it is no wonder, that's 30,000 lies. That is almost unbelievable, but the man has had lots of practice. Remember, his first entry on the public policy stage was to challenge Barack Obama's birthplace, a challenge which he continued even after documentary proof was offered proving he was born in the state of Hawaii. And he has never conceded that President Obama was born in the U.S.A., just as he has never conceded that he lost the 2020 election. Facts have never mattered to this man. Of course there have always been men who ignore or dispute facts.

Interestingly enough, our second president, John Adams, even before he was president, or there was a country of which to be a president (1770), in his courageous argument defending British soldiers in the Boston Massacre said:

"Facts are stubborn things; and whatever may be our wishes, our inclinations or the dictates of our passions, they cannot alter the state of facts and evidence."

What was true in 1770 is true today, but unfortunately during the reign of the Big Lie, lots of people, particularly in the new Republican Party, ignore the truth, just as they also ignore "Justice and the American Way!"

Back before he was elected president, John F. Kennedy saw to the compilation and publication of a widely sold book called "Profiles in Courage," made up of short accounts of numerous instances in U.S. history in which people stood up and did the right thing, even though it might have been the unpopular thing to do, or a thing that was almost certain to cost them politically, socially or financially. It was, and is, an inspiring story and reading it might be beneficial for some of the folks like those Republicans who are censuring their fellow Republicans, people like the widow of John McCain and Rep. Liz Cheney for doing what they all should have done, were they not scared of Trump.

If such a factual book were to be written today, unfortunately, for every Profile in Courage, there would be a half-dozen or more Profiles in Cowardice, we fear.

We sincerely hope that this column's pessimistic tenor will need never be repeated and that we can in good conscience return to our usual optimistic outlook, for we have faith in the American people and our institutions. Maybe after we have had our inoculation next week and possibly several of the Republican senators may see the right course and a few of the Evangelicals feel the Call and finally become true Christians, we'll feel better about it all. Let us hope so.

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top ten

Collector Car Sales*

1. Porsche 911
2. Chevy Corvette
3. Ford Mustang
4. Mercedes-Benz SL
5. Chevy Camaro
6. Ford Shelby Mustang
7. Ford GT
8. Chevy Chevelle
9. BMW 3 Series
10. Chevy C/K

*2020 dollar volume

Source: Classic.com

Tell us what you think about the issues of the day.

Did you know?

The official beginning of spring is a highly anticipated day among people who can't wait to put away their winter coats and soak up some warm sunlight. But the day of the spring equinox is just as worthy of celebration for its uniqueness as it is for its symbolic connection with the end of winter.

According to the *Old Farmer's Almanac*, on the spring equinox, which is sometimes referred to as the "vernal equinox" or the "March equinox," the sun crosses the celestial equator going south to north.

Equinoxes (there's another one in September each year) are the only two times a year that the sun rises due east and sets due west for everyone on Earth. As the sun passes overhead on the equinox, the tilt of Earth is zero relative to the sun.

That means that the planet's axis neither points toward or away from the sun. Though it's understandable why so many people appreciate the spring equinox, which ushers in increasing sunlight hours and later sunsets, the day's uniqueness makes it even more worthy of celebration.

This year the spring equinox happens on Saturday, March 20 at 5:37 a.m. EDT in the northern hemisphere.

Public Notice TVA

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State housing authority to offer rental relief

Assistance program may be in place by March 1

Yue Stella Yu
Nashville Tennessean
USA TODAY NETWORK – TENNESSEE

Callie Clark, 28, with her children Peyton Rinehart, 4, left, Cain Rinehart, 2, and Ella Jo Rinehart, 7 months, in front of her apartment on Dec. 8 in Nashville. Clark is at risk of getting evicted after recently losing her job. She received some aid to help her from the Metro Action Commission. MARK ZALESKI/FOR THE TENNESSEAN

Tennesseans struggling to pay rent due to the pandemic may soon receive help through the state's housing authority, as part of a statewide rental assistance program currently underway.

Funded by federal dollars, the program would help eligible tenants catch up on rent payments if they've experienced financial difficulties caused by the pandemic, said Ralph Perrey, director of the Tennessee Housing Development Agency.

The rental relief program, which could be in place by March 1, would come in the waning days of the nationwide eviction moratorium running through March. Meanwhile, more than 1 million Tennesseans have lost their income and filed unemployment claims since last March, and tens of thousands are still waiting to receive their benefits.

"First priority for us is going to be making sure we can keep as many people as possible decently housed," Perrey said.

Tennessee has received roughly $458 million in federal funding under the COVID-19 Rent Relief Act. More than $383 million of that would be administered by THDA and distributed to help tenants in most parts of the state, Perrey said. The agency is also allowed to spend up to 10% of the funds to cover administrative expenses.

The act allows local governments with 200,000 or more residents to receive the funds directly. In Tennessee, the remaining $75 million is split among Davidson, Knox, Rutherford, Shelby counties and Memphis, which applied for funds as a separate entity, Perrey said. The five local authorities will set up their own programs, and Memphis and Shelby County will collaborate, he said.

Tenants who lost their job or "significant income" and now make less than 80% of the area median income because of the pandemic qualify for the statewide assistance, Perrey said. The agency will prioritize residents who have been unemployed for 90 days or longer and those with earnings below half of the area median income.

Perrey said the program is estimated to help 25,000 households pay off overdue rent. Rent payments go to the landlords directly, he said. The money could also go toward late fees and utility payments, he said, and any leftover funding could help provide legal services for tenants in need.

For each household, the aid could last for up to 12 months.

"If that applicant is four months behind on their rent, we can catch them up," he said. "And if they are still not working or remain eligible, we can make payments to their landlords for eight more months."

Eligible tenants or their landlords will be able to apply for assistance via an online portal, Perrey said, and a call center will be available for questions about the process.

Landlords applying for assistance can provide THDA with tenant information, he said, and tenants need to prove their income level and inability to afford rent due to the pandemic. A check for unemployment benefits, for example, can be proof of loss of income.

"You got to show us your current finance situation is a result of COVID," he said. "We want to make this as easy as possible for applicants to show us what we need to see."

Roughly 3,000 people have signed up to receive notifications once the portal is open, Perrey said. THDA is now working with Horne, a business advisory firm contracted with the state, to staff the call center and manage the website to make sure the portal functions smoothly, he said.

"We want to be sure that, when we open the portal, that we built out the system to be able to function and take in thousands of applicants right away," Perrey said.

Despite the high volume of potential applicants, Perrey said he does not expect a wait list of them.

If the funds dry up before demand does, the U.S. Treasury Department can re-evaluate the situation in the summer and redistribute funds across the nation.

"If someone has only committed 20% of their funds, Treasury can take some of all of the balance back and send it to a place that has committed 90%," Perrey said.

THDA could also look to help other local authorities if their funds quickly burn out, he said.

"We will set up some kind of subcontracting arrangement with each of them, so that if we have sufficient reserves in these funds and they are going through theirs more rapidly, we have some abilities to shift some resources to assist them," Perrey said.

Multiple rental assistance programs have already started helping tenants who are behind on rent payments.

For example, Nashville residents in need for help can access rental assistance through various programs set up by the city government and local groups.

The city-run Metro Action Commission offers emergency assistance for three to six months to those at risk of eviction or foreclosure. Similar programs are also available at groups such as The Nashville Conflict Resolution Center and nonprofit The Housing Fund.

Reach Yue Stella Yu at yyu@tennessean.com or 615-913-0945. Follow her on Twitter at @bystellayu_tnsn.

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PUBLIC NOTICE

The Tellico Reservoir Development Agency (TRDA) Board of Directors will meet in regular quarterly session on Friday, February 12, 2021, at 11:00 a.m. In accordance with Tennessee Governor Bill Lee's Executive Order No.71, the meeting will be held by electronic means. The link to join the meeting may be obtained by calling the TRDA office at (865) 673-8599. Persons desiring to make public comment prior to the meeting must submit their comments in writing by February 11, 2021, to TRDA, 165 Deer Crossing, Vonore, Tennessee 37885. No member of the public may be physically present. However, an audio recording of the meeting will be available two business days after the meeting.

NOTICE TO SEEK TITLE
2000 Ford Explorer
VIN# 1FMZU63E9YZA22684
Any and all parties holding an interest in this car should contact Charles Hicks at 1298 Turn Lane, Lenoir City, TN 37771 by certified mail, return receipt requested, within ten (10) business days of this publication.
February 3, 10 & 17, 2021

NOTICE OF PUBLIC HEARINGS

The Loudon City Council will conduct public hearings on February 22, 2021 for the following:

6:20 PM amending Title 5, Chapter 9, Section 14 of the Municipal Code of the City of Loudon regarding the parking of trucks on certain city streets

6:25 PM designating parallel on-street parking on Grove Street from Wharf Street to College Street

The ordinances are available for review at the Municipal Building. The hearings will be held in the Municipal Building located at 2480 Highway 72N. Anyone needing special accommodations in order to participate in the meetings should contact the City Manager's office or ADA Coordinator Travis Gray as soon as possible, but no later than 48 hours prior to the meeting. The city's phone number is 865-458-2033.

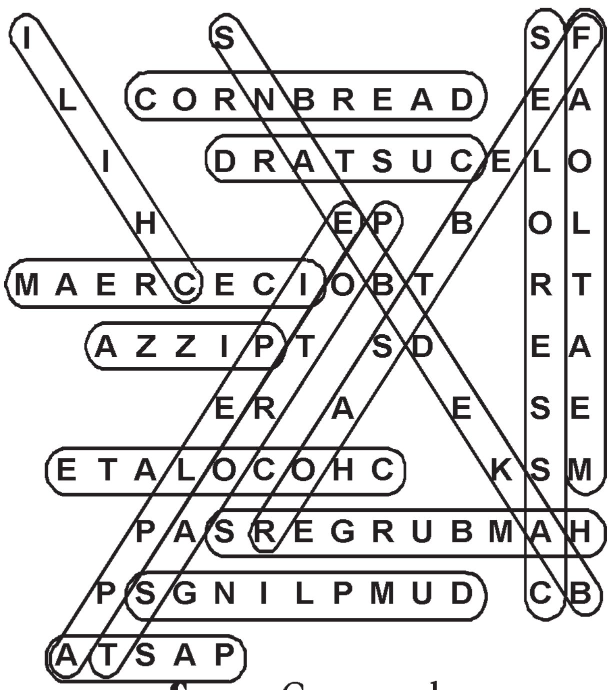
P LE ANSWERS

Weekly SUDOKU

Answer

2	5	1	8	7	3	4	6	9
3	4	9	2	6	1	8	5	7
7	8	6	4	9	5	2	1	3
1	7	2	3	8	4	6	9	5
4	9	5	7	1	6	3	8	2
6	3	8	5	2	9	1	7	4
5	1	4	6	3	7	9	2	8
9	2	7	1	4	8	5	3	6
8	6	3	9	5	2	7	4	1

COMFORT FOODS



Super Crossword

Answers

E	M	I	R	S		H	A	T	P	E	G		G	A	R	B		G	A	H
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T	W	A		A	N	E			S	I	E	N	A			A	N	I	O	N
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		F	A	M	I	S	H	I	N	G	E	X	P	E	D	I	T	I	O	N
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B	R	U	S	S	E	L	S		Y	O	Y	O	D	I	A	M	E	T	E	R
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Y	E	N		R	O	A	N		U	S	N	A	V	Y		N	O	T	E	D

NOTICE OF SPECIAL MEETING OF THE INDUSTRIAL DEVELOPMENT BOARD OF LOUDON COUNTY

The Industrial Development Board of Loudon County (the "Board") will hold a special meeting on Thursday, February 18th at 11:00 a.m. Due to the COVID-19 pandemic and in accordance with Governor Lee's Executive Order No. 16, as extended by Executive Order No. 34, No. 51, No. 60 and No. 65, the Commissioners of the Board may attend the meeting either electronically or in-person at the offices of Loudon County Government located at 100 River Road, Loudon, Tennessee 37774.

There will be considered at such meeting the approval of documentation related to a payment in lieu of tax agreement with respect to Project Strength in connection with property generally located at 14542 El Camino Lane, Lenoir City, Tennessee. If any person wishes to obtain real-time, live access to the meeting, contact Jack Qualls, at (865) 988-0843 for more information. This Notice is published in compliance with Tenn. Code Ann. § 7-53-305(j).

29384008.1

Loudon County Government
Surplus Equipment Sale
Loudon County Government has for auction on GovDeals.com the following:

Powermatic Upcut Saw (Model #COS-18L)
Powermatic Lathe (Model #4224)
DS-90 Folding and Inserting System for Processing Mail

Descriptions and pictures of items are available on the GovDeals.com website. The Closing Auction date will be February 22,2021. Interested bidders can contact Teresa Everett at 865-458-4663 or Susan Huskey 865-458-9042. Loudon County Government will not discriminate on the basis of sex, race, national origin, creed, age, marital status or disability.

USA's Osterman looks to end decorated softball career on top

(AP) — Cat Osterman is primed to end her softball career on top.

The dominant left-handed pitcher is set to compete for Team USA at the Tokyo Olympics, then she will defend her individual championship at Athletes Unlimited later this year before retiring.

Osterman was an Olympic gold medalist in 2004 and a silver medalist in 2008. In college at Texas, she was a three-time USA Softball Collegiate Player of the Year.

She is ready for one more run at greatness, then that's it.

"It's just time," she said. "I have a family and I've been doing this for a long, long time. Slowly but surely, the signs were there that it was time for me to phase into a new direction."

Last season, Osterman was the highest point earner for Athletes Unlimited in games played during a five-week season played in a bubble at a sports complex in Rosemont, Illinois. The league featured 57 of the world's best players.

Osterman didn't go in expecting to win the individual honor — after all, she had planned to retire after the Olympics and joined the league only after the Tokyo Games were postponed because of the coronavirus pandemic and she was looking for a way to stay competitive.

She said she's glad she joined and that it was an easy decision to commit for a second season.

"The cool part is that I was able to perform the way that I was at the peak of my career when I was 27, 28," she said. "So that was an exciting moment to see. But I think more than anything, I was proving to myself that I could throw at an elite level and at a level that I was satisfied with."

Osterman initially wasn't sure that an individual points-based system would catch on, but it worked.

"It's obviously super exciting for softball that there's a pro avenue that looks like it can be sustained, not only that the fans fell in love with, but that the players fell in love with," she said. "I know plenty of players had doubts when the idea was first pitched, but once we were in it, we were all in love with it."

Osterman's work continued after the season. She and her husband turned a spare bedroom into a workout room. Her trainer, Lance Sewell, continues to help her get results after seven years of working together.

Her workouts have changed over the years.

"I do a little bit more of it, but less intensity than I used to simply because I'm older, but I have to keep my body moving and let it recover the right way," she said. "It's very scripted out."

Osterman said she admires stars in other sports such as Tom Brady, Justin Verlander and Aaron Rodgers who have remained elite competitors at advanced ages.

"I can relate to the fact that you're passionate about what you do, and that you want to keep doing it as long as you're able to," she said. "I read articles about them and I think, 'I know what this feels like.'"

Osterman said Team USA is training together two weeks per month. If all goes as planned, the team will go into a bubble environment to limit exposure to others before heading to Tokyo.

After that, she'll try to defend her championship. She wants fans to be able to watch her play one last time before she retires.

"It's fun to return and see who takes the title after this," she said. "If it's me, there will be no Season 3 for me. If it's not me, I'm going to enjoy watching whoever comes after that championship title."

Pitcher Cat Osterman smiles as she answers a question during a news conference to announce the USA Softball 2020 Women's Olympic Team in Oklahoma City, in this Tuesday, Oct. 8, 2019, file photo. (AP Photo/Sue Ogrocki, File)

ADAMS SIGNS — Cole Adams receives a scholarship to play football for Valparaiso University, Indiana. Pictured with Cole are family members Ryan and Blake Overton, Paul and Lauren Adams; ORHS Principal Garfield Adams, Athletic Director Mike Mullins and Head Football Coach Joe Gaddis. Special to The Oak Ridger

Webb's Noelle Fuchs to row at Duke University

KNOXVILLE — Webb School of Knoxville will celebrate senior Noelle Fuchs' signing with the Duke University women's rowing team, Friday, Feb. 5, 2021. The outdoor ceremony will take place at 12:10 p.m., at Webb's Science Center fountain on the Webb School campus.

Fuchs has been a member of Atomic Rowing in Oak Ridge, since her sophomore year. She helped lead her teammates to a gold-medal finish in the women's junior eight at the 2019 Head of the South regatta and first place in the women's junior four and eight at the 2020 Secret City Head Race.

A member of Webb's National Honor Society and an AP Scholar with Honor, Fuchs has been active in community service at Webb as one of the leaders of the Upper School Interact Club, and served as Club president her junior year. In addition, she is the recipient of a national President's Volunteer Service Award (PVSA) Gold Medal for contributing 250 or more volunteer hours over a 12-month period.

A co-captain of this year's Atomic junior women's crew team, Fuchs exemplifies both outstanding athletic effort and character, according to Atomic Rowing head coach, John Davis. "Noelle is a hard worker and has come a long way in a short amount of time," Davis says. "We're seeing her true potential in rowing and much of that potential is still untapped." He added that Fuchs is joining a strong rowing program at Duke "and we have high hopes for great things for Noelle," Davis noted. "We look forward to her impact on the Blue Devils rowing team."

SUNNY SIDE UP

by Joe A Hollingsworth, Jr.

Real friends are the people who, when you make a fool of yourself, don't feel you've done a permanent job.

Sorghum: what you have after a dental appointment.

One flea to another: "Shall we walk home, or do you want to take a dog?"

Appendix B

Public and Agency Comments Submitted During the Scoping Period

(February 2, 2021 through March 19, 2021)

From:	Long, Larry
To:	nepa
Cc:	Kajumba, Ntale
Subject:	PEIS TVA Clinch River
Date:	Thursday, March 11, 2021 8:36:25 AM

Mr. J. Taylor Cates
Tennessee Valley Authority
NEPA Compliance
1101 Market Street
BR2C-C
Chattanooga, Tennessee 37402

Re: Draft Programmatic Environmental Impact Statement for the Clinch River Nuclear Site and the Tennessee Valley Authority

Mr. J. Taylor Cates:

The U.S. Environmental Protection Agency (EPA) has reviewed the Programmatic Environmental Impact Statement (PEIS) scoping documents for the Clinch River Nuclear (CRN) site. The PEIS will examine the environmental impacts associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at the CRN site.

The proposed alternatives include construction of light water reactor (LWR) alternatives and non-LWR alternatives. There are two areas within the CRN site that are proposed for development (Area 1 and Area 2). TVA plans to evaluate four alternatives (A-D) for the proposed action including the No-Action Alternative (A) and an advanced nuclear reactor technology park at Area 1 (B), Area 2 (C), and Area 1 and Area 2 (D).

The EPA has identified environmental concerns associated with this project, which should be included in the Draft PEIS. The alternatives evaluate the economic feasibility (EF) of LWR and non-LWR modular type reactors. The EPA recommends that the EF studies be more inclusive and encompass the full or true cost associated with each of the alternatives. The true cost would include impacts to the environment including site preparation activities in a process-specific section of each alternative, financial assurance, social cost to the local community and those associated with civil defense for the potential impact areas in the event of a catastrophic failure. Thermal discharge effects to wetlands and streams that also include the impact of drought conditions/periods and transport and storage of waste material over the expected life of the facility should also be examined. See link below for information on drought conditions in Tennessee - https://www.drought.gov/drought/states/tennessee.

The EPA appreciates the opportunity to work with the TVA and looks forward to continuing the collaboration process on the PDEIS. If you wish to discuss this project further, please contact Mr. Larry Long, Project Manager, of the NEPA Section at (404) 562-9460 or by email at long.larry@epa.gov.

Larry Long
Regional Mining Expert
Physical Scientist/Sr. Principle Reviewer
NEPA Section/Strategic Programs Office
Office of the Regional Administrator
61 Forsyth Street, SW
Atlanta, GA 30303
404-562-9460
404-562-9598(FAX)
long.larry@epa.gov

Intelligence does not always define wisdom, but adaptability to change does

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF WATER RESOURCES
William R. Snodgrass - Tennessee Tower
312 Rosa L. Parks Avenue, 11th Floor
Nashville, Tennessee 37243-1102

February 18, 2021

Ms. J Taylor Cates
Tennessee Valley Authority
1101 Market Street, BR 2C-C
Chattanooga, TN 37402

Subject: TVA Clinch River Siter Scoping for Programmatic EIS
Roane County, TN

Sent via email to jtcates@tva.gov and nepa@tva.gov

Dear Ms. Cates:

As this is at the scoping for a PEIS, there is not sufficient information to address the requirements for the permits in detail. The construction of a light water reactor and/or non LWR at the TVA Clinch River site will require a construction storm water permit (CGP) based on the land disturbance being expected to be well more than one acre. This facility will also be required to have a Tennessee Storm Water Multi-Sector General Permit. A National Pollutant Discharge Elimination Permit NPDES permit will be required if there is to be a discharge from the facility into the Clinch River. An Aquatic Resource Alteration Permit (ARAP) will be required if there is to be a water withdrawal for the facility.

There have not been any public water supply intakes, wells or springs identified that would be impacted from the proposed facility. The TVA Clinch River Nuclear Site Early Site Permit Application (ML16144A086) noted that due to the interactions of the Watts Bar Dam, Melton Hill Dam and Fort Loudon Dam, that the river flow "can be upstream, downstream or quiescent, depending on the modes of operation" within the vicinity of the site. This could mean that for short periods of time, an intake at the Clinch River facility would be downstream of the NPDES discharge point for the facility. It is not clear what impact if any this flow reversal would have, but it may need to be considered in the PEIS.

If you have any further questions, I will be glad to try to assist you. You may reach me at (615) 532-0170 or tom.moss@tn.gov.

Sincerely,

Thomas A. Moss

Thomas A. Moss, P.G.
Environmental Review Coordinator
Compliance and Enforcement Unit

cc: Michael Atchley, DWR Manager, Knoxville Environmental Field Office

STATE OF TENNESSEE
DEPARTMENT OF ENVIRONMENT AND CONSERVATION
DIVISION OF AIR POLLUTION CONTROL
William R. Snodgrass Tennessee Tower, 15th Floor
312 Rosa L. Parks Avenue
Nashville, TN 37243
(615) 532-0554 Voice or (615) 532-0614 FAX

March 19, 2021

J. Taylor Cates, NEPA Compliance
Tennessee Valley Authority
1101 Market Street, BR2C-C
Chattanooga, Tennessee 37402

Subject: Clinch River Nuclear (CRN) Site Advanced Nuclear Reactor Technology Park

Dear Ms. Cates:

The Division of Air Pollution Control has reviewed the scoping request/Notice of Intent (NOI) for the Clinch River Nuclear (CRN) Site advanced nuclear reactor technology park in Roane County in Tennessee. The park would contain one or more advanced nuclear reactors with a cumulative electrical output not to exceed 800 megawatts electric (MWe). Thank you for the opportunity to provide comments.

The Programmatic Environmental Impact Statement (PEIS) will address a range of alternatives for construction, operation, and decommissioning of an advanced nuclear reactor technology park at the CRN site. The Division recommends that you evaluate the potential impacts on air quality during construction, operation, and demolition in detail in the PEIS.

The Division recommends that you address air emissions from the operation and idling of heavy-duty non-road mobile sources, evaluate alternatives to open burning for the disposal of uprooted trees and other vegetation, and minimize the generation of fugitive dust from the project through best management practices. Additional information about Tennessee's fugitive dust requirements can be found at https://publications.tnsosfiles.com/rules/1200/1200-03/1200-03-08.20180904.pdf and about open burning can be found at https://publications.tnsosfiles.com/rules/1200/1200-03/1200-03-04.pdf.

The NOI acknowledges that air quality permits may be needed for this project. Be advised that air quality construction permits must be issued prior to undertaking certain construction activities. Activities that can occur prior to receipt of such permits vary depending on the type of permit needed, so it is recommended that you contact the Division prior to groundbreaking activities.

Federal regulations enforced by the EPA and TDEC DAPC apply to asbestos renovation and demolition activity. These regulations apply to any building or structure known to contain asbestos and to any buildings proposed to be demolished. When any structures are proposed to be demolished, an asbestos demolition notification must be provided in advance, and proper pre demolition surveys need to be conducted to identify any regulated asbestos containing material (ACM) present. Prior to any demolition, all facilities must to be examined for ACM, and all potential ACM in the buildings proposed for demolition must be handled and disposed of according to the applicable Federal, state, and local regulations. Tennessee's asbestos regulations can be found in chapter 1200-03-11 of the Tennessee Air Pollution Control Regulations.

If you have any questions or comments, please feel free to contact Ms. Lacey Hardin of my staff at (615) 532-0545.

Sincerely,

Michelle W. Owenby

Michelle W. Owenby
Director

From: Shaun Armstrong
To: Michael Gilbert
Subject: RE: TVA: Notice of Intent to Prepare a Programmatic Environmental Impact Statement -- Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park
Date: Monday, March 8, 2021 1:05:37 PM
Attachments: image001.png
image002.png
image003.jpg
image004.png

Mike,
Based on a review of the TVA site location, and there does not appear to be any active projects within close proximity of this location. SR-58 is the route that will serve the site and is currently a 5 lane facility, however the map shown does highlight potential local roadway improvements at the interchange of SR-58 and Bear Creek Road. Improvements touching the state route system and on state right-of-way will need to be coordinated through the Region 1 Traffic for review and permitting.

Thank you,
Shaun

Shaun Armstrong, P.E. |Civil Engineering Manager 2
Strategic Transportation Investments Division/ Project Investigation
James K. Polk Building, 10th Floor
505 Deaderick Street, Nashville, TN 37243
p. 615-253-5327
c. 615-339-7371
Shaun.Armstrong@tn.gov
http://www.tn.gov/tdot/section/strategic-transportation-investments

---

From: Michael Gilbert <Michael.Gilbert@tn.gov>
Sent: Tuesday, March 2, 2021 7:39 AM
To: Shaun Armstrong <Shaun.Armstrong@tn.gov>

Subject: FW: TVA: Notice of Intent to Prepare a Programmatic Environmental Impact Statement -- Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Hey bud just making sure this is in the queue for review.. I am sure you are on it…
Thanks for your help and let me know if you need my help at all with it dude! I think comments are due March 19th…..

Have a good one!
Mike G

From: Michael Gilbert
Sent: Wednesday, February 10, 2021 11:11 AM
To: Shaun Armstrong <Shaun.Armstrong@tn.gov>
Subject: FW: TVA: Notice of Intent to Prepare a Programmatic Environmental Impact Statement -- Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Here is the project we discussed. Just let me know when you all have the comments and I can send them on to Susannah. Looks like they need them by March 21st so I guess probably aim for something prior to that date if you agree!
Thanks dude and let me know if you need me….

Mike G

From: Susannah Kniazewycz <Susannah.Kniazewycz@tn.gov>
Sent: Tuesday, February 2, 2021 3:04 PM
To: Michael Gilbert <Michael.Gilbert@tn.gov>
Subject: FW: TVA: Notice of Intent to Prepare a Programmatic Environmental Impact Statement -- Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Hi Mike and hope all is well with you!

Thanks for you or your team reviewing other agencies capital improvement projects and commenting on behalf of the department as needed.
Susannah

Susannah Kniazewycz, P.E. | Director
TDOT Environmental Division
James K. Polk Bldg, 9th Floor
505 Deaderick Street, Nashville, TN 37243
p. 615-741-5373 c. 615-232-4208
susannah.kniazewycz@tn.gov
https://www.tn.gov/tdot/environmental-home.html

From: Cates, J. Taylor <jtcates@tva.gov>
Sent: Tuesday, February 2, 2021 12:36 PM
Cc: Cates, J. Taylor <jtcates@tva.gov>
Subject: [EXTERNAL] TVA: Notice of Intent to Prepare a Programmatic Environmental Impact Statement -- Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Hello,
Today, February 2, 2021, TVA posted the Notice of Intent (NOI) to prepare the Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park Programmatic Environmental Impact Statement (CRN PEIS) on TVA's website at www.tva.com/nepa under "Open for Public Comment." To ensure consideration, any comments must be postmarked or electronically submitted no later than Friday, March 19, 2021. Please see the attached letter for more details.

Please pass this information along to anyone as appropriate.

Thank you.

J. Taylor Cates
NEPA Compliance Specialist
Federally Mandated Environmental Compliance
TVA logo

M. 423-599-9035 **E.** jtcates@tva.gov
1101 Market Street Chattanooga, TN 37402

TVA Notice of Intent to Prepare a Programmatic Environmental Impact Statement
Comments from the Roane County Environmental Review Board
March 1, 2021

Here are a few of my comments so far:

1. Surface water temperatures were monitored in the Clinch River arm of the Watts Bar Reservoir as part of the NRCEIS data collection activities. Is water temperature monitoring ongoing now and will future water temperature monitoring be continued during operation of any new reactors?
2. The environmental effects of discharging warmer water from reactor cooling activities needs to be addressed. The Clinch River could become warmer, thus encouraging further growth and spread of aquatic plant invasive species. Other effects of this warmer water also need to be addressed (e.g., impacts to aquatic species like fish, amphibians, reptiles, invertebrates, etc.). TVA will need to consider expanding invasive weed control activities and schedule to include this area of the Clinch River arm of the Watts Bar Reservoir, just as the effluent discharge area for the Kingston Steam Plant has been treated in the past.
3. Scoping needs to address environmentally sensitive species, like bats and pink mucket mussels. Destruction of habitats needs to be prevented. Mitigation for bats could take the form of artificial roosting habitat (such as Branden Bark) and artificial bat caves for hibernation. These could be located in the general area prior to start of construction thus making them readily available before the natural roosting or hibernation sites are lost.
4. Any Cooling-Water Discharge System may require some potential river bottom disturbance. How will the disturbed bottom silt be monitored for contaminants to prevent unplanned release of previously immobilized constituents to prevent contamination of downstream drinking water supply systems? Any discharge system needs to address how flow will be mitigated to prevent disturbance of contaminants in the sediments.
5. Any air and water discharges need to address the prevention of radioactivity being introduced into the environment, whether cooling water discharge into the Clinch River or air venting to the atmosphere.
6. Disturbed sediments carrying downstream from shoreline work and stormwater runoff into the Clinch River need to be addressed. Since any disturbed sediment will be entrained into the river currents and be carried further than probably anticipated downstream, there is considerable potential for increased fish contamination in species that currently do not have consumption restrictions on them therefore, during construction and for some calculated period afterward it may be advisable to widen the consumption restriction on fish taken in in this portion of the Clinch River arm of the Watts Bar Reservoir.
7. Consider the environmental impacts of Gasoline, diesel fuel, hydraulic lubricants, and other similar products used for equipment during construction and operation. These same constituents were used during construction and operations at Paducah Gaseous Diffusion Plant. The area designated for these activities was later found to be highly contaminated, so much so that it had contaminated the groundwater in a large area. Since the groundwater movement to the Clinch River arm has been shown to be very fast, it is essential that all such activities be contained in a maintenance pit impervious to penetration by these constituents to prevent their introduction into the environment and tainting of downstream drinking supplies.
8. Any transportation studies need to include the bicycling lanes of SR58 should be included since they are used by a high volume of cyclists for transportation and recreation purposes, especially during the summer and on weekends.

9. Scoping needs to include the impacts of plume shadowing created from reactor operations, particularly effects on the SR58 bridge crossing the Clinch River.
10. Include lessons learned from other reactor accident sites, such as Fukushima and the effects of seismic and flooding hazards. The main long-term issue with Fukushima was loss of coolant for the spent nuclear fuel, which resulted in radiological contamination (air/fallout), high radiation fields in the buildings (making repairs difficult if not impossible), and radiological contamination of the ground water. In addition, waste disposal of the contaminated material resulting from an accident needs to also be addressed as well. Include how you plan to protect the population immediately near the nuclear site, as well as those downwind of it, such as potassium iodine pills to saturate the thyroid to prevent radioactive iodine uptake?
11. The EIS needs to include and address the storage, handling, and disposal of spent fuel and low-level radwaste. These are important waste streams that carry low to high moderate risk for exposure to the public/workers and contamination of the environment.
12. Kairos Power is planning on constructing and operating a nuclear reactor on the old ETTP site in the demolished K-33 Building area. Address how cumulative effects of environmental impacts and accident scenarios will be addressed.

From:	Hunter, Malinda
To:	Jack Keeling
Cc:	nepa
Subject:	RE: TVA Asks for Public Input on the Clinch River Nuclear Site
Date:	Tuesday, February 2, 2021 5:39:40 PM
Attachments:	image001.png

Mr. Keeling,

Thank you for your comment. Comments for this project should be submitted to nepa@tva.gov. I passed your comment along.

Kind Regards,

Malinda Hunter
Public/Media Relations

TENNESSEE VALLEY AUTHORITY

M. 423-718-9245 **E.** mhunter@tva.gov
1101 Market St. Chattanooga, TN 37402

From: Jack Keeling <jack_k.glen_rose@yahoo.com>
Sent: Tuesday, February 02, 2021 4:10 PM
To: Hunter, Malinda <mhunter@tva.gov>
Subject: TVA Asks for Public Input on the Clinch River Nuclear Site

If the Administration favors Clinch River, I favor it. I do not think there should be any new nuclear power facilities. Renewable energy is becoming competitive.

Sent from Mail for Windows 10

From:	David Lawson
To:	nepa
Subject:	Clinch river nuclear site
Date:	Tuesday, February 2, 2021 6:44:32 PM

Build it.

Address: [redacted]
Date: 2.3.21

Name: Rick Clemenzi

Comments: I am shocked at the level of stupidity behind pursuing a new Nuclear plant on both Financial and Environmental grounds. This plant MUST BE DROPPED!

First to the Environment, we live in Western NC down wind from the Clinch River site and frankly it has already been proven globally that engineers have no idea how to design a fully safe Nuclear plant. Thus this would endanger our lives and MUST not happen. Every Nuclear failure to date has uncovered a new area of systemic engineering and management failure suggesting there could well be many more such failure paths that have not and could never be fully resolved for this proposed installation. As a professional engineer myself, I strongly proclaim the engineering failures in this field to date are despicable and that I have seen no reason to now suddenly trust Nuclear system engineers. For this reason alone and the Environmental Disaster any such to-be-expected-as possible failure would bring, I most strongly Oppose Any Consideration of a future Nuclear Plant in Tennessee.

But further to the well proven/demonstrated strong possibility of an Environmental Disaster that a Nuclear Plant brings to locations everywhere, the whole idea of building a New Nuclear Plant in today's market is Economic Stupidity! Per Lazard and Bloomberg, the leading Energy Power Generation Cost Analysis firms, New Nuclear costs many times what ANY of the Clean Energy options now cost. As you can clearly see in this graphic (https://intelli-products.com/market/) showing Levelized Cost of Energy (e.g., Life Cycle Cost presented as kWH/MWh), Nuclear is fully non-competitive with either Solar, Wind, or even Solar + Batteries. It would be Economic Stupidity to build a new Nuclear plant in today's market, and thus should NOT BE ALLOWED by a public entity like the TVA where costs are passed on to Consumers or Citizens. The Highly Negative Impact on Consumers MUST be taken into account, and this foolish Nuclear Plant proposal DROPPED!!

I am shocked anyone was even Stupid Enough to suggest this plant in today's rapidly evolving Wind/Solar/Battery Clean Energy market.

close window

Address: [redacted]
Date: 2.4.21

Name: Ken Hayse

Comments: So the organization that can't manage ash at a nearby fossil plant wants to be trusted with managing nuclear waste with a half-life of a couple of thousands years? Sounds like a disaster waiting to happen. I recommend that TVA put remediation costs equal to the cost of the Chernobyl on going cleanup (ongoning after 30 plus years) in escrow before construction.

close window

From: nepa
To: Cates, J. Taylor; Freeman, Carol
Subject: FW: Clinch River Nuclear
Date: Friday, February 5, 2021 10:50:10 AM

FYI

From: Daniel & Jennifer [redacted]
Sent: Friday, February 05, 2021 9:52 AM
To: nepa <nepa@tva.gov>
Subject: Clinch River Nuclear

This is an EXTERNAL EMAIL from outside TVA. THINK BEFORE you CLICK links or OPEN attachments. If suspicious, please click the "Report Phishing" button located on the Outlook Toolbar at the top of your screen.

To whom it my concern;

I personally feel like the proposed nuclear site on the Clinch River is a wonderful idea. It will create new jobs, and use clean nuclear energy to produce our needed energy. I live in Monroe County Tennessee so I am used to being near nuclear power, and have no concerns of a new facility being created nearby.

Respectfully,
Daniel Keller

From:	Clay & Nancy Landers and Wilma Fisher
To:	nepa
Subject:	Clinch River Nuclear Site
Date:	Friday, February 5, 2021 8:37:47 PM

My husband and I want to go on record as supporting the development of the Clinch River Nuclear Site. Nuclear energy will be needed to help offset the emissions causing global warming. we live in Kingston, TN. I worked at the Oak Ridge National Laboratory and he worked at Y-12. We have seen first hand the effects of warming in the trees and plants of the region. When I first came to Tennessee in 1962, redbuds were blooming in early May. Now they usually bloom in late March.

Nancy Landers

[redacted]

[redacted]

Date: 2.8.21

Name: Joseph Kintz

Comments: Dear TVA:

I'm a strong supporter of nuclear energy, including efforts to improve the safety, reliability, cost effectiveness, and environmental aspects of this technology. I assume these be the focus of the Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park.

Regardless of the care that I know everyone involved will take, there will be risks to the surrounding public and the environment. There will be pollution of some sort. Accidents will happen. Mistakes will be made. Such is the case with all human endeavor.

Rather than committing a currently unspoiled tract of land to this endeavor, why not find a place to put it somewhere in the Oak Ridge nuclear complex? With much of the old Manhattan Project facilities gone or being dismantled, surely there is room for your Nuclear Technology Park there. The Oak Ridge facility is already committed to nuclear research, and on a huge scale. They are already used to dealing with the risks, hazards, and pollution from nuclear work. They already have facilities and systems in place to deal with safety, security, environmental protection, and other issues that will be needed. Much of the needed infrastructure is already in place.

Doesn't this make more sense than converting a new piece of land, which has never been used for nuclear energy work and is surrounded by communities that have never dealt with living next door to a nuclear facility?

Thank you for being open to public comment. Please give mine serious consideration.

Kind regards,

Joe

close window

From:	Nancy Schmitt-Hoover
To:	nepa
Subject:	Nuclear Reactor
Date:	Monday, February 15, 2021 11:11:07 AM

Are concerns about the influence of earthquake tremors being addressed?

Sent from Mail <https://go.microsoft.com/fwlink/?LinkId=550986> for Windows 10

From: Emma Fitzgerald
To: nepa
Subject: Programmatic Environmental Impact Statement-Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park
Date: Tuesday, February 16, 2021 7:30:25 PM

As a student group at GVSU we understand that the economic benefits of building a nuclear plant are substantial, however we feel that the EIS needs to be more specialized to the local environment. It is discussed in the proposal to evaluate many different environmental aspects, but focusing on aquatic and surrounding species is of special concern. The EIS should also include the impact that the citizens of Oak Ridge may feel from consuming species impacted from the nuclear plant. There may also be a compounding effect with the addition of more nuclear plants. What is the anticipated plan if the EIS determines to have detrimental short and long term effects on the environment? The EIS should also include a worst case scenario for the environment and the surrounding populations

From:	Don Safer
To:	nepa
Subject:	extension request for comment period for Nuclear Park PEIS
Date:	Friday, February 19, 2021 4:10:03 PM

To: J. Taylor Cates, TVA NEPA Specialist

Mr. Cates,

Concerning the proposed Programmatic Environmental Impact Statement for an advanced nuclear reactor technology park at the Clinch River Site.

Please extend the comment period for 6 months (until September 19, 2021).

The COVID-19 pandemic is still requiring significant attention by members of the public, making review of documents and new nuclear plans difficult and extra burdensome. Plans to develop nuclear facilities on this site have been proposed for decades and ultimately not proceeded. Please do not rush another nuclear plan through under the cover of the covid crisis.

The broad scope of this proposal merits and demands extensive research on each of the possible proposed technologies: these include three different types of light water small modular reactors and five types of non-light water reactors including three that are graphite moderated: molten salt, fluoride salt, and high temperature helium gas, plus a molten chloride fast reactor and micro reactors.

Thank you for consideration of this urgent request.

Sincerely,

Don Safer
Board Member
Tennessee Environmental Council

Bellefonte Efficiency & Sustainability Team

B.E.S.T.

A local chapter of Blue Ridge Environmental Defense League ▪

February 20, 2021

J. Taylor Cates
1101 Market Street, 2C-C
Chattanooga, TN 37402

Dear Mr. Cates,

Noting TVA's call for comments regarding the preparation of a Programmatic Environmental Impact Statement related to a future Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park, I ask that the comment period be extended for an additional 6 months.

What with the COVID-19 pandemic restrictions still continuing plus the large list of 'new' and 'advanced' nuclear reactors to be considered, the public needs more time to gather information in order to supply valuable comments.

Thank you for consideration of this urgent request.

Yours truly,

Sandy Kurtz

Sandra Kurtz
BEST (Bellefonte Efficiency & Sustainability Team)

Chloe O’Neil, Grace Watson, Cole Jersey and Julia Walsh

NEPA Comment

The TVA’s Programmatic Environmental Impact Statement (PEIS) will address any foreseen environmental impacts of the project. The environmental impacts they have identified include, but are not limited to, air quality; aquatics; botany; climate change; cultural resources; emergency planning; floodplains; geology and groundwater; hydrothermal; land use; navigation; noise and vibration; radiological safety; soil erosion and surface water; socioeconomics and environmental justice; threatened and endangered species; transportation; visual; waste; water use; wetlands; and wildlife. In their PEIS, they will also provide “measures to avoid, minimize and mitigate” these adverse effects on the environment. We believe the TVA has accurately identified any impacts that arise from the construction, operation, and decommissioning of this project. The TVA covered all social and cultural influences like appearance, noise, emergency plans, safety, socioeconomics and environmental justice, and others. They have also determined the potential biophysical impacts of this project, which are crucial to consider.

The project is entirely self-supported by the TVA without federal funding, invests its profits in its electric system, aids the Tennessee River system with navigation, flood control, and land management, therefore positively affecting the economy. The TVA also helps with economic development and increasing employment rates with local and state governments and local power companies. These will positively influence the economy and do not demonstrate any potential negative impacts from this project.

From: Penny
To: Cates, J. Taylor
Subject: Question on Terra power
Date: Monday, March 1, 2021 8:42:24 PM

Hello Ms. Cates,

Has TVA consider Terra Power?
https://www.terrapower.com/our-work/traveling-wave-reactor-technology/

Thank you,

Penny Kemle

Name: keith kline

Comments: Recommend that the scope include special study and consideration of:
hydrology and potential flooding,
karst geology,
eagle nesting, eagle prey and prey habitat,
potential populations and habitat for bats and other species of special concern,
any vegetation that has been undisturbed for 40 years or more,
future recreational uses of the river, shoreline, and flood zones, and
active outreach to engage with local communities and stakeholders.

close window

Name: ray moore

Comments: Will the power generated from the proposed facility at Clinch River be considered Green Energy?

close window

Name: Ron Woody

Comments: Good to see all of you this evening. Is there a plan relationship with Kairos Power who is planning a test reactor at K31 and K33 site?

close window

[redacted]

Name: Peggy Zukas

Comments: Bill Gates has a nuclear reactor company - TerraPower. Is it feasible to build one of his reactors? I was under the impression it is safer.

close window

From:	Gwendolyn Blanton
To:	nepa
Subject:	Comments on Clinch River Nuclear RTP
Date:	Tuesday, March 2, 2021 11:55:32 AM

This is an EXTERNAL EMAIL from outside TVA. THINK BEFORE you CLICK links or OPEN attachments. If suspicious, please click the “Report Phishing” button located on the Outlook Toolbar at the top of your screen.

Dear TVA,

I am opposed to building any more nuclear reactors in Tennessee for the following reasons:

1. Nuclear power is not clean. It will never be “clean” until there is a way to recycle the spent fuel rods and to eliminate the long-lasting radioactivity of nuclear material that needs to be stored.

2. Nuclear power is not cheap. In fact, it’s so expensive that the US Government has to supplement the cost of building new reactors. If TVA is already BILLIONS of dollars in debt, then building another expensive Nuclear Reactor of any kind is the wrong direction.

3. Both Solar and Wind power are under-developed in the Tennessee Valley. We’ve known about Climate Change for 100 years. In the last 50 years, millions of people across the planet have worked to make change for the better, to almost no avail. It is now time for the big energy companies, like TVA, to take the lead in renewable energy and to phase out toxic solutions like nuclear.

4. With climate change, come increased risks of climate catastrophes, like tornadoes and flooding. The Clinch River site appears to be well within the 500 year flood plain and will almost certainly flood within the next 50-100 years, given the increased intensity of flooding due to Climate Change. Additionally, Tornado Alley has been slowly adjusting its path over the previous decade and care should be taken about putting any type of nuclear power in the path of a tornado.

5. We don’t want any more nuclear. I live within 100 miles of the proposed site and I do not feel safe. My family lives in Chattanooga and I believe they are not safe from a nuclear release as it is. We do not need nor want any more nuclear power in Tennessee.

Sincerely,

Gwendolyn E. Blanton
[redacted]

From:	Hunter, Malinda
To:	nepa
Subject:	FW: Public comment of nuclear reactor on Clinch River (and nuclear energy in general)
Date:	Wednesday, March 3, 2021 11:34:26 AM

Did this also come to the NEPA inbox?
Want to make sure it was included in your public comments.

From: Jeff Lloyd [redacted]
Sent: Tuesday, March 02, 2021 12:33 PM
To: Hunter, Malinda <mhunter@tva.gov>
Subject: Re: Public comment of nuclear reactor on Clinch River (and nuclear energy in general)

This is an EXTERNAL EMAIL from outside TVA. THINK BEFORE you CLICK links or OPEN attachments. If suspicious, please click the "Report Phishing" button located on the Outlook Toolbar at the top of your screen.

Having issues sending you my comments.
Cheers,
Jeff

On Mon, Mar 1, 2021, 11:03 AM Jeff Lloyd <[redacted]wrote:

> nepa@tva.gov
> Dear Sir/Madam
> I am writing to you to provide comments against adding any more nuclear power including the small nuclear reactors you have asked for public comment on. I am a scientist that both lives and works in East Tennessee.
> There are many reasons against the addition of such nuclear reactors and nuclear energy in general, and I have listed some of my concerns below:
> Nuclear power has proven far too dangerous on a global scale with disasters such as 3 mile Island, Chernobyl and Fukushima immediately spring to mind. I know these new smaller reactors are supposed to be much safer and of low risk, but with the potential total loss of Roane and Knox counties as livable areas, the hazard is simply far too high.
> With respect, TVA has proven many times it is not capable of managing such terribly dangerous facilities. We have had the ash spill disaster into the TN river that not only contaminated the environment but also resulted in the loss of lives I understand. We have also had numerous safety violations and non-compliant situations at TVA's other nuclear sites including at Watts Bar. I do recognize it is a difficult management task and I would certainly not want it myself nor think that I could do better.
> There has been no long term assessment for the costs of nuclear waste disposal and plant final decommissioning at the end of life. Nuclear waste lasts effectively forever and there is nowhere safe to put it.
> There has not been a study of the costs of insurance against the loss of life and the loss of property. I would personally want an insurance policy against any nuclear incident or radiation contamination, and I am sure that every citizen in East TN would like to receive such a policy with premiums paid for by TVA.
> There are far more cost effective alternatives to nuclear including natural gas, but now it is actually cheaper to put in wind and solar generation and natural gas will need to go also due to CO2 emissions. However, biogas –natural gas captured at landfills and commercially produced with agricultural products and byproducts and even human waste is fully sustainable and could be helpful to continue the use of natural gas infrastructure (and has a double benefit in reducing methane leakage – 24 time more impacting than CO2 emissions.

No organic material should ever be allowed in non captured landfill).
Solar capability is huge especially if you also look at residential and commercial building rollouts – and TVA could lead the way and provide such installations, and even retain ownership of them. With the help of the utility there is no reason why every home and every business cannot be net zero (as is my own).
There are also other modern alternatives that should be investigated including improving our hydroelectric capability (especially as physical energy storage capacity (pump upstream – effectively adopted in Germany)) and the use of passive geothermal (thermal syphoning underground wells tapping magma or volcanic heat – now being implemented in Canada).
On a smaller scale, there are 22 million used rail ties disposed of per year and this is dwarfed by C & D material. This valuable biomass could be used in gasification such as at the Rockwood facility in Lebanon TN (Aries energy or similar Proton Energy plants – two TN based companies)) or even torrefied for use in a converted fossil plant (use of Biomass is good to fill in the 'gaps' with other renewable power sources and it can be controlled on demand).
Finally in addition to large scale wind and solar, there is also a massive opportunity to simply reduce need by the improvement of home insulation and the installation of more energy efficient equipment such as heat pumps (for heating and water heating). Most homes in TN are not built to current codes with regard to energy conservation and insulation and upgrading these homes is a huge employment opportunity as well as an opportunity to reduce energy need permanently. Such endeavors could be considered in partnership with TVA and local utilities with the billing potentially including upgrades for conservation (charge more per KW hour but the same overall per household).
Of course there are certain increasing needs due to the massive adoption of electric vehicles already underway. We will have to look at large potential increases in electrical need to power this fleet, but nuclear energy already makes up too large a percentage of our current supply and as it has not been fully costed, and has such a high hazard, it should be used only as a last resort – after we have implemented all of the above as well as other solutions not yet considered.
Thank you kindly for the opportunity to provide comment.
Yours Faithfully
Jeff Lloyd PhD

March 3, 2021

J. Taylor Cates
NEPA Specialist
1101 Market Street, BR 2C-C
Chattanooga, TN 37402

SUBJECT: Comments on TVA Programmatic Environmental Impact Statement — Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park, *Federal Register*, Vol. 86, No. 23, February 5, 2021, pp. 8476-8478

Comments submitted via email to nepa@tva.gov and [redacted]

Good Day:

Pursuant to the subject *Federal Register* notice, I am commenting on the Tennessee Valley Authority's Programmatic Environmental Impact Statement (PEIS) covering "a range of alternatives for construction, operation, and decommissioning of an advanced nuclear reactor technology park" at the Clinch River site in Tennessee. TVA anticipates the PEIS will evaluate four alternatives:

1) No-Action
2) Advanced nuclear reactor technology park at Area 1 of the site
3) Advanced nuclear reactor technology park at Area 2 of the site
4) Advanced nuclear reactor technology park at Areas 1 and 2 of the site

For the PEIS to properly evaluate the No-Action alternative against the three alternatives for an advanced nuclear reactor technology park, it is essential to consider more than four decades of TVA's experience constructing and operating nuclear reactors. As detailed below, that history is replete with billions of dollars spent on unfinished nuclear reactors and billions more spent restoring under-performing finished nuclear power reactors to the minimum levels allowed for resumption of power generation.

In short, TVA's nuclear reactor history can be summed up in three words: **MONEY FOR NOTHING**.

The three advanced nuclear reactor technology options must realistically consider the very real, if not entirely unavoidable, likelihood that any nuclear reactor built by TVA might not ever operate and that any reactor operated by TVA might encounter costly repairs. Evaluations that only consider optimistic forecasts of construction projects completed on time and within initial budgets or completed reactors that operate at high capacity factors and low operating and maintenance costs would replicate mistakes TVA too many times over the past four-plus decades and result in American taxpayers and ratepayers spending even more **MONEY FOR NOTHING**.

Consider the Bellefonte debacle. TVA planned to construct and operate two reactors. Decades later with billions down the drain, TVA opted to forego finishing Bellefonte Units 1 and 2 and instead embarking on the construction of two brand new reactors at the site. That plans did not pan out either. Billions of dollars spent building and NOT operating four nuclear reactors without even a kilowatt of electricity generated.

TVA began construction of ten nuclear reactors that it gave up on after spending billions of dollars for zero electricity generated. TVA only completed and operated nine nuclear reactors.

Consider the Watts Bar debacle. TVA finished construction of Watts Bar Unit 2 more than 40 years after it began constructing it — more than 40 years to construct a reactor that has a 40-year operating license.

Consider the Browns Ferry and Sequoyah nuclear plants — nine operating reactors at two plants that have, so far, experienced nine year-plus outages. These year-plus outages — more than ten times the outage length of reactors NOT mis-operated by TVA — cost billions of dollars for electricity NOT being generated.

TVA's nuclear history is filled with overly optimistic expectations for construction project and under-performance of operating reactors. The advanced nuclear reactor technology park might, repeat might, be the exception to this decades-long trend. But it is equally if not more likely that the park will cost way more and supply way less electricity than hoped for by TVA.

At some point, citizens of the Valley must stop paying for TVA's ill-advised nuclear ambitions. A realistic PEIS properly considering the past as well as forecasting the future would help prevent more **MONEY FOR NOTHING**.

Sincerely,

David Lochbaum
[redacted]

Attachments

TVA's Operating Nuclear Plants

Browns Ferry

- Unit 2 restarted on September 10, 1976, after a 1.5-year outage
- Unit 1 restarted on September 24, 1976, after a 1.5-year outage
- Unit 3 restarted on November 28, 1984, after a 1.2-year outage
- GAO reported in May 1989 that NRC rated safety performance at Browns Ferry between 1980 and 1986 far lower than for 10 other boiling water reactor plants – no boiling water reactor was reported to have lower ratings
- Unit 2 restarted on May 24, 1991, after a 6.7-year outage that reportedly cost more than $1.3 billion ($2.5 billion today)
- Unit 3 restarted on November 19, 1995, after a 10.7-year outage that reportedly cost more than $1.4 billion ($2.4 billion today)
- Unit 1 restarted on June 2, 2007, after a 22.2-year outage that reportedly cost more than $1.8 billion ($2.27 billion today)

Sequoyah

- Unit 2 restarted on May 13, 1988, after a 2.7-year outage.
- Unit 1 restarted on November 10, 1988, after a 3.2-year outage.
- Unit 1 restarted on April 20, 1994, after a 1.1-year outage.

Watts Bar

- NRC issued TVA an operating license for Unit 1 on February 7, 1996, more than 21 years after TVA began its construction
- NRC issued TVA an operating license for Unit 2 on October 22, 2015, more than 41 years after TVA began its construction

TVA's nine operating reactors experienced nine year-plus outages (50.8 years total) caused by poor performance, far worse than achieved at other U.S. nuclear power reactors.

The two reactors at Watts Bar required more than six decades to construct. No nuclear reactor in the United States took longer to build.

That's not megawatts, it's negawatts — money for nothing.

TVA's Non-Operating Nuclear Plants

Bellefonte

- The actual cost for constructing Units 1 and 2 through September 30, 1982, were $2.064 billion ($5.59 billion today).

- GAO reported in August 1995 that TVA had spent nearly $20 billion constructing nuclear power reactors that were not operating.($34.3 billion today)

- In November 2016. TVA announced the sale of the 1,400 acre site to Nuclear Development LLC for $111 million ($121 million today).

Hartsville

- The actual cost for constructing Units A1 and A2 through September 30, 1982, were $1.502 billion ($4.07 billion today).

- The actual cost for constructing Units B1 and B2 through September 30, 1982, were $726 million ($1.97 billion today).

Phipps Bend

- The actual cost for constructing Units 1 and 2 through September 30, 1982, were $997 million ($2.7 billion today).

Yellow Creek

- The actual cost for constructing Units 1 and 2 through September 30, 1982, were $1.113 billion ($3.01 billion today).

TVA spent over $17.3 billion dollars constructing ten nuclear power reactors that never, ever generated a single watts of electricity.

That's not megawatts, it's negawatts — money for nothing.

TVA Safety Culture

- In only eight (8) of the thirty (30) years between 1990 and 2019, the NRC received more allegations from the average U.S. nuclear plant than from the average TVA nuclear plant. That eight year period (1998-2005) ended more than a decade ago.

- In only ten (10) of the thirty (30) years between 1990 and 2019, the NRC received more allegations from the average U.S. nuclear plant than from the average TVA nuclear plant. The most recent time (2011) was nearly a decade ago.

TVA's deficient nuclear safety culture is neither a recent affliction nor a long-healed affliction — it's a chronic malaise sustained across generations of workers, senior managers, and Board members.

BELLEFONTE NUCLEAR PLANT

Scottsboro, Alabama **Four Pressurized Water Reactors**

Date	Event	Reference
April 1970	TVA estimated that construction of the plant would cost $650 million.	U.S. General Accounting Office, "Bellefonte Nuclear Plant," March 1, 1976. (PSAD-76-86)
June 19, 1973	TVA applied to the AEC for construction permits to build Units 1 and 2.	Letter dated June 19, 1973, from Lynn Seeber, General Manager, Tennessee Valley Authority, to John F. O'Leary, Director, Directorate of Reactor Licensing, U.S. Atomic Energy Commission. (ML111030259)
August 1974	TVA revised the estimated cost of the plant to $1 billion.	U.S. General Accounting Office, "Bellefonte Nuclear Plant," March 1, 1976. (PSAD-76-86)
September 1974	TVA began construction of the plant.	U.S. General Accounting Office, "Bellefonte Nuclear Plant," March 1, 1976. (PSAD-76-86)
December 24, 1974	AEC issued TVA a construction permit for Units 1 and 2.	Letter dated March 23, 1993, from Oliver D. Kingsley, Jr., President Generating Group, Tennessee Valley Authority, to Thomas E. Murley, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML111080395)
August 1975	TVA revised the estimated cost of the plant to $1.2 billion.	U.S. General Accounting Office, "Bellefonte Nuclear Plant," March 1, 1976. (PSAD-76-86)
August 31, 1975	Construction of the plant was estimated to be 6 percent.	U.S. General Accounting Office, "Bellefonte Nuclear Plant," March 1, 1976. (PSAD-76-86)
February 1, 1978	TVA applied to the NRC for operating licenses for Units 1 and 2.	Letter dated March 23, 1993, from Oliver D. Kingsley, Jr., President Generating Group, Tennessee Valley Authority, to Thomas E. Murley, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML111080395)
October 23, 1984	TVA informed the NRC that the estimated fuel loading date for Unit 1 had been revised to October 1987 and to October 1989 for Unit 2.	Letter dated October 23, 1984, from L. M. Mills, Manager, Nuclear Licensing, Tennessee Valley Authority, to Chief, Management Information Branch, Office of Management

BELLEFONTE NUCLEAR PLANT

Scottsboro, Alabama **Four Pressurized Water Reactors**

Date	Event	Reference
		and Program Analysis, U.S. Nuclear Regulatory Commission. (ML082340283)
June 29, 1988	TVA deferred the construction of Units 1 and 2 due to lower than expected demand for electricity and cost-cutting efforts.	Letter dated July 29, 1988, from R. Gridley, Director, Nuclear Licensing and Regulatory Affairs, Tennessee Valley Authority, to U.S. Nuclear Regulatory Commission.
September 30, 1982	The construction cost for Units 1 and 2 increased from the original estimate of $650 million to $2.411 billion.	Comptroller General of the United States, "Triennial Assessment Of The Tennessee Valley Authority — Fiscal Years 1980-1982," GAO/RCED-83-123, April 15, 1983.
September 30, 1982	The actual construction cost for Units 1 and 2 to date were $2.064 billion.	Comptroller General of the United States, "Triennial Assessment Of The Tennessee Valley Authority — Fiscal Years 1980-1982," GAO/RCED-83-123, April 15, 1983.
March 23, 1993	TVA notified NRC of its plan to complete construction of Units 1 and 2.	Letter dated March 23, 1993, from Oliver D. Kingsley, Jr., President Generating Group, Tennessee Valley Authority, to Thomas E. Murley, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML111080395)
December 12, 1994	TVA halted work on Units 1 and 2.	Matthew L. Wald, *New York Times*, "T.V.A. to Stop All Work on 3 Reactors," December 13, 1994.
December 12, 2005	TVA informed NRC that is placed Units 1 and 2 in terminated status.	Letter dated December 12, 2005, from Glenn W. Morris, Manager, Corporate Nuclear Licensing and Industry Affairs, Tennessee Valley Authority, to James E. Dyer, Director, Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML060120054)
April 6, 2006	TVA requested that NRC terminate the construction permits for Units 1 and 2.	Letter dated September 14, 2006, from Catherine Haney, Director, Division of Operator Reactor Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, to Karl W. Singer, Chief Nuclear Officer and

BELLEFONTE NUCLEAR PLANT

Scottsboro, Alabama **Four Pressurized Water Reactors**

Date	Event	Reference
		Executive Vice President, Tennessee Valley Authority. (ML061810505)
September 14, 2006	NRC notified TVA that it approved the termination of the construction permits of Units 1 and 2.	Letter dated September 14, 2006, from Catherine Haney, Director, Division of Operator Reactor Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, to Karl W. Singer, Chief Nuclear Officer and Executive Vice President, Tennessee Valley Authority. (ML061810505)
October 30, 2007of the appl	TVA applied to the NRC for combined licenses to build and operate Units 3 and 4.	Letter dated January 18, 2008, from David B. Matthews, Director, Division of New Reactor Licensing, Office of New Reactors, U.S. Nuclear Regulatory Commission, to Ashok S. Bhatnagar, Senior Vice President, Nuclear Generation Development and Construction, Tennessee Valley Authority. (ML080140230)
August 26, 2008	TVA applied to the NRC for reinstatement of the construction permits for Units 1 and 2.	Letter dated August 10, 2009, from Ashok Bhatnagar, Senior Vice President, Nuclear Generation Development and Construction, Tennessee Valley Authority, to U.S. Nuclear Regulatory Commission. (ML092230594)
March 9, 2009	NRC granted TVA reinstatement of the construction permits for Units 1 and 2.	Letter dated August 10, 2009, from Ashok Bhatnagar, Senior Vice President, Nuclear Generation Development and Construction, Tennessee Valley Authority, to U.S. Nuclear Regulatory Commission. (ML092230594)
August 10, 2009	TVA notified NRC that placed Units 1 and 2 in deferred status.	Letter dated August 10, 2009, from Ashok Bhatnagar, Senior Vice President, Nuclear Generation Development and Construction, Tennessee Valley Authority, to U.S. Nuclear Regulatory Commission. (ML092230594)
March 28, 2016	TVA requested the withdrawal of the combined licenses for Units 3 and 4.	Letter dated March 28, 2018, from J.W. Shea, Vice President, Nuclear Licensing, Tennessee Valley Authority,

Date	Event	Reference
		to U.S. Nuclear Regulatory Commission, "Request to Withdraw the Bellefonte Nuclear Plant Units 3&4 Combined License Application." (ML16099A258)
November 14, 2016	TVA announced the sale of the 1,400 acre site to Nuclear Development LLC for $111 million.	Tennessee Valley Authority, Press Release dated November 14, 2016, "TVA Completes Bellefonte Sale." (ML18036A954)

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
1966	TVA announced plans to build 17 nuclear reactors.	U.S. General Accounting Office, "Tennessee Valley Authority: Financial Problems Raise Questions About Long-term Viability," GAO/AIMD/RCED-95-134, August 1995.
May 10, 1967	Atomic Energy Commission issued Construction Permits for Units 1 and 2	Letter dated May 10, 1967, from Peter A. Morris, Director, Division of Reactor Licensing, Atomic Energy Commission, to G. O. Wessenauer, Manager of Power, Tennessee Valley Authority
July 31, 1968	Atomic Energy Commission issued Construction Permit for Unit 3	Letter dated July 31, 1968, from Peter A. Morris, Director, Division of Reactor Licensing, Atomic Energy Commission, to G. O. Wessenauer, Manager of Power, Tennessee Valley Authority (ML020100063)
August 1, 1974	TVA placed Unit 1 into commercial operation.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
January 29, 1975	NRC ordered Unit 1 and 2 shut down for inspections of piping for signs of cracking	Article dated January 30, 1975, "Browns Ferry 2 Of 23 To Close," by William Stockton, Associated Press, *The Tennessean*
March 1, 1975	TVA placed Unit 2 into commercial operation.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
March 22, 1975	A worker using a candle to check for air leaks through walls in the cable spreading room started a fire that blazed for nearly seven hours, damaged over 1,600 electrical cables, and disabled all of the emergency core cooling systems for Unit 1 and	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
	many of these systems for Unit 2. The control room operators manually shut down the two reactors after the fire began.	
May 9, 1975	NRCs amended the operating licenses for Units 2 and 3 requiring the reactors to remain shut down until fire damage was been corrected.	Letter dated May 9, 1975, from Robert A. Purple, Chief, Operating Reactors Branch #1, Division of Reactor Licensing, Nuclear Regulatory Commission, to James E. Watson, Manager of Power, Tennessee Valley Authority (ML013610106)
September 10, 1976	TVA restarted Unit 2 from a 1.5 year outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
September 24, 1976	TVA restarted Unit 1 from a 1.5 year outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
March 1, 1977	TVA placed Unit 3 into commercial operation.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
March 4, 1983	NRC issued Bulletin 83-02 requiring owners of boiling water reactors to inspect piping for signs of cracking was had been found on other reactors.	Nuclear Regulatory Commission Bulletin 83-02, "Stress Corrosion Cracking in Large-Diameter Stainless Steel Recirculation System Piping at BWR Plants," dated March 4, 1983 (ML931219776)
July 21, 1983	NRC required TVA to submit, in writing, its justification for continuing to operate the reactors until the requested piping inspections are completed.	Letter dated July 21, 1983, from Darrel G. Eisenhut, Director, Division of Licensing, Office of Nuclear Reactor Regulation, Nuclear Regulatory Commission, to Hugh G. Parris, Manager of Power, Tennessee Valley Authority. (ML20024D872)

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
August 9, 1983	TVA presented NRC its reasons for not inspecting the Unit 3 piping when requested.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
August 26, 1983	NRC ordered Unit 3 to be shut down no later than September 6, 1983. Owners of other reactors voluntarily complied with the March 1983 safety bulletin.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
September 7, 1983	TVA shut down Unit 3 to comply with a NRC order to inspect piping connected to the reactor vessel. The inspections revealed cracking that required repairs or replacements.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
June 1984	NRC reported that TVA provided "*lack of management attention to the identification of the root cause of problems*" and had a "*lack of an effective quality assurance program*."	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
June 27, 1984	TVA's Nuclear Safety Review Staff reported that the High Pressure Coolant Injection system, a primary reactor core cooling system, has been so unreliable since 1973 that operators are afraid to even test it for fear of breaking it.	Article dated September 25, 1984, "Browns Ferry safety system said unreliable," by Phillip Gentry, *Decatur Daily*
August 14, 1984	An improperly rebuilt valve, a poorly written procedure, and an operator error resulted in piping of an emergency core cooling system being over-pressurized and damaged.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
August 21, 1984	TVA shut down Unit 1 for repairs of damaged piping.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
September 15, 1984	TVA shut down Unit 2 to enter a planned refueling outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
October 22, 1984	TVA attempted to restart Unit 3, but numerous serious departures from approved procedures caused the reactor to be shut back down.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
October 25, 1984	NRC required Unit 3 to remain shut down until reasons for operators failing to follow procedures during an attempted startup on October 22, 1984, were identified and confirmed to have bene corrected.	Letter dated October 25, 1984, from James P. O'Reilly, Regional Administrator, Nuclear Regulatory Commission, to H. G. Parris, Manager of Power and Engineering, Tennessee Valley Authority (ML18029A264)
November 16, 1984	NRC concurred with TVA's request to restart Unit 3.	Letter dated November 16, 1984, from James P. O'Reilly, Regional Administrator, Nuclear Regulatory Commission, to H. G. Parris, Manager of Power and Engineering, Tennessee Valley Authority (ML20100C464)
November 28, 1984	TVA restarted Unit 3 after a 1.2 year outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
February 13, 1985	TVA attempted to restart Unit 3 from a short outage when the three instruments measuring the water level above the reactor core showed significantly different indications. Rather than halting to discern the reason for the different readings and correct it, the operators focused on increasing the reactor power level. Similar water level instrument problems had been experienced on November 20, 1984, but ignored then, too.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
February 27, 1985	NRC proposed a $150,000 civil penalty for numerous safety violations during the attempted startup of Unit 3 on October 22, 1984.	Nuclear Regulatory Commission Enforcement Action 84-136 dated February 27, 1985. (ML20100M630)
March 9, 1985	TVA shut down Unit 3 to investigate and correct reactor vessel water level measurement problems.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
March 19, 1985	TVA shut down Unit 1 after several containment isolation valves failed leak rate testing. The motor-operated valves failed because workers reassembled them with the gears installed backwards. TVA announced operation of all three reactors would be suspended until broad programmatic problems affecting the site were corrected.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
July 22, 1985	The NRC proposed a $150,000 civil penalty for safety violations during the February 13, 1985, startup of Unit 3.	Nuclear Regulatory Commission Enforcment Action 85-51 dated July 22, 1985. (ML18029A788)
May 1987	TVA's Inspector General reported on its review of 100 employees "*in key positions that could significantly affect nuclear plant safety or efficiency*" and concluded 28 of the 100 did not satisfy the requirements needed for the positions and "*four provided false information regarding their qualifications*."	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
May 4, 1989	U.S. General Accounting Office reported that the NRC conducted five Systematic Assessments of Licensee Performance (SALPs) at Browns Ferry between 1980 and 1986. The ratings (1 being	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
	highest and 3 being lowest performance) for Browns Ferry and other boiling water reactors during this period:	

Plant	SALP 1	SALP 2	SALP 3	SALP Avg.
Vermont Yankee	67.4%	32.6%	0.0%	1.3
Monticello	50.9%	45.6%	3.5%	1.5
Cooper	42.4%	52.5%	5.1%	1.6
Quad Cities	36.2%	55.3%	8.5%	1.7
FitzPatrick	21.8%	65.5%	12.7%	1.9
Dresden	23.3%	58.3%	18.3%	2.0
Hatch	12.7%	78.2%	9.1%	2.0
Peach Bottom	17.2%	62.5%	20.3%	2.0
Pilgrim	23.1%	50.0%	26.9%	2.0
Brunswick	14.9%	57.4%	27.7%	2.1
Browns Ferry	2.2%	45.7%	52.2%	2.5

Date	Event	Reference
January 1991	TVA began efforts to restart Unit 3.	U.S. General Accounting Office, “Tennessee Valley Authority: Financial Problems Raise Questions About Long-term Viability,” GAO/AIMD/RCED-95-134, August 1995.

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
May 2, 1991	NRC approved the restart of Unit 2. The repairs to Browns Ferry reportedly cost more than $1.3 billion.	Article dated May 2, 1991, "Industry Gets a Lift As Agency Approves Restarting a Reactor," by Keith Schneider, *New York Times*
May 24, 1991	TVA restarted Unit 2 to end a 6.7 year outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
August 1995	TVA spent about $25 billion constructing nuclear power reactors, only about $5 billion on reactor now operating.	U.S. General Accounting Office, "Tennessee Valley Authority: Financial Problems Raise Questions About Long-term Viability," GAO/AIMD/RCED-95-134, August 1995.
August 1995	GAO reported steady increases in TVA's estimated cost of returning Unit 3 to operation as well as extended times to complete the recovery work. Management at Browns Ferry told GAO's investigators that cost estimates prior to August 1993 were overly optimistic.	U.S. General Accounting Office, "Tennessee Valley Authority: Financial Problems Raise Questions About Long-term Viability," GAO/AIMD/RCED-95-134, August 1995.

BROWNS FERRY NUCLEAR PLANT

Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference

Dollars in millions

	1990	1991	1992	1993	1994
Balance sheet investment at year-end	$296	$406	$775	$1,171	$1,475[a]
TVA estimated cost to complete	510	610	318	780	524
TVA total estimated cost	$806	$1,016	$1,093	$1,951	$1,999
Scheduled commercial operation date	Jan. 1993	Sept. 1993	March 1994	Dec. 1995	Feb. 1996

[a]Approximately $296 million of Browns Ferry 3's costs are included in completed plant and are being depreciated and included in current rates. As a result, at the end of fiscal year 1994, TVA's estimated cost to restart Browns Ferry 3 was about $1.7 billion.

November 19, 1995	TVA restarted Unit 3 after more than $1.4 billion in repairs and a 10.7 year outage.	Article dated December 7, 1995, "NRC Clears Browns Ferry-3 For Full Power Operation," by Wilson Dizard III, *Nucleonics Week*
May 2002	TVA Board voted to restart Unit 1 for an estimated cost of $1.7 to 1.8 billion.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
May 15, 2007	NRC authorized restart of Unit 1.	Nuclear Regulatory Commission News Release II-07-032 dated May 15, 2007. (ML071350475)

BROWNS FERRY NUCLEAR PLANT

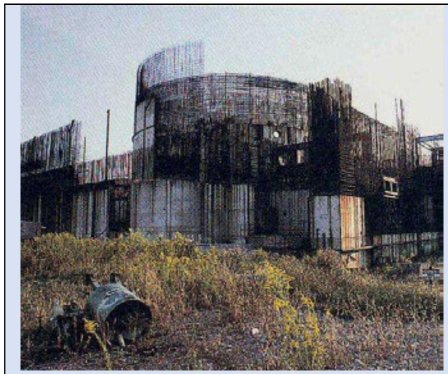
Athens, Alabama **Three Boiling Water Reactors**

Date	Event	Reference
June 2, 2007	Unit 1 connected to the electrical grid to end a 22.2 year outage.	Nuclear Regulatory Commission Inspection Report 05000259/2007003, 050000260/2007003 and 05000296/2007003 dated July 30, 2007. (ML072120205)
July 9, 2007	Bloomberg News reported that TVA spent over $1.8 billion preparing Unit 1 for restart and spent another $10.9 billion on eleven uncompleted reactors.	Article dated July 9, 2007, "New Reactor Costs Daunt U.S. Utilities," by Elliot Blair Smith, *Bloomberg News*

HARTSVILLE NUCLEAR PLANT

Hartsville, Tennessee **Four Boiling Water Reactors**

Date	Event	Reference
January 1972	TVA estimated construction of the plant would cost $1.425 billion.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.
July 1, 1974	TVA applied to the AEC for construction permits to build two plants each having two reactors.	Elmer B. Staats, Comptroller General of the United States, Report to Representative Tom Bevill, Chairman, Public Works Subcommittee, House Committee on Appropriations, February 16, 1978. (EMD-78-37)
April 1976	NRC issued TVA limited work authorizations to begin construction of the plant.	Elmer B. Staats, Comptroller General of the United States, Report to Representative Tom Bevill, Chairman, Public Works Subcommittee, House Committee on Appropriations, February 16, 1978. (EMD-78-37)
April 1976	TVA began construction of the plant.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.
May 9, 1977	NRC issued TVA construction permits for the four reactors. Issuance of the permits was delayed by a federal court decision that caused the NRC to temporarily stop issuing permits.	Elmer B. Staats, Comptroller General of the United States, Report to Representative Tom Bevill, Chairman, Public Works Subcommittee, House Committee on Appropriations, February 16, 1978. (EMD-78-37)
September 1978	TVA estimated construction of the plant would cost $3.5 billion.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.



HARTSVILLE NUCLEAR PLANT

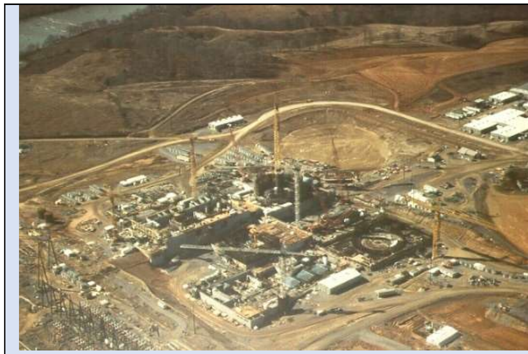
Hartsville, Tennessee **Four Boiling Water Reactors**

Date	Event	Reference
July 24, 1981	TVA announced it extended the projected completion date for Unit A1 to April 1991 and for Unit A2 to 1992.	U.S. Nuclear Regulatory Commission, "Construction Delays," PNO-II-81-55, July 24, 1981. (ML20063C806)
August 14, 1981	TVA informed NRC that the projected fuel loading date for Unit A1 had been revised to January 1990 and for Unit A2 to January 1991.	Letter dated August 14, 1981, from L. M. Mills, Manager, Nuclear Regulation and Safety, Tennessee Valley Authority, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML20063C806)
March 4, 1982	TVA Board voted 2-1 to indefinitely defer construction of Units A1 and A2.	U.S. Nuclear Regulatory Commission, "Deferral of TVA Units," PNO-II-82-25, March 4, 1982. (ML20041F906)
March 19, 1982	NRC listed the status of Unit B1 as indefinitely deferred after being 17 percent completed.	Memo dated March 19, 1982, from Kevin Cornell, Office of the Deputy Executive Director For Operations, U.S. Nuclear Regulatory Commission, to Commission Ahearne, U.S. Nuclear Regulatory Commission. (ML20063C823)
March 19, 1982	NRC listed the status of Unit B2 as indefinitely deferred after being 7 percent completed.	Memo dated March 19, 1982, from Kevin Cornell, Office of the Deputy Executive Director For Operations, U.S. Nuclear Regulatory Commission, to Commission Ahearne, U.S. Nuclear Regulatory Commission. (ML20063C823)
April 1, 1982	NRC listed the status of Unit A1 as deferred after being 33 percent completed.	Memo dated April 1, 1982, from A. Schwencer, Chief, Licensing Branch 2, Division of Licensing, U.S. Nuclear Regulatory Commission, to Robert L. Tedesco, Assistant Director for Licensing, Division of Licensing, U.S. Nuclear Regulatory Commission, "Use of Staff Resources of Hartsville A1, A2, B1, B2, Phipps Bend 1 & 2 and Yellow Creek – Plants Deferred by TVA." (ML20063C806)
April 1, 1982	NRC listed the status of Unit A2 as deferred after being 26 percent completed.	Memo dated April 1, 1982, from A. Schwencer, Chief, Licensing Branch 2, Division of Licensing, U.S. Nuclear

HARTSVILLE NUCLEAR PLANT

Hartsville, Tennessee **Four Boiling Water Reactors**

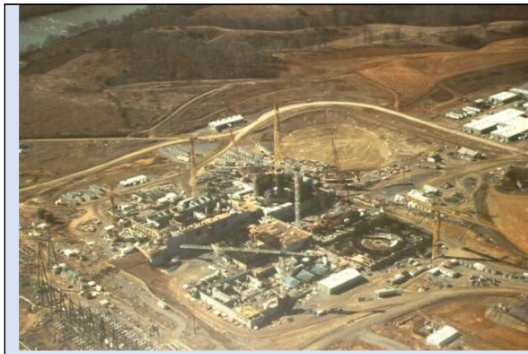
Date	Event	Reference
		Regulatory Commission, to Robert L. Tedesco, Assistant Director for Licensing, Division of Licensing, U.S. Nuclear Regulatory Commission, "Use of Staff Resources of Hartsville A1, A2, B1, B2, Phipps Bend 1 & 2 and Yellow Creek – Plants Deferred by TVA." (ML20063C806)
September 30, 1982	The actual construction cost for Units A1 and A2 to date were $1.502 billion.	Comptroller General of the United States, "Triennial Assessment Of The Tennessee Valley Authority — Fiscal Years 1980-1982," GAO/RCED-83-123, April 15, 1983.
September 30, 1982	The actual construction cost for Units B1 and B2 to date were $726 million.	Comptroller General of the United States, "Triennial Assessment Of The Tennessee Valley Authority — Fiscal Years 1980-1982," GAO/RCED-83-123, April 15, 1983.
January 21, 1983	TVA requested that NRC extend the construction permits for Units A1 and A2.	Letter dated May 5, 1983, from L. M. Mills, Manager, Nuclear Licensing, Tennessee Valley Authority, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML20073S859)
August 29, 1984	TVA cancelled Units A1 and A2. TVA estimated that Unit A1 was 82 percent complete and Unit A2 was 67 percent complete.	Letter dated October 24, 1985, from J. W. Huffman, Manager, Licensing and Risk Protection, Tennessee Valley Authority, to Hugh L. Thompson, Jr., Director of Licensing, Division of Licensing, U.S. Nuclear Regulatory Commission. (ML20133N732)



PHIPPS BEND NUCLEAR PLANT

Surgoinsville, Tennessee **Two Boiling Water Reactors**

Date	Event	Reference
January 1975	TVA estimated construction of the plant would cost $1.6 billion.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.
October 1, 1975	TVA applied to the NRC for construction permits for Units 1 and 2. TVA projected Unit 1 would be placed into commercial operation in April 1984 and Unit 2 placed in commercial operation in April 1985.	U.S. Nuclear Regulatory Commission, "Draft Environmental Statement related to construction of Phipps Bend Nuclear Plant, Units 1 and 2," August 1976. (ML20032B695)
December 23, 1975	TVA submitted NRC an environmental report, needed by the NRC before it could issue a limited work authorization. The NRC rejected the environmental report as being incomplete.	Elmer B. Staats, Comptroller General of the United States, Report to Representative Tom Bevill, Chairman, Public Works Subcommittee, House Committee on Appropriations, February 16, 1978. (EMD-78-37)
April 1, 1976	The NRC accepted TVA's revised environmental report.	Elmer B. Staats, Comptroller General of the United States, Report to Representative Tom Bevill, Chairman, Public Works Subcommittee, House Committee on Appropriations, February 16, 1978. (EMD-78-37)
October 18, 1977	NRC issued TVA limited work authorizations for the two reactors. The issuance was delayed because TVA challenged the NRC's jurisdiction over TVA under the National Environmental Policy Act of 1969.	Elmer B. Staats, Comptroller General of the United States, Report to Representative Tom Bevill, Chairman, Public Works Subcommittee, House Committee on Appropriations, February 16, 1978. (EMD-78-37)
January 16, 1979	NRC issued TVA construction permits for Units 1 and 2.	Memo dated April 1, 1982, from A. Schwencer, Chief, Licensing Branch 2, Division of Licensing, U.S. Nuclear Regulatory Commission, to Robert L. Tedesco, Assistant Director for Licensing, Division of Licensing, U.S. Nuclear Regulatory Commission, "Use of Staff Resources of Hartsville A1, A2, B1, B2, Phipps Bend 1 & 2 and Yellow Creek – Plants Deferred by TVA." (ML20063C806)



PHIPPS BEND NUCLEAR PLANT

Surgoinsville, Tennessee **Two Boiling Water Reactors**

Date	Event	Reference
September 1978	TVA estimated construction of the plant would cost $1.8 billion.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.
July 24, 1981	TVA announced it had indefinitely deferred construction on both reactors.	U.S. Nuclear Regulatory Commission, "Construction Delays," PNO-II-81-55, July 24, 1981. (ML20063C806)
August 14, 1981	TVA informed NRC that the projected fuel loading date for Unit 1 had been revised to January 1992.	Letter dated August 14, 1981, from L. M. Mills, Manager, Nuclear Regulation and Safety, Tennessee Valley Authority, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML20063C806)
March 19, 1982	NRC listed the status of Unit 1 as having a deferred completion date of January 1993 and being 29 percent complete.	Memo dated March 19, 1982, from Kevin Cornell, Office of the Deputy Executive Director For Operations, U.S. Nuclear Regulatory Commission, to Commission Ahearne, U.S. Nuclear Regulatory Commission. (ML20063C823)
March 19, 1982	NRC listed the status of Unit 2 as indefinitely deferred after being 5 percent completed.	Memo dated March 19, 1982, from Kevin Cornell, Office of the Deputy Executive Director For Operations, U.S. Nuclear Regulatory Commission, to Commission Ahearne, U.S. Nuclear Regulatory Commission. (ML20063C823)
September 30, 1982	The actual construction cost for Units 1 and 2 to date were $997 million.	Comptroller General of the United States, "Triennial Assessment Of The Tennessee Valley Authority — Fiscal Years 1980-1982," GAO/RCED-83-123, April 15, 1983.

SEQUOYAH NUCLEAR PLANT

Soddy-Daisy, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
May 27, 1970	AEC issued TVA provisional construction permits to build Units 1 and 2.	Letter dated May 27, 1970, from Peter A. Morris, Director, Division of Reactor Licensing, Atomic Energy Commission, to James E. Watson, Manager of Power, Tennessee Valley Authority. (ML013330478)
November 26, 1973	TVA informed the NRC that the estimated fuel loading date for Unit 1 had been revised to December 1976 and to August 1976 for Unit 2.	Letter dated November 26, 1973, from J. E. Gilleland, Assistant to the Manager of Power, Tennessee Valley Authority, to John F. O'Leary, Director, Directorate of Licensing, Office of Regulation, U.S. Nuclear Regulatory Commission. (ML073400390)
March 1975	TVA initially estimated that Unit 1 would be placed into commercial operation in October 1973 and Unit 2 would enter commercial operation in April 1974. TVA officials told GAO that the schedule was optimistic and based on projections of when the plants' electricity would be needed rather than "*a realistic assessment of the time needed for design and construction*."	U.S. General Accounting Office, "Staff Study – Sequoyah Nuclear Plant," March 1975.
March 1975	GAO reported that the cost estimate for the plant in 1968 was $346 million but increased to $675 million by September 1974 and attributed the increase to cost estimating inadequacies, design and engineering changes during construction, inflation, and high interest rates on borrowed money. Sequoyah's design was less than two percent complete when the initial cost estimate was made. Construction labor hours nearly doubled to 15.4 million hours from the	U.S. General Accounting Office, "Staff Study – Sequoyah Nuclear Plant," March 1975.

SEQUOYAH NUCLEAR PLANT

Soddy-Daisy, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
	initial estimate of 8.2 million hours. Engineering design costs tripled to $45 million from the original estimate of $15 million.	
March 1975	Westinghouse Electric Corporation was still testing and analyzing the ice condenser containment design when construction started. Problems with the system required major design changes impacting the schedule and increasing the construction costs. Westinghouse plans to complete its redesigned ice condenser system in February 1975.	U.S. General Accounting Office, "Staff Study – Sequoyah Nuclear Plant," March 1975.
February 29, 1980	NRC issued an operating license for Unit 1.	Letter dated February 29, 1980, from D. F. Ross, Jr., Acting Director, Division of Project Management, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, to H. G. Parris, Manager of Power, Tennessee Valley Authority. (ML013240049)
July 1, 1981	TVA placed Unit 1 into commercial operation.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
September 15, 1981	NRC issued an operating license for Unit 2.	Letter dated September 15, 1981, from Darrell G. Eisenhut, Director, Division of Licensing, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, to H. G. Parris, Manager of Power, Tennessee Valley Authority. (ML013330142)
June 1, 1982	TVA placed Unit 2 into commercial operation.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

SEQUOYAH NUCLEAR PLANT

Soddy-Daisy, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
July 1985	TVA informed NRC in writing that all safety-related equipment at the plant had been properly qualified to ensure performance in the post-accident environmental conditions (e.g., temperature, pressure radiation levels, humidity).	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
August 22, 1985	TVA shut down Units 1 and 2 after an independent review of the environmental qualification of safety-related equipment concluded there was insufficient documentation to conclude the equipment would function properly in event of an accident. The independent consultant only found three of the first twenty-seven components reviewed to be adequately qualified.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
January 28, 1987	With Unit 1 shut down with the reactor vessel head removed, a plugged level instrument allowed the water level to steadily drop unnoticed. The indicated water level jumped 11 inches when the plug was dislodged. When operators attempted to figure out the actual water level, they let the water level drop so low that the reactor water cooling pump lost suction. When operators attempted to restore shutdown cooling flow, the water level rose so high that water spilled out from open steam generator manways onto the containment floor.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
February 1, 1987	With Unit 1 shut down with the reactor vessel head removed, the operators recognized that a test they were assigned to perform was not written for the plant conditions they were in. Rather than revise the	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

SEQUOYAH NUCLEAR PLANT

Soddy-Daisy, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
	inapplicable procedure, the operators decided to run it anyway. Two to three gallons of radioactively contaminated water from the Reactor Water Storage Tank overfilled the reactor vessel and spilled thtough open steam generator manways into containment, contaminating several workers.	
June 1987	NRC informed TVA that it needed assurance that problems at the plant had been effectively resolved. When TVA balked at conducting a self-assessment to provide NRC this assurance, the NRC dispatched an Independent Design Inspection team to examine a single safety system — the Essential Raw Cooling Water system.	Union of Concerned Scientists, “Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages,” November 6, 2006.
September 11, 1987	NRC’s Independent Design Inspection report chronicled 64 problems with the sole safety system it examined — the Essential Raw Cooling Water system.	Union of Concerned Scientists, “Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages,” November 6, 2006.
November 13, 1987	The Institute of Nuclear Power Operations provided TVA with results from its special assistance visit. INPO identified three areas that needed correction before restart: (1) procedures and training for operators on reactor startups, (2) maintenance practices for nuclear instrumentation, and (3) updating emergency operating procedures to incorporate recommendations from the Westinghouse Owners Group.	Union of Concerned Scientists, “Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages,” November 6, 2006.

SEQUOYAH NUCLEAR PLANT

Soddy-Daisy, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
January 5, 1988	A special Operational Readiness Review chartered by TVA reported five problem areas to the Manger of Power: (1) numerous procedural and quality control problems, (2) inadequate chemistry control processes, (3) insufficient valve and electrical alignment procedures, (4) inadequate knowledge of reactivity control methods, and (5) inadequate radiological control standards.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
March 30, 1988	The NRC authorized restart of Unit 2.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
May 13, 1988	TVA connected Unit 2 to the electrical grid to end a 2.7 year outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
November 10, 1988	Unit 1 was connected to the electrical grid to end a 3.2 year outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
March 1, 1993	Unit 2 was shut down after a feedwater heater extraction steam line ruptured. The steam pipe was ten inches in diameter.	NUS Licensing Information Service Meetings Report dated December 16, 1994.
March 2, 1993	TVA shut down Unit 1 for piping inspections following a pipe rupture on Unit 2.	NUS Licensing Information Service Meetings Report dated December 16, 1994.
March 4, 1993	NRC issued a Confirmatory Action Letter listing seven steps that must be completed by TVA to the NRC's satisfaction before either reactor can be restarted.	Letter dated March 4, 1993, from Stewart D. Ebneter, Regional Administrator, U.S. Nuclear Regulatory Commission, to Mark G. Medford, Vice President, Nuclear Assurance, Licensing & Fuels, Tennessee Valley Authority. (ML20044B992)

SEQUOYAH NUCLEAR PLANT

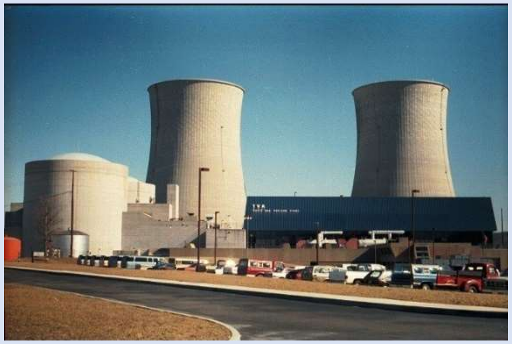
Soddy-Daisy, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
March 24, 1993	NRC notified other plant owners of the mistakes made at Sequoyah: *The augmented inspections using ultrasonic techniques showed indications that might earlier have revealed the cracks, but the licensee misinterpreted these as resulting from the geometric configuration of the pipe. After finding the leak, the licensee performed radiography on all feedwater nozzles of both units and found cracks in five of the eight nozzles*	U.S. Nuclear Regulatory Commission Information Notice No. 93-20, "Thermal Fatigue Cracking of Feedwater Piping to Steam Generators," dated March 24, 1993. (ML031080045)
June 15, 1993	NRC notified other plant owners of the operator performance shortcomings in responding to the December 31, 1992, shut downs of both reactors, such as being unable to prevent an excessive cool-down rate on Unit 2.	U.S. Nuclear Regulatory Commission Information Notice No. 93-44, "Operational Challenges During a Dual-Unit Transient," dated June 15, 1993. (ML031070483)
August 13, 1993	NRC notified other plant owners of the electrical breaker testing deficiencies that caused the dual-unit trips on December 31, 1992.	U.S. Nuclear Regulatory Commission Information Notice No. 93-65, "Reactor Trips Caused by Breaker Testing with Fault Protection Bypassed," dated August 13, 1993. (ML031070172)
October 18, 1993	NRC approved restart of Unit 2.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
October 21, 1993	TVA connected Unit 2 to the electrical grid.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

SEQUOYAH NUCLEAR PLANT

Soddy-Daisy, Tennessee **Two Pressurized Water Reactors**

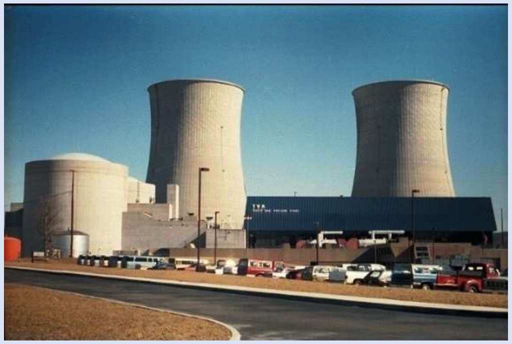
Date	Event	Reference
April 12, 1994	NRC approved restart of Unit 1.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
April 20, 1994	TVA connected Unit 1 to the electrical grid to end a 1.1 year outage.	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.
September 30, 1994	Approximately 6,000 feet of piping less than two inches in diameter and about 1,000 feet of piping larger than two inches in diameter had been replaced since March 1993.	NUS Licensing Information Service Meetings Report dated December 16, 1994.



WATTS BAR NUCLEAR PLANT

Spring City, Tennessee **Two Pressurized Water Reactors**

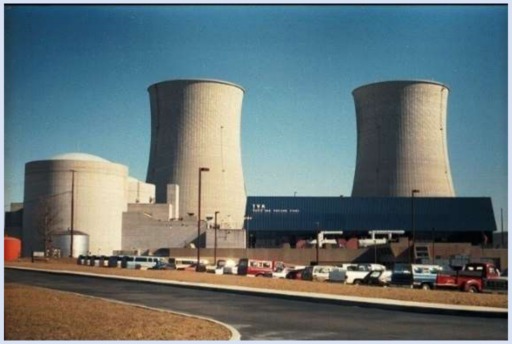
Date	Event	Reference
August 25, 1970	TVA announced that it selected Rhea County as the site for the Watts Bar nuclear plant.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
May 14, 1971	TVA applied to the AEC for construction permits to build Units 1 and 2.	Letter dated May 14, 1971, from Aubrey J. Wagner, Chairman of the Board, Tennessee Valley Authority, to P. A. Morris, Director, Division of Reactor Licensing, U.S. Atomic Energy Commission. (ML073400588)
December 1972	TVA began construction at the site. TVA revised the cost estimate of the two-unit plant to $685 million.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
November 26, 1973	TVA informed the AEC that the estimated fuel loading date for Unit 1 had been revised to January 1978 and to October 1978 for Unit 2.	Letter dated November 26, 1973, from J. E. Gilleland, Assistant to the Manager of Power, Tennessee Valley Authority, to John F. O'Leary, Director, Directorate of Licensing, Office of Regulation, U.S. Atomic Energy Commission. (ML073400390)
May 14, 1974	TVA informed the AEC that the estimated fuel loading date for Unit 1 had been revised to June 1978 and to March 1979 for Unit 2.	Letter dated May 14, 1974, from J. E. Gilleland, Assistant to the Manager of Power, Tennessee Valley Authority, to John F. O'Leary, Director, Directorate of Licensing, Office of Regulation, U.S. Atomic Energy Commission. (3002000219)
January 9, 1978	TVA informed the NRC that the estimated fuel loading date for Unit 1 had been revised to June 1979 and to March 1980 for Unit 2. The delay was attributed to late delivery of ice condenser embedments.	Letter dated January 9, 1978, from J. E. Gilleland, Assistant to the Manager of Power, Tennessee Valley Authority, to S. A. Varga, Chief, Light Water Reactors Branch No. 4, Division of Project Management, U.S. Nuclear Regulatory Commission. (ML072960408)
November 1980	NRC expressed concern over quality assurance programs at the plant.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.



WATTS BAR NUCLEAR PLANT

Spring City, Tennessee **Two Pressurized Water Reactors**

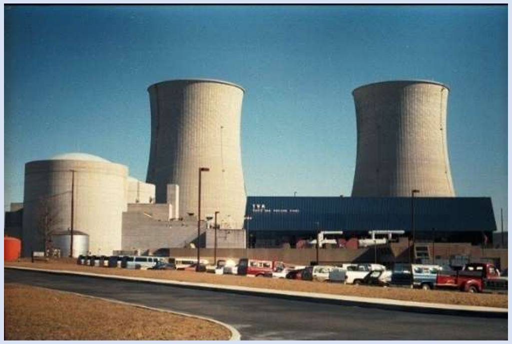
Date	Event	Reference
August 1982	NRC's Advisory Committee on Reactor Safeguards criticized TVA for a "serious quality assurance breakdown" in design and construction of the plant. The cost estimate for the plant rose to $2 billion.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
January 1983	TVA reported that construction of both units was 77.4 percent complete.	Gunter Wadewitz, Project Manager, Tennessee Valley Authority, "Watts Bar Nuclear Plant Construction Progress," January 1983. (ML082310480)
October 23, 1984	TVA informed the NRC that the estimated fuel loading date for Unit 1 had been revised to March 1985 and to March 1987 for Unit 2.	Letter dated October 23, 1984, from L. M. Mills, Manager, Nuclear Licensing, Tennessee Valley Authority, to Chief, Management Information Branch, Office of Management and Program Analysis, U.S. Nuclear Regulatory Commission. (ML082340283)
February 20, 1985	TVA certified to the NRC that Unit 1 was essentially complete and in accordance with regulatory standards. TVA scheduled fuel loading of te Unit 1 reactor core on April 23, 1985.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
March 1985	Numerous TVA employee voice safety concerns to the NRC.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
April 12, 1985	After substantiating a number of employee safety concerns, NRC confronts TVA about the issues.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
June 1985	TVA hired Quality Technology Company to investigate safety and harassment concerns raised by TVA workers. Estimated cost of the plant revised to $4.1 billion.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
March 1986	Estimated cost of the plant revised to $5 billion.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.



WATTS BAR NUCLEAR PLANT

Spring City, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
May 5, 1988	NRC issued violations to TVA for serious quality assurance program problems and an inadequate welding program.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
December 1989	TVA halts construction work at the plant due to inadequate controls.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
March 1990	Estimated cost of the plant revised to $5.8 billion.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
August 1991	NRC informed TVA that problems at the plant remained extensive and uncorrected.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
June 1992	NRC allowed TVA to resume full construction activities at the plant following eight months of monitoring.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
March 1993	Estimated costs of the plant revised to $9 billion.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
April 1993	NRC criticized TVA for an inadequate quality assurance program.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
August 1993	NRC released report criticizing TVA for having failed to correct safety concerns since 1982.	Valley Watch, "History of a troubled plant – Watts Bar: 1970-1993," September 1993.
December 12, 1994	TVA halted work on Unit 2.	Matthew L. Wald, *New York Times*, "T.V.A. to Stop All Work on 3 Reactors," December 13, 1994.
August 1995	TVA reported having replaced 457 miles of electrical cables on Unit 1 that had not been originally installed properly. The replacement cost was estimated to cost $22 million.	U.S. General Accounting Office, "Tennessee Valley Authority: Financial Problems Raise Questions About Long-term Viability," GAO/AIMD/RCED-95-134, August 1995.
February 7, 1996	NRC issued TVA an operating license for Unit 1.	U.S. Nuclear Regulatory Commission, February 7, 1996. (ML073460319)



WATTS BAR NUCLEAR PLANT

Spring City, Tennessee **Two Pressurized Water Reactors**

Date	Event	Reference
October 22, 2015	NRC issued TVA an operating license for Unit 2.	U.S. Nuclear Regulatory Commission, October 22, 2015. (ML15301A140)
March 23, 2016	NRC issued a “Chilled Work Environment” letter to TVA after received safety allegations from operators in late 2015 and early 2016.	Letter dated March 23, 2016, from Catherine Haney, Regional Administrator, U.S. Nuclear Regulatory Commission, to Joseph P. Grimes, Chief Nuclear Officer and Executive Vice President, Tennessee Valley Authority. (ML16083A479)

YELLOW CREEK NUCLEAR PLANT

Iuka, Mississippi **Two Pressurized Water Reactors**

Date	Event	Reference
January 1975	TVA estimated construction of the plant would cost $1.9 billion.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.
July 16, 1976	TVA applied to the NRC for construction permits. TVA projected that fuel would be loaded into the Unit 1 reactor core on December 1, 1983, and into the Unit 2 reactor core on December 1, 1984.	U.S. Nuclear Regulatory Commission, "Safety Evaluation Report related to construction of Yellow Creek Nuclear Plant Units 1 & 2," NUREG-0347, December 1977. (ML13294A515)
February 1978	TVA began construction of the plant.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.
September 1978	TVA estimated construction of the plant would cost $2.4 billion.	U.S. General Accounting Office, "Tennessee Valley Authority Can Improve Estimates And Should Reassess Reserve Requirements For Nuclear Power Plants," PSAD-79-49, March 22, 1979.
November 29, 1978	NRC issued TVA construction permits for Units 1 and 2.	U.S. Nuclear Regulatory Commission, "Order Revoking Construction Permits," August 29, 1988. (ML20153E496)
July 24, 1981	TVA announced it was extending the projected completion date for Unit 1 to October 1990.	U.S. Nuclear Regulatory Commission, "Construction Delays," PNO-II-81-55, July 24, 1981. (ML20063C806)
August 14, 1981	TVA notified NRC that the estimated fuel loading date for Unit 1 had been revised to July 1989.	Letter dated August 14, 1981, from L. M. Mills, Manager, Nuclear Regulation and Safety, Tennessee Valley Authority, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML20063C806)
March 4, 1982	TVA Board voted 2-1 to indefinitely defer construction of Unit 1.	U.S. Nuclear Regulatory Commission, "Deferral of TVA Units," PNO-II-82-25, March 4, 1982. (ML20041F906)

YELLOW CREEK NUCLEAR PLANT

Iuka, Mississippi **Two Pressurized Water Reactors**

Date	Event	Reference
March 19, 1982	NRC listed the status of Unit 2 as indefinitely deferred after being 3 percent completed.	Memo dated March 19, 1982, from Kevin Cornell, Office of the Deputy Executive Director For Operations, U.S. Nuclear Regulatory Commission, to Commission Ahearne, U.S. Nuclear Regulatory Commission. (ML20063C823)
April 1, 1982	NRC listed the status of Unit 1 as deferred after being 28 percent completed.	Memo dated April 1, 1982, from A. Schwencer, Chief, Licensing Branch 2, Division of Licensing, U.S. Nuclear Regulatory Commission, to Robert L. Tedesco, Assistant Director for Licensing, Division of Licensing, U.S. Nuclear Regulatory Commission, "Use of Staff Resources of Hartsville A1, A2, B1, B2, Phipps Bend 1 & 2 and Yellow Creek – Plants Deferred by TVA." (ML20063C806)
August 6, 1982	TVA reported Unit 1 as being 28 percent completed with estimated commercial operation between January and October 1990.	Letter dated August 6, 1982, from L. M. Mills, Manager, Nuclear Licensing, Tennessee Valley Authority, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML073511551)
August 6, 1982	TVA reported Unit 2 as being 3 percent completed with construction deferred.	Letter dated August 6, 1982, from L. M. Mills, Manager, Nuclear Licensing, Tennessee Valley Authority, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML073511551)
September 30, 1982	The actual construction cost for Units 1 and 2 to date were $1.113 billion.	Comptroller General of the United States, "Triennial Assessment Of The Tennessee Valley Authority — Fiscal Years 1980-1982," GAO/RCED-83-123, April 15, 1983.
January 21, 1983	TVA requested that NRC extend the construction permits for Units 1 and 2.	Letter dated May 12, 1983, from L. M. Mills, Manager, Nuclear Licensing, Tennessee Valley Authority, to Harold R. Denton, Director, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission. (ML20023C336)

YELLOW CREEK NUCLEAR PLANT

Iuka, Mississippi **Two Pressurized Water Reactors**

Date	Event	Reference
August 29, 1984	TVA cancelled the plant. TVA estimated Unit 1 was 52 percent completed.	Letter dated October 24, 1985, from J. W. Huffman, Manager, Licensing and Risk Protection, Tennessee Valley Authority, to Hugh L. Thompson, Jr., Director of Licensing, Division of Licensing, U.S. Nuclear Regulatory Commission. (ML20133N732)
October 24, 1985	TVA requested NRC withdraw the construction permits for Units 1 and 2.	U.S. Nuclear Regulatory Commission, "Order Revoking Construction Permits," August 29, 1988. (ML20153E496)
August 29, 1988	NRC revoked the construction permits for Units 1 and 2.	U.S. Nuclear Regulatory Commission, "Order Revoking Construction Permits," August 29, 1988. (ML20153E496)

TVA'S NUCLEAR SAFETY CULTURE		
Date	**Event**	**Reference**
September 20, 1983	The NRC issued TVA a violation after the U.S. Department of Labor found that TVA discriminated against William Daniel DeFord for having raised nuclear safety issues during an NRC inspection in July 1980 at Sequoyah. TVA appealed the DOL's decision, but the U.S. Court of Appeals for the Sixth Circuit upheld the decision. The NRC noted that regulations had been revised since the time of the infractions, and that under the revised regulations the violation would be accompanied by a $64,000 civil penalty.	U.S. Nuclear Regulatory Commission, "Employee Protection from Illegal Discrimination," September 20, 1983. (ML20080N306)
October 7, 1985	NRC's Office of Investigations initiated an investigation of allegations by members of TVA's Nuclear Safety Review Staff that their reports were being wrongfully altered by management to downplay the significance of the findings.	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty — $240,000 (NRC Investigation Report No. 2-85-031)," April 12, 1990. (ML073580075)
December 19, 1985	NRC Commissioner James Asselstine and NRC staff members were briefed by TVA Nuclear Safety Review Staff members Jerry D. Smith, Phillip Washer, and Robert C. Sauer about non-compliances with NRC's safety regulations.	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty — $240,000 (NRC Investigation Report No. 2-85-031)," April 12, 1990. (ML073580075)
February 1986	TVA Nuclear Safety Review Staff members Jerry D. Smith, Phillips Washer, and Robert C. Sauer were transferred into a newly created, leaderless section.	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty — $240,000 (NRC Investigation Report No. 2-85-031)," April 12, 1990. (ML073580075)
October 27, 1986	"*In late August Monsour Guity, another independent TVA investigator … and* [Jerry] *Smith complained to the U.S. Labor Department that they had been harassed and intimidated by TVA managers for raising safety issues*."	Brian Dumaine, *Fortune* magazine, "Nuclear Scandal Shakes the TVA," October 27, 1986
December 16, 1986	NRC Regional Administrator J. Nelson Grace briefed his Commissioners including about a survey of TVA's nuclear workers showing that "*up to 75% lacked confidence in TVA management.*"	Union of Concerned Scientists, "Walking a Nuclear Tightrope: Unlearned Lessons of Year-plus Reactor Outages," November 6, 2006.

TVA's NUCLEAR SAFETY CULTURE		
Date	**Event**	**Reference**
June 23, 1988	U.S. Department of Labor found that a contract employee at TVA's Sequoyah nuclear plant had been wrongfully terminated because he raised nuclear safety concerns at TVA's Watts Bar nuclear plant.	U.S. Nuclear Regulatory Commission, "U.S. Department of Labor Case No. 87-ERA-28," September 12, 1988. (ML12074A018)
April 12, 1990	The NRC reported three violations of federal regulations protecting workers from retaliation for raising nuclear safety concerns and proposed $80,000 civil penalties each for its determinations that TVA retaliated against former Nuclear Safety Review Staff members Jerry D. Smith, Phillips Washer, and Robert C. Sauer because they raised safety concerns ($240,000 total proposed civil penalty).	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty — $240,000 (NRC Investigation Report No. 2-85-031)," April 12, 1990. (ML073580075)
September 20, 1990	NRC ordered the imposition of the $240,000 civil penalty for discriminating against Nuclear Safety Review Staff members Jerry D. Smith, Phillips Washer, and Robert C. Sauer because they raised safety concerns. TVA appealed the proposed civil penalty, but NRC denied the appeals.	U.S. Nuclear Regulatory Commission, "Order Imposing Civil Penalty — $240,000 – Watts Bar," September 20, 1990. (ML073580333)
April, 25, 1995	NRC notified TVA that its investigation concluded TVA had not wrongfully removed Donald Ralph Matthews from his Superintendent of Chemistry position at Watts Bar shortly after he raised nuclear safety concerns, they were concerned that TVA may have created chilling effects at the plant for workers with concerns.	U.S. Nuclear Regulatory Commission, "Enforcement Discretion Concerning the Apparent Violation of 10 CFR 50.7, Employee Protection (Office of Investigations Case No. 2-93-057R)," April 25, 1995. (ML073270593)
February 14, 1996	NRC proposed an $80,000 civil penalty after its investigation concluded TVA discriminated against Douglas Harrison, an ironworker general foreman at Browns Ferry, because he raised concerns about inadequate fire watch activities.	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty $80,000 (Department of Labor Case No. 93-ERA-044)," February 14, 1996. (ML20097G275)
February 23, 1996	NRC proposed an $80,000 civil penalty after its investigation concluded TVA discriminated against a former TVA nuclear inspector by not hiring him for positions at the Sequoyah and Watts Bar nuclear plant due to his having raised nuclear safety concerns to TVA and the NRC.	U.S. Nuclear Regulatory Commission, "NRC Staff Proposed $80,000 Civil Penalty Against TVA for Alleged Discrimination at Sequoyah and Watts Bar," February 23, 1996. (ML003706041)

TVA's Nuclear Safety Culture		
Date	**Event**	**Reference**
January 13, 1997	NRC issued an order banning Joseph R. Bynum from participating in NRC-licensed activities for five years. The order was based on the NRC's determination that in April 1993, Mr. Bynum, then TVA's Vice President of Nuclear Operations, was guilty of deliberate misconduct by discriminating against William F. Jocher for raising nuclear safety concerns.	U.S. Nuclear Regulatory Commission, "Order Prohibiting Involvement in NRC-Licensed Activities (Effective Immediately)," January 13, 1997. (ML20133F788 and ML20133F798)
January 13, 1997	NRC issued a violation and proposed a $100,000 civil penalty after its investigation concluded that TVA forced William F. Jocher, its corporate Manager, Chemistry and Environmental Protection as well as Chemistry Manager at Sequoyah, to resign "because he engaged in the identification of deficiencies in the chemistry program and inconsistencies in TVA reports to the NRC."	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty — $100,000 (NRC Office of Investigation Report No. 2-93-015 and Department of Labor Administrative Law Judge Recommended Decision and Order dated July 31, 1996)," January 13, 1997. (ML20134G857)
September 8, 1997	NRC notified TVA of its concerns that remarks by a manager at Sequoyah had a chilling effect on workers' feeling they could raise safety concerns without fear of retaliation. NRC had been informed by TVA's Inspector General told a work group that an environmental engineer who reported safety concerns "had burned his bridges" and was not wanted at the site.	U.S. Nuclear Regulatory Commission, "Safety Conscious Work Environment at Sequoyah (NRC Office of Investigations Report No. 2-93-001)," September 8, 1997. (ML20217E744)
January 10, 2002	NRC issued a violation to TVA for an incident at Sequoyah where a security officer was ordered by management to violate security procedures after a senior manager set off the metal detector upon entering the facility.	U.S. Nuclear Regulatory Commission, "Notice of Violation, Sequoyah Nuclear Plant (NRC Office of Investigations Report No. 2-2000-019A, and Inspection Report Nos. 50-327/01-07, 50-328/0107)," January 10, 2002. (ML020100478)
February 7, 2000	NRC issued a violation and proposed a $110,000 civil penalty after concluding TVA discriminated against Gary L. Fiser for having raised nuclear safety concerns.	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty — $110,000 *Nuclear Regulatory Commission's Office of Investigations Report No. 2-98-013)," February 7, 2000. (ML0034681385)
May 4, 2001	NRC imposed a $110,000 civil penalty on TVA for discriminating against the Chemistry and Environmental Protection Program Manager after considering numerous TVA appeals.	U.S. Nuclear Regulatory Commission, "Order Imposing Civil Monetary Penalty — $110,000 Tennessee Valley Authority," EA-99-234, May 4, 2001. (ML011350133)

TVA'S NUCLEAR SAFETY CULTURE

Date	Event	Reference
June 18, 2001	NRC notified TVA that it found two apparent violations in the firing of Curtis Overall from the Watts Bar Nuclear Plant for having raised nuclear safety concerns.	U.S. Nuclear Regulatory Commission, "Apparent Violations of Employee Discrimination Requirements (U.S. Department of Labor Case No. 1997-ERA-0053)," June 18, 2001. (ML011690336)
October 15, 2001	NRC issued a violation and proposed an $88,000 civil penalty on TVA for having wrongfully terminated Curtis Overall from Watts Bar for having raised nuclear safety concerns.	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty — $88,000 (U.S. Department of Labor Case No. 1997-ERA-0053)," October 15, 2001. (ML012890117)
January 31, 2007	NRC issued a violation to TVA but exercised Enforcement Discretion in not proposing a civil penalty or other sanction for a contractor at Browns Ferry being terminated because he refused to sign off sub-par work as being acceptable.	U.S. Nuclear Regulatory Commission, "Exercise of Enforcement Discretion (Office of Investigations Report No. 2-2006-001)," EA-07-013, January 31, 2007. (ML070320162)
December 22, 2009	NRC issued a Confirmatory Order to TVA requiring several steps to be taken after finding that a Nuclear Assurance inspector and a maintenance mechanic at Browns Ferry had been illegally discriminated against for having raised safety concerns.	U.S. Nuclear Regulatory Commission, "Confirmatory Order (Effective Immediately) (Office of Investigation Report Nos. 2-2006-025 % 2-2009-003)," December 22, 2009. (ML093510121)
March 23, 2016	NRC notified NRC of its concerns about a chilled work environment in the Operations Department for workers raising safety concerns at Watts Bar.	U.S. Nuclear Regulatory Commission, "Chilled Work Environment for Raising and Addressing Safety Concerns at the Watts Bar Nuclear Plant," EA-16-051, March 23, 2016. (ML16083A479)
September 15, 2016	TVA's Inspector General reported on its evaluations of the work forces at Sequoyah and Browns Ferry and in the Nuclear Oversight organization in response to the NRC's finding of a chilled work environment within the Operations Department at Watts Bar. The Inspector General found that "most ECP [Employee Concerns Program] employees did not feel free to raise concerns or problems without fear of retaliation." The Inspector General found that 10 of 33 Quality Assurance workers did not trust TVA management below the Vice President.	Tennessee Valley Authority, Office of the Inspector General, "Request for Final Action — Evaluation 2016-15398 — Work Environment for Nuclear Oversight," September 15, 2016.

<table>
<tr><th colspan="3">TVA’S NUCLEAR SAFETY CULTURE</th></tr>
<tr><th>Date</th><th>Event</th><th>Reference</th></tr>
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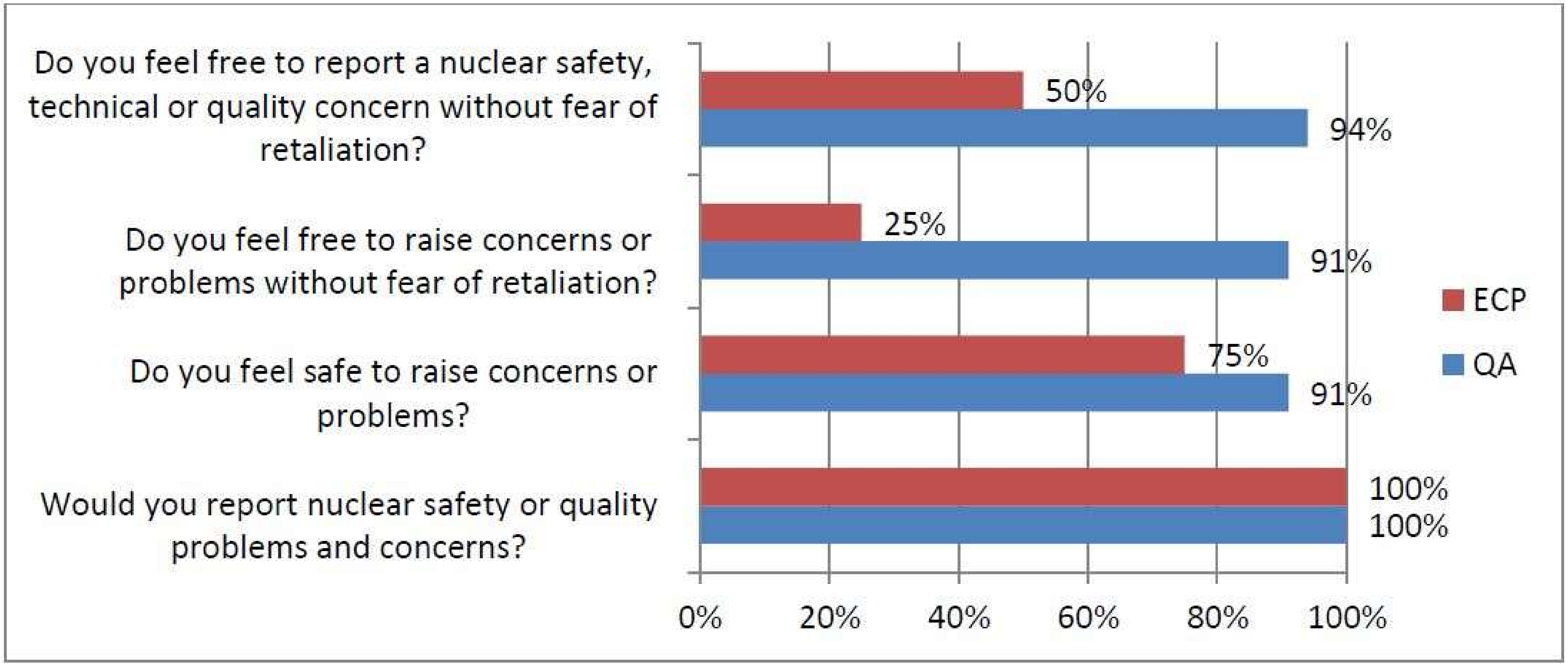
Figure 1: Responses Related to Reporting Concerns



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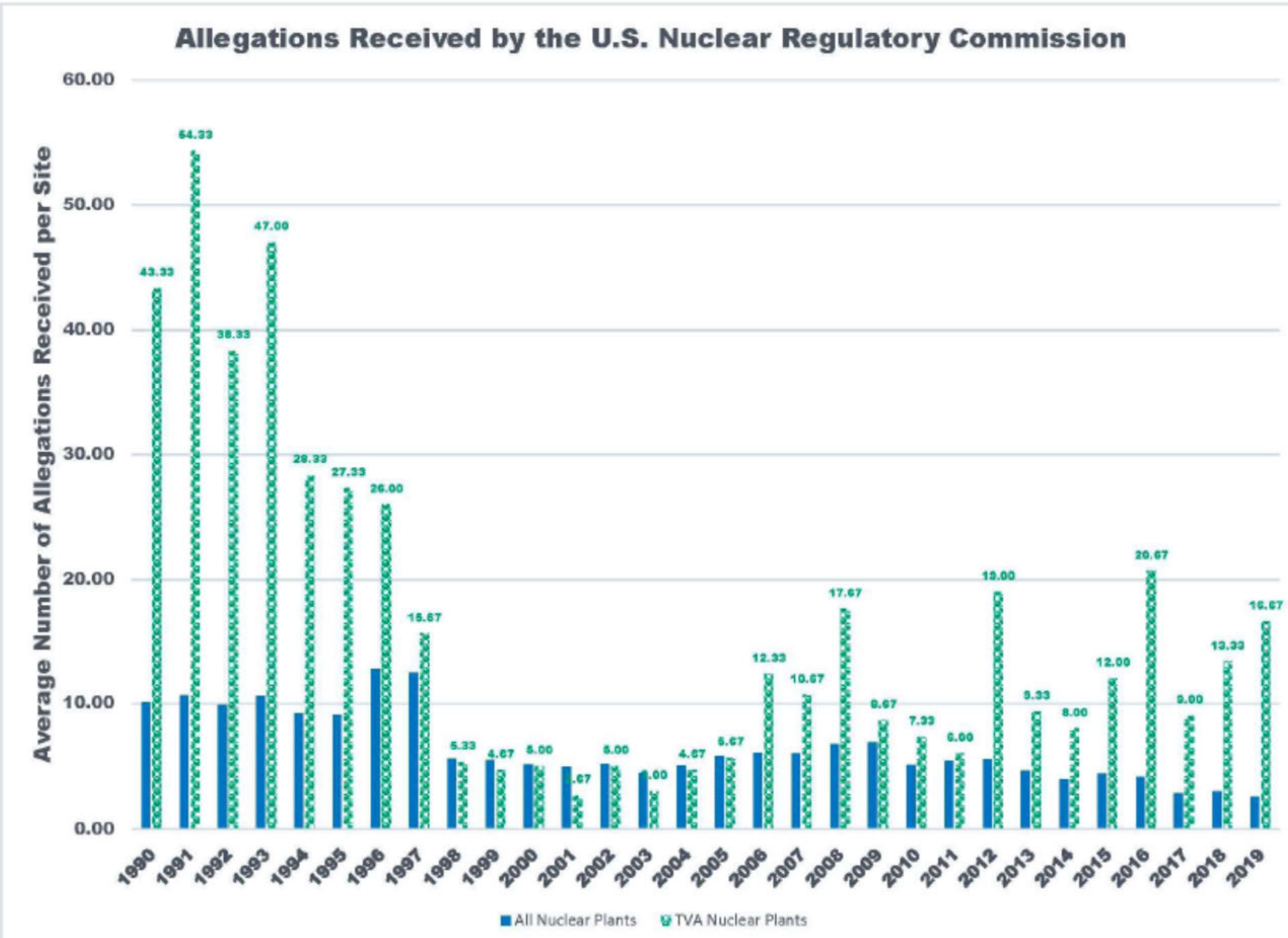
<tr><td>July 27, 2017</td><td>NRC issued TVA a Confirmatory Order requiring TVA to take several steps after finding TVA violated terms of the December 22, 2009, Confirmatory Order. That order required TVA to formally review proposed adverse employment actions to ensure employee protection regulations are satisfied and to take measures when necessary to avoid having employment actions have a negative impact on the safety conscious work environment. The NRC found that TVA failed to implement these processes at Watts Bar between November 2014 and August 2016.</td><td>U.S. Nuclear Regulatory Commission, “Confirmatory Order (Effective Immediately),” EA-17-022, July 27, 2017. (ML17208A647)</td></tr>
<tr><td>January 10, 2018</td><td>TVA’s Inspector General reported that TVA had ineffectively implemented five of the ten actions committed to in the NRC’s October 2009</td><td>Tennessee Valley Authority, Office of the Inspector General, “Request for Final Action — Evaluation 2017-15448 — TVA Nuclear’s Process for Addressing the</td></tr>
</table>

TVA'S NUCLEAR SAFETY CULTURE		
Date	**Event**	**Reference**
	Confirmatory Order. The Inspector General further reported that problems with implementation of the Confirmatory Order actions had been repeatedly identified (and repeatedly uncorrected).	Nuclear Regulatory Commission's 2009 Confirmatory Order," January 10, 2018.
March 14, 2018	NRC inspectors noted that a survey of the work force at Watts Bar conducted for TVA in 2017 indicated that 10 percent of the workers provided a negative response to the question "I feel free to raise a safety concern without fear of retaliation," a relatively high level of negative response compared to nuclear industry averages.	U.S. Nuclear Regulatory Commission, "Watts Bar Nuclear Plant — Follow-up for NRC Confirmatory Order EA-17-022 and Chilled Work Environment Letter (EA-16-061; NRC Inspection Report 05000390/2017009, 05000391/2017009," March 14, 2018. (ML18073A202)
June 3, 2020	I reported to the NRC results of my review of the allegations received by the NRC about nuclear plant safety issues. In only eight (8) of the past thirty (30) years, the NRC received more allegations from the average U.S. nuclear plant than from the average TVA nuclear plant. That eight year period (1998-2005) ended more than a decade ago.	Memo dated June 3, 2020, from Dave Lochbaum, Advisor to the 2.206 Petitioners, to Andrew Hon, Petition Manager, U.S. Nuclear Regulatory Commission, "Review of TVA Employee Concerns Program 2.206 Petition."

TVA's Nuclear Safety Culture

Date	Event	Reference



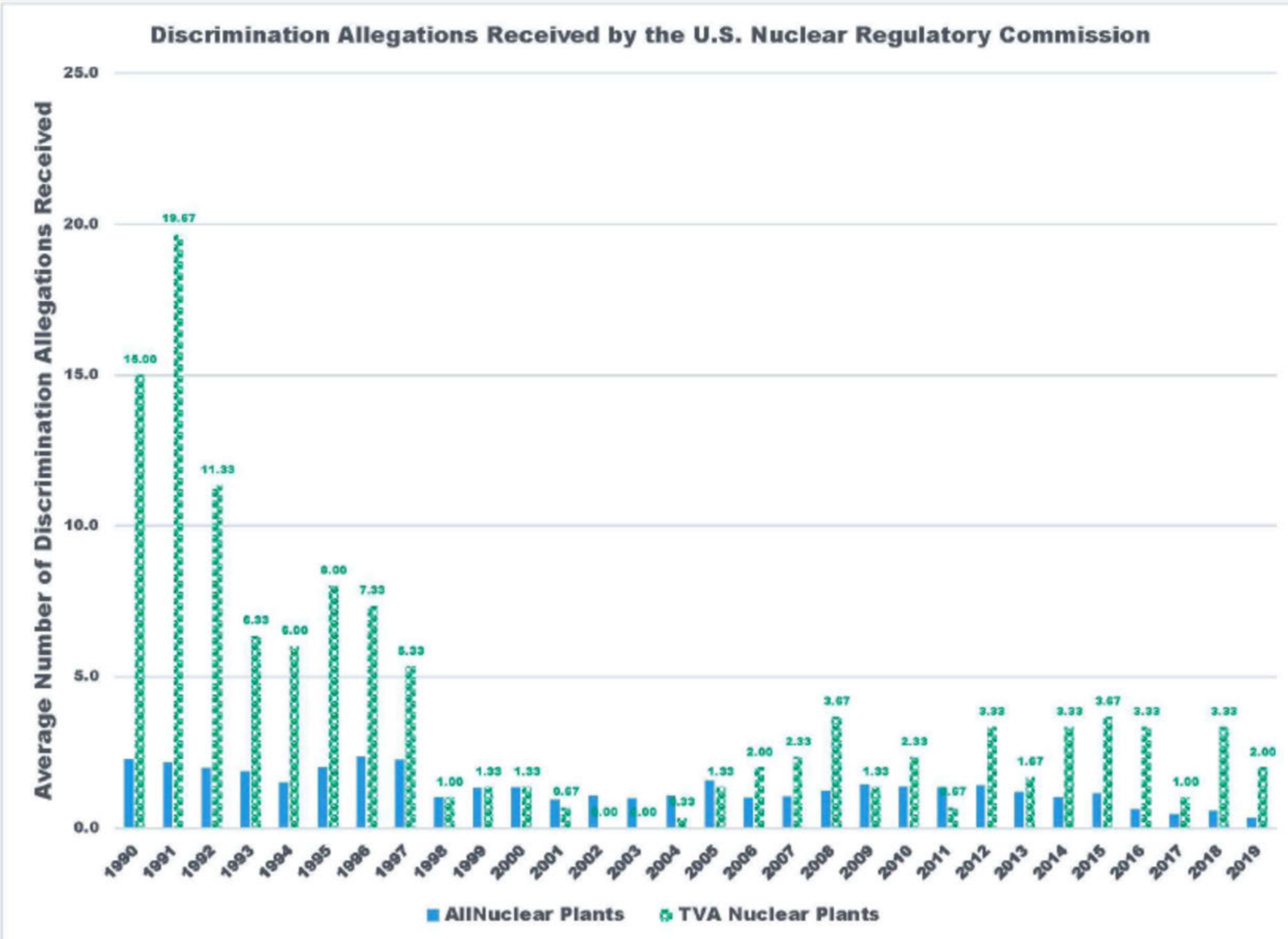
June 3, 2020	I also reported to the NRC results of my review of the allegations of discrimination received by the	Memo dated June 3, 2020, from Dave Lochbaum, Advisor to the 2.206 Petitioners, to Andrew Hon, Petition Manager,

TVA's Nuclear Safety Culture

Date	Event	Reference
	NRC from nuclear plant workers. In only ten (10) of the past thirty (30) years, the NRC received more allegations from the average U.S. nuclear plant than from the average TVA nuclear plant. The most recent time (2011) was nearly a decade ago.	U.S. Nuclear Regulatory Commission, "Review of TVA Employee Concerns Program 2.206 Petition."

TVA's Nuclear Safety Culture

Date	Event	Reference



August 24, 2020	NRC issued four violations and proposed a $606,942 civil penalty for discriminations at Sequoyah against four workers who raised safety concerns: (1) worker	U.S. Nuclear Regulatory Commission, "Notice of Violation and Proposed Imposition of Civil Penalty, "EA-20-006 and EA-20-007, August 24, 2020. (ML20232B803)

TVA's NUCLEAR SAFETY CULTURE		
Date	**Event**	**Reference**
	raising concerns about a chilled work environment and inadequate responses to two NRC non-cited violations, (2) worker raising concerns about a chilled work environment, (3) worker investigated by TVA's Office of the General Counsel after raising concerns of a chilled work environment, and (4) worker who raised concerns about a chilled work environment to TVA's Vice President of Regulatory Affairs during an Office of the General Counsel investigation.	
September 23, 2020	TVA responded to the August 24, 2020, NRC violations by denying all four violations and contending that if NRC insisted on issuing them, NRC should reduce the amount of the civil penalty.	U.S. Nuclear Regulatory Commission, "Order Imposing Civil Monetary Penalty," EA-20-006 and EA-20-007, October 29, 2020. (ML20297A544)
October 29, 2020	NRC considered TVA's appeal, but reaffirmed the four violations issued on August 24, 2020, and ordered the $606,942 civil penalty imposed,	U.S. Nuclear Regulatory Commission, "Order Imposing Civil Monetary Penalty," EA-20-006 and EA-20-007, October 29, 2020. (ML20297A544)
February 4, 2021	NRC considered TVA's appeal of its October 29, 2020, order. The NRC revised the severity of the violations from Level I to Level II but sustained the civil penalty at $606,942 – the maximum allowed under the regulations.	U.S. Nuclear Regulatory Commission, "Reduction of Severity Levels in the October 29, 2020, Order Imposing Civil Penalty – Tennessee Valley Authority," February 4, 2021. (ML21028A707)

From: lisa k. Worley
To: nepa
Date: Thursday, March 4, 2021 9:16:43 AM

Why would we invest in old technology. Look to renewables for our energy not a tech which is out dated and unnecessary

From: Ryan Thier
To: nepa
Subject: Support for the Clinch River Nuclear Site
Date: Monday, March 15, 2021 5:56:22 PM

To whom it may concern,

I wholeheartedly support the construction of the Clinch River Nuclear Site Advanced Nuclear Reactor Technology park. Not only will nuclear power be increasingly vital in supporting a non-carbon based energy supply as the harmful effects of climate change accelerate, but the construction of such a park here in East Tennessee continues a long tradition of nuclear power innovation in the region. It positions East Tennessee to ramp up production and prosper as these technologies are proved out, standing at the vanguard of an energy renaissance. Modern nuclear risk-mitigation technology and design strategy have advanced tremendously over the years and the construction of this site can prove out the viability and low environmental impact of nuclear power. For the sake of the future I can only recommend the project proceed with full momentum.

Sincerely,
Ryan C. Thier
[redacted]

From:	Wufoo
To:	nepa
Subject:	Scoping Comments - Clinch River Nuclear Site EIS [#2]
Date:	Wednesday, March 17, 2021 10:56:34 AM

Name	Jan Berry
City	[redacted]
State	[redacted]
Email	[redacted]
Phone Number	[redacted]

Please provide your comments by uploading a file or by entering them below. *

I fully support TVA in development of the Programmatic Environmental Impact Statement for the Clinch River Nuclear Site to support implementation of TVA's 2019 Integrated Resource. The environmental impact of advanced nuclear technology is beyond the impact at the site and extends to the need to clean energy technology as rapidly as possible.

Please include an analysis or statements regarding the following in the PEIS:
o the potential for advanced nuclear technology to improve TVA's carbon-free energy portfolio over time especially whether this technology would/could eliminate the need to build new natural gas powered electricity generation;
o demonstration of nuclear technology (e.g., molten salt reactors) that can use nuclear waste as fuel, thus reducing the issue of long-term storage of fuel rods and depleted uranium;
o potential for job growth in the TVA region based on deployment of advanced technology (e.g., nuclear technology business development);
o technology development, deployment and commercialization time line;
o collaboration with the University of Tennessee and Oak Ridge National Lab in the development of advanced nuclear technology; and
o life-cycle cost comparison of alternative carbon-free technologies to produce electricity.

From: [redacted]
To: nepa
Cc: [redacted]
Subject: Pub;lic Comments -- TVA Clinch River Nuclear Site
Date: Wednesday, March 17, 2021 12:54:58 PM

This is an EXTERNAL EMAIL from outside TVA. THINK BEFORE you CLICK links or OPEN attachments. If suspicious, please click the "Report Phishing" button located on the Outlook Toolbar at the top of your screen.

Attn; Review of Programmatic EIS for Proposed TVA Small Modular Nuclear Reactor Test Site
I have studied Chapter 9 of

Notification of The Issuance Of The Draft Environmental Impact Statement For The Early Site Permit Application For The Clinch River Nuclear Site In Roane County, Tennessee (Region 4 EPA).

ML18106B115

and find no SMR site options discussion of the many (and growing number) decommissioned fossil fuel power plants throughout the TVA system. These locations (especially the soon to be closed Bull Run Fossil Plant) have the basic infrastructure needs for siting the SMR project including a railroad in most cases, as well as cooling water , highways, transmission lines, sewage system, potable water supply, etc. Thus saving 10's of millions of dollars over a greenfield site.
Furthermore there is no indication that the 850 acre former CRBRP site has been assigned a $ value as a protected natural landscape at least half of which is undisturbed for the last 75 years and the remainder healed in the past 40 years . It is a mature forested area rich in wildlife numbers and diversity. And wildlife has returned in numbers to the extent that the Tennessee Wildlife Resources Agency in cooperation with TVA conducts permitted spring wild turkey hunting and deer hunting each fall. It is also a vital part of the greater Oak Ridge Reservation environmental research park. It has been characterized as free of any legacy cold war era contamination .
As responsible stewards of the public resources the fundamental principals of reduce/reuse should be given the highest in point ratings in site selection. Has this factor been included in the site reviews? Indications are that it has not, but rather the former CRBRP site is

considered 'free". It is far from that . The last thing we need be doing is creating another nuclear contaminated site , especially when there are many brownfield options in this instance.
I am reminded of what happened recently when (largely without public awareness) TVA chose the undisturbed and mature forested top of Pine Ridge for a UPF power line because it was "free" . The citizens of Oak Ridge objected when plans were discovered at the 11th hour , but by then it was too late. Some compromise was eventually reached , but some clear cutting occurred on the scenic ridge top that forms a border of Oak Ridge. This is a quantifiable loss to the community on many levels. Undisturbed natural landscapes have great value. If you have traveled east-west on I-40 you are likely aware of the 6 mile or so diversion of I-40 to the north around Memphis. The original design routing by the Federal Highway Administration in the early 1960's, was directly through the middle of Memphis. A route partially chosen because much of the ROW would have been through a City Park, and thus "free" . Not so argued citizen grassroots organizations contending the "Old Forest" (an old growth forest) had great value. A fact the U. S. Supreme Court confirmed .
https://en.wikipedia.org/wiki/Citizens_to_Preserve_Overton_Park_v._Volpe
A simple calculation of I-40 through traffic making the ~ 6 mile diversion around Memphis for the past 45 years is a big number giving an indication of the value ($'s) of undisturbed natural areas.
Please consider doing a independent life cycle cost and in the instance of the former CRBRP site , an environmental preservation assessment of SMR site options . By placing the true $ value on the undisturbed CRBRP greenfield, it will be more equitably contrasted to brownfield sites and quickly lose distinction of the preferred option.
Sincerely, Doug Colclasure, [redacted]

______

Blue Ridge Environmental Defense League

www.BREDL.org PO Box 88 Glendale Springs, North Carolina 28629 BREDL@skybest.com (336) 982-2691

March 17, 2021

J. Taylor Cates, NEPA Specialist
[redacted]

RE: Programmatic Environmental Impact Statement-Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Dear Tennessee Valley Authority,

On behalf of Blue Ridge Environmental Defense League, we submit the following comments. We are writing in opposition to construction, operation, and decommissioning of an advanced nuclear reactor technology park at the Clinch River Nuclear (CRN) Site in Oak Ridge, Roane County, Tennessee. We are in favor of the no-action alternative. These written remarks are for the public notice and comment period and will supplement any virtual or oral public hearings.

Overview

The Tennessee Valley Authority (TVA) intends to prepare a Programmatic Environmental Impact Statement (PEIS) to address the potential environmental effects associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at the Clinch River Nuclear (CRN) Site in Oak Ridge, Roane County, Tennessee. The park would contain one or more advanced nuclear reactors with a cumulative electrical output not to exceed 800 megawatts electric (MWe). TVA plans to evaluate a variety of alternatives including a no-action alternative.

Comments

A Variety of Negative Environmental and Human Health Impacts

Resource areas to be addressed in the PEIS include, but are not limited to: Air quality; aquatics; botany; climate change; cultural resources; emergency planning; floodplains; geology and groundwater; hydrothermal; land use; navigation; noise and vibration; radiological safety; soil erosion and surface water; socioeconomics and environmental justice; threatened and endangered species; transportation; visual; waste; water use; wetlands; and wildlife.

1. Intergovernmental Panel on Climate Change Fifth Assessment Report, https://www.ipcc.ch/
2. Advanced nuclear reactors no safer than conventional nuclear plants, says science group, https://www.reuters.com/article/us-usa-nuclearpower/advanced-nuclear-reactors-no-safer-than-conventional-nuclear-plants-says-science-group-idUSKBN2BA0CP?utm_source=Energy+News+Network+daily+email+digests&utm_campaign=aa5ec72c58-EMAIL_CAMPAIGN_2020_05_11_11_46_COPY_01&utm_medium=email&utm_term=0_724b1f01f5-aa5ec72c58-89308088

Nuclear waste, the by-product of nuclear reactors will remain hazardous to humans and other living beings for hundreds of thousands of years. Other radioisotopes will remain hazardous for millions of years. Thus, these wastes must be shielded for centuries and isolated from the living environment for hundreds of millenia. Therefore, construction, operation, and decommissioning of an advanced nuclear reactor technology park would have negative effects on all aspects of these environmental concerns, in fact, advanced reactors emit large amounts of radioactive gases which would be another problematic waste stream. Ed Lyman from Union of Concerned Scientists, said money going into advanced nuclear would be better spent on bolstering conventional nuclear plants from the risks of earthquakes and climate change, such as flooding. [2]

There are No Efficient and Practical Solutions for Nuclear Waste

The results from a Stanford study show that SMRs and nuclear power in general will not reduce the size of a geologic repository for spent nuclear fuel, nor the associated future dose rates. Rather, SMRs are poised to discharge spent fuel with relatively high concentrations of fissile material, which may pose re-criticality risks in a geologic repository. [3]

There is no safe or permanent solution that has been found anywhere in the world and may never be found for the nuclear waste problem. In the U.S. the only identified and flawed high-level radioactive waste deep repository site at Yucca Mountain, Nevada has been canceled. There needs to be an end to the production of nuclear waste and for securing the existing reactor waste in hardened on-site storage. There is no need to spread nuclear and the waste produced by it further with new and better technology available now.

Small Modular Reactors and Microreactors Are Not The Future or Cost Effective

The project should not go into effect, because it relies on the usage and 'cost effectiveness' of SMR's and Microreactors. "Affordable" doesn't necessarily mean "cost-effective." According to basic economic principles, the cost per kilowatt-hour of the electricity produced by a small reactor will be higher than that of a large reactor, all other factors being equal. That is because SMRs are penalized by the economies of scale of larger reactors—a principle that drove the past industry trend to build larger and larger plants. [6]

Esse quam videri

3. A Critical Analysis Of The Nuclear Waste Management Consequences For Small Modular Reactors, https://fsi.stanford.edu/events/critical-analysis-nuclear-waste-management-consequences-small-modular-reactors
4. Nuclear Power & Global Warming, Union of Concerned Scientists, https://www.ucsusa.org/resources/nuclear-power-global-warming
5. Global energy demand to plunge this year as a result of the biggest shock since the Second World War, Global Energy Review 2020, https://www.iea.org/news/global-energy-demand-to-plunge-this-year-as-a-result-of-the-biggest-shock-since-the-second-world-war
6. Small Isn't Always Beautiful: Safety, Security, and Cost Concerns about Small Modular Reactors, Union of Concerned Scientists, 2013 report

While dealing with new and advanced reactors such as SMR's and microreactors, designs are not yet finalized and cost claims made by designers are not reliable. Actual costs and maintenance would be far higher. Along with the upfront costs of SMR's, there also has to be maintenance, operational, and labor costs in a safe and secure way. "In addition to imposing a penalty on the capital cost of SMRs, economies of scale would also negatively affect operations and maintenance (O&M) costs (excluding costs for nuclear fuel, which scale proportionately with capacity). Labor costs are a significant fraction of nuclear plant O&M costs, and they do not typically scale linearly with the capacity of the plant: after all, a minimum number of personnel are required to maintain safety and security regardless of the size." [6]

Nuclear Energy is a Struggling Industry

> Renewables are set to be the only energy source that will grow in 2020, with their share of global electricity generation projected to jump thanks to their priority access to grids and low operating costs. Despite supply chain disruptions that have paused or delayed deployment in several key regions this year, solar PV and wind are on track to help lift renewable electricity generation by 5% in 2020, aided by higher output from hydropower. [4]

While TVA continues to finance nuclear power and have it as 42% of all energy generated, several of the 94 U.S. conventional nuclear plants are shutting due to high safety costs and competition from natural gas and wind and solar energy. [2] The nuclear industry is a struggling industry as more and more plants get shut down and retire. Since 2012, six reactors have shut down and there are plans that seven others will close. Shutting these plants down is not a short term trend, while the price of renewables gets cheaper. We believe that nuclear power should not be used at all and, in fact, should be replaced with truly renewable energy and energy efficiency. [5]

Energy Demands are Decreasing

> A new report released by the International Energy Agency projects that energy demand will fall 6% in 2020 – seven times the decline after the 2008 global financial crisis. In absolute terms, the decline is unprecedented – the equivalent of losing the entire energy demand of India, the world's third largest energy consumer. Advanced economies are expected to see the biggest declines, with demand set to fall by 9% in the United States and by 11% in the European Union. The impact of the crisis on energy demand is heavily dependent on the duration and stringency of measures to curb the spread of the virus. For instance, the IEA found that each month of worldwide lockdown at the levels seen in early April reduces annual global energy demand by about 1.5%. [4]

The total demand for energy is decreasing and building a new reactor park does not match the need for energy needed. And with TVA spending $4 million dollars on this project, it is a risk and wasteful spending of taxpayer and customers money. [7]

Esse quam videri

7.Yale Environment 360, Industry Meltdown: Is the Era of Nuclear Power Coming to an End? https://e360.yale.edu/features/industry-meltdown-is-era-of-nuclear-power-coming-to-an-end

Conclusion

Blue Ridge Environmental Defense League is in opposition to Tennessee Valley Authority going through with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at the Clinch River Nuclear (CRN) Site in Oak Ridge, Roane County, Tennessee. for the following reasons: A variety of negative environmental and human health impacts, there are no efficient and practical solutions for nuclear waste, small modular reactors and microreactors are not the future or cost effective, nuclear energy is a struggling industry, and energy demands are decreasing.

Submitted Respectfully,
Jenn Galler, Campaign Coordinator
Blue Ridge Environmental Defense League
[redacted]

From:	Tom Clements
To:	nepa
Subject:	Comment on PEIS on "Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park"
Date:	Thursday, March 18, 2021 8:05:17 PM
Attachments:	advanced-isnt-always-better summary March 18 2021.pdf Advanced-isnt-always-better-full report Lyman March 18 2021.pdf

Comment for PEIS on Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Submitted by Tom Clements, Director, Savannah River Site Watch, Columbia, SC, https://srswatch.org/, March 19, 2021

In support of the No Action Alternative and for the record, I hereby submit the report on "advanced reactors" and the summary of it released on March 18, 2021 by the Union of Concerned Scientists. All the points raised in the report that would be applicable to reactors considered for the Clinch River Nuclear Site must be analyzed in the PEIS. The "advanced reactor" concept is riddled with problems and DOE should focus on safety of current reactors, until they are shut down, and better waste management.

Please confirm receipt of this comment and two attachments.

I am also forwarding for the PEIS record my comments submitted on February 12, 2021 into the draft EIS record for the Versatile Test Reactor. Oak Ridge National Lab is considered an alternate site for that reactor. I supported the No Action Alternative for the VTR project. Comments on the VTR are applicable to so-called "advanced reactors" that might be considered for the Clinch River site.

So-called "advanced reactors" are very much overhyped, not needed, could be more unsafe than traditional light-water reactors, are expensive and unfunded and could pose fuel-cycle proliferation risks if plutonium fuel or High Assay LEU (HALEU) fuel is used. The PEIS must analyze the source of the fuel and proliferation impacts of fuel production and irradiation in any reactor, especially if plutonium is produced during reactor operation.The proliferation and safety risks of sodium-cooled or salt-cooled reactors must be fully examined, including the possibility of sodium fires, as we saw in1995 with the Monju breeder reactor in Japan, or explosions.

The US Nuclear Regulatory Commission is evidently in secret preparing a draft Environmental Assessment on the Centrus High-Assay Low-Enriched Uranium Demonstration Project, in Piketon, Ohio. the public is so far not being allowed to see that document or comment on it. I have requested it be released for comment. What is relationship between the Clinch River PEIS and HALEU production by Centrus or any other HALEU provider?

Who would partner in fuel production or reactor construction and who would pay? Would public or private funds be involved? What would be the impact of sale of electricity from any so-called "advanced reactor" and would ORNL be expected to pay an elevated "special" rate (above market kwh costs) to fund reactor construction and operation? Compare such electricity costs to other forms of generation, such as solar or wind, as well as costs for conservation to reduce electricity use.

Where would all forms of waste produced by the reactors and accompanying fuel cycles be disposed of? As there is no geologic repository, where would spent fuel go? Would spent fuel eventually be reprocessed? What are the safety and proliferation risks of that and how much weapon-usable plutonium would be produced? Who would pay for reprocessing facilities, where would waste streams from reprocessing be disposed of and where would they be located? Would plutonium from reprocessing be used as fuel?

Recalling the failed mixed oxide fuel (MOX) project at DOE's Savannah River Site, how much would a plutonium fuel facility cost? That MOX debacle serves as a warning to production of plutonium fuel, for which there will be little demand. How much would it cost to produce plutonium or HALEU fuel and what would be the associated waste streams?

As the DOE's Waste Isolation Pilot Plant (WIPP) may well be oversubscribed, due to the volume cap under the Land Withdrawal Act and due to large amounts of TRU slated for that facility, where would TRU waste from any aspect of the so-called "advanced reactors" go? Demonstrate that WIPP with the current volume cap has capacity for any TRU from "advanced reactors." As TRU from plutonium disposition, nuclear warhead pit production and the Versatile Test Reactor are slated for WIPP, explain how TRU from "advanced reactors" fits in the WIPP pecking order for disposition.

How much volume and weight of TRU would be produced? How much LLW and Mixed LLW would be produced? Would any waste go to commercial facilities in Utah or Texas, or to DOE's National Nuclear Security Site in Nevada? What would local environmental impacts be of waste disposal at those sites?

I recall that in the mid-201os that boosters and contractors at the Savannah River Site proposed a fanciful "Energy Park," with "advanced" SMRs, reprocessing and plutonium fuel fabrication. The Clinch River project sounds similar. The SRS Energy Park never got off the ground. See

The news release by the Union of Concerned Scientist about the advanced reactor report is posted here - points raised here must be addressed as part of the PEIS record:

"Report Finds That ‘Advanced’ Nuclear Reactor Designs Are No Better Than Current Reactors—and Some Are Worse
Proposed Non-Light-Water Reactors Not Clearly Safer and Will Likely Take Decades to Achieve Reliable Commercial Operation"

Published Mar 18, 2021

WASHINGTON (March 18, 2021)—A report released today by the Union of Concerned Scientists (UCS) analyzed the designs of a number of so-called “advanced” non-light-water nuclear reactors currently in development and found that they are no better—and in some respects significantly worse—than the light-water reactors in operation today.

The 140-page report, *“Advanced” Isn’t Always Better*, assesses the pros and cons of three main types of non-light-water reactors: sodium-cooled fast reactors, high-temperature gas-cooled reactors, and molten salt-fueled reactors. It rates them on three broad criteria: safety and security; nuclear proliferation and terrorism risks; and “sustainability,” which refers to how efficiently they use uranium and how much long-lived nuclear waste they generate.

“If nuclear power is to play a larger role to address climate change, it is essential for new reactor designs to be safer, more secure, and pose comparable or—better yet—lower risks of nuclear proliferation and nuclear terrorism than the existing reactor fleet,” says report author Dr. Edwin Lyman, a physicist and director of nuclear power safety at UCS. “Despite the hype surrounding them, none of the non-light-water reactors on the drawing board that we reviewed meet all of those requirements.”

The report takes a close look at unsubstantiated claims developers are making about their designs, which are largely based on unproven concepts from more than 50 years ago. With little hard evidence, they assert that their reactors have the potential to lower costs, reduce nuclear waste, burn uranium more efficiently, strengthen safety, and lower the risk of nuclear proliferation.
One of the proposed sodium-cooled fast reactors, TerraPower’s 345 megawatt Natrium, has received considerable media attention recently because TerraPower founder Bill Gates has been citing it during interviews about his new book, *How to Avoid a Climate Disaster*. In mid-February, Gates told *60 Minutes* correspondent Anderson Cooper that the Natrium reactor will produce less nuclear waste and be safer

than a conventional light-water reactor.

In fact, according to the UCS report, sodium-cooled fast reactors such as the Natrium would likely be less “uranium-efficient.” They would not reduce the amount of waste that requires long-term isolation in a geologic repository. They also could experience safety problems that are not an issue for light-water reactors. Sodium coolant, for example, can burn when exposed to air or water, and a sodium-cooled fast reactor could experience uncontrollable power increases that result in rapid core melting.

“When it comes to safety and security, sodium-cooled fast reactors and molten salt-fueled reactors are significantly worse than conventional light-water reactors,” says Dr. Lyman. “High-temperature, gas-cooled reactors may have the potential to be safer, but that remains unproven, and problems have come up during recent fuel safety tests.”

Timing is also an issue. Some developers promise that they can demonstrate, license and deploy their non-light-water reactors on a commercial scale as early as the end of this decade, enabling them to address the climate crisis in the near term. For example, last fall the Department of Energy (DOE) gave both TerraPower and X-Energy, developer of a high-temperature, gas-cooled “pebble-bed” reactor, $80 million grants to begin operating first-of-a-kind commercial units by 2027, most likely at the Columbia Generating Station site in Washington.

According to the report, if federal regulators require the necessary safety demonstrations, it could take at least 20 years—and billions of dollars in additional costs—to commercialize non-light-water reactors, their associated fuel cycle facilities, and other related infrastructure.

“One of the new reactor designs being considered, the ‘breed-and-burn’ reactor, has the most potential because it doesn’t require reprocessing—or recycling—spent nuclear fuel, which poses unacceptable proliferation risks,” says Dr. Lyman. “But the concept is still saddled with considerable technical obstacles and safety hazards due to the fact that fuel would remain in the reactor longer than in a light-water reactor, allowing fission gases and pressure to build.”

The report recommends that the DOE suspend its advanced reactor demonstration program until the Nuclear Regulatory Commission determines whether it will require full-scale prototype tests before licensing any designs for commercial deployment, which the report argues are essential. It also calls on Congress to require the DOE to convene an independent commission to review the technical merits of all proposed non-light-water reactors and only approve projects with a high likelihood of commercialization that are clearly safer and more secure than the current fleet. Finally, the DOE and Congress should consider spending more research and development dollars on improving the safety and security of light-water reactors, rather than on commercializing immature, overhyped non-light-water reactor designs.

Thank you for considering these comments for the PEIS record.

From:	Tom Clements
To:	nepa
Subject:	Additional Comment of Clinch River Nuclear Site PEIS Fwd: Comment and attachments on Draft VTR EIS, by SRS Watch - please confirm receipt
Date:	Thursday, March 18, 2021 8:22:47 PM
Attachments:	Greg Jones on VTR Nov 19 2019.pdf plutonium disposition scoping comments by SRS Watch Jan 28 2021.pdf plutonium-inventory-SRS-2020-FOIA-rcvd-Sep-22-2020.pdf Comment by SRS Watch on draft VTR EIS Feb 12 2021.pdf

Comment for PEIS on Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Submitted by Tom Clements, Director, Savannah River Site Watch, Columbia, SC, https://srswatch.org/, March 19, 2021

In support of the No Action Alternative and for the PEIS record, I hereby submit my comments (and attachments) submitted on February 12, 2021 into the draft EIS record for the Versatile Test Reactor. Oak Ridge National Lab is considered an alternate site for that reactor. I supported the No Action Alternative in that NEPA process. Comments on the VTR are applicable to so-called "advanced reactors" that might be considered for the Clinch River site.

Please confirm receipt of this additional comment and four attachments (which must be considered in the PEIS).

The attached plutonium disposition comment is relevant given the issue of TRU disposal from "advanced reactors" in the Waste Isolation Pilot Plant. Such waste must be part of the requested PEIS needed on plutonium waste (TRU) disposal from various projects - plutonium disposition, pit production (for nuclear warheads) and the Versatile Test Reactor- in WIPP.

Thank you.

-----Original Message-----
From: Tom Clements [redacted]
To: [redacted]
Sent: Fri, Feb 12, 2021 10:27 am
Subject: Comment and attachments on Draft VTR EIS, by SRS Watch - please confirm receipt

February 12, 2021

To: Mr. James Lovejoy
Document Manager
U.S. Department of Energy
Idaho Operations Office
[redacted]

I hereby submit the attached comments for the record of the draft EIA on the VTR. Please confirm receipt.

I have also attached three documents for the record. Please confirm receipt of them.

The comment has been posted on the SRS Watch website at:

https://srswatch.org/srs-watch-comments-on-plutonium-fueled-versatile-test-reactor-halt-eis-process-for-unjustified-sodium-cooled-reactor/

I will also be mailing the above-mentioned documents.

I may submit other comments before the new comment period deadline of March 2, if I deem such comments to be relevant.

Thank you.

Tom Clements
Director, Savannah River Site Watch
[redacted]
https://srswatch.org/

TVA March 18, 2021

Programmatic Environmental Impact Statement Comments to Consider for Proposed Advanced Nuclear Reactor Technology Park at Clinch River Nuclear Site in Oak Ridge, Roane County, Tennessee

To whom it may concern,

Concerning the potential environmental effects association with the construction, operation, and decommissioning of an advanced nuclear reactor technology park that would produce up to 800 megawatts, thank you for listing the no-action alternative (A). Federal Register/Vol. 86, No. 23/Friday, February5, 2021/Notices

The PEIS evaluation lists a large number of possible impacts to be addressed including those of biological and environmental justice. The one not listed that should be included is climate change impacts. With increasing climate change disruptions and possible triggering feedback systems, any scoping should seek to determine whether advanced nuclear power will provide the <u>clean</u>, <u>reliable</u> and <u>low-cost</u> energy TVA has listed as the project purpose:

1. First, SMRS is not <u>clean</u> energy. Nuclear energy of any kind is not carbon free if one includes the uranium mining along with the processing and transportation emissions required to deliver a pellet to a fuel rod. Data shows us many worker illnesses from this fuel chain preparation. In these small modular reactors (SMRs), what will be the level of hydrogen buildup? Is there daily venting? What are the common wind patterns showing the path of any emissions and who will any releases impact? Is there water from the reactor being placed in the river and what is the level of tritium being deposited?
2. Is it <u>reliable</u>? No. Numerous shutdowns and accidents attributed to TVA nuclear reactors over the years give pause to think that we can rely on nuclear power. This base-load thinking is not going to be reliable in a climate heated world since the technology must have cool water. There have already been examples of nuclear power stations shutting down due to water being too hot or flooding and catastrophic storms. Please compare the option of renewable energy reliability when coupled with battery storage to the reliability of small nuclear reactors being considered.
3. What about <u>low cost</u>? Numerous studies have shown that renewable energy costs come in lower than that produced from nuclear reactors. Further, the building costs and building times are enormous and always more than originally declared e.g. seemingly never-ending Vogtle work. These upfront costs are supported by numerous loans and subsidies from DOE/taxpayers. The $4 million going to prepare this PEIS is wasted when the time to effectively constrain climate change impacts comes sooner than it will take to build a technology park. Not one kilowatt before 2030? What is the cost for equal equivalent of renewable energy construction

and megawatts production to 800MWe of nuclear power and how quickly can it come on line?

Safety

Not only does an advanced nuclear technology park not meet TVA's list of purposes for a project, but there is the matter of safety that is always of concern with nuclear power. Radiation exposure of course can be deadly. Is it worth the risk? Dr. Edwin Lyman from the Union of Concerned Scientists says it is not. In his report "Advanced Isn't Always Better" he states, "Nearly all of the NLWRs currently on the drawing board fail to provide significant enough improvements over LWRs to justify their considerable risks."

The report compares NLWRs to LWRs and shows that safety, sustainability and proliferation risk shows their safety is 'significantly worse'.

https://www.ucsusa.org/resources/advanced-isnt-always-better

Given Dr. Lyman's report pointing out the poor safety of advanced nuclear reactors, a safety perimeter and evacuation zones should not be lessened from those used for existing nuclear sites.

Then there is the radioactive waste issue. To date, no permanent solution has been found. The PEIS must address waste questions. How large is a spent fuel pool to accommodate fuel cells at appropriate distance? What storage casks will be used and where will they be stored or will the waste be transported to Western U.S. waste sites exposing humans along highways? What is the stewardship burden required to care for this long-lasting radioactive waste? What is the cost of dealing with waste. Consider this cost as part of the total cost for the park? What happens when decommissioning is required and what is the lifespan of these reactors?

Here are conclusions from a study and event by Dr. Lindsay Krall from the Stanford University Freeman Spogli Institute for International Studies regarding the various SMR designs. https://fsi.stanford.edu/events/critical-analysis-nuclear-waste-management-consequences-small-modular-reactors

By analyzing the published design specifications for water-, sodium-, and molten salt-cooled SMRs, I here characterize their notional, high-level waste streams in terms of decay heat, radiochemistry, and fissile isotope concentration, each of which have implications for geologic repository design and long-term safety. Volumes of low- and intermediate-level decommissioning waste, in the form of reactor components, coolants, and moderators, have also been estimated.

The results show that SMRs will not reduce the size of a geologic repository for spent nuclear fuel, nor the associated future dose rates. Rather, SMRs are poised to discharge spent fuel with relatively high concentrations of fissile material, which may pose re-criticality risks in a geologic repository. Furthermore, SMRs—in particular, designs that call for molten salt or sodium coolants—entail increased volumes of decommissioning waste, as compared to a standard 1100 MW_e, water-cooled reactor. Many of the anticipated SMR waste challenges are a consequence *of neutron leakage, a basic physical process that reduces the fuel burnup efficiency in small reactor cores. Common approaches to attenuating neutron leakage from SMRs, such as the introduction of radial neutron reflectors, will increase the generation of decommissioning waste. The feasibility of managing SMR waste streams should be performed before these reactors are licensed, and future clean energy policies should acknowledge the adverse impact that SMRs will have on radioactive waste management and disposal.*

More information may also be found on this subject in the "Handbook of Small Modular Nuclear Reactors" (ISBN 9780857098511).

<u>Environmental Concerns</u>
The site sits on a peninsula at an elevation of about 800 feet surrounded by the Clinch River which is at an elevation of about 740 feet. The proposed nuclear reactors will require that water be taken from the river. This will require a system to both pump the water to the reactors and return it to the river. The site map shows a canal cut. Due to the height between the top of the site and the river, inevitably there will be erosion and perhaps landslides due to increased heavy rain events already occurring in the Tennessee Valley. Management costs must be included in the site preparation.

While the land was cleared for the earlier nuclear reactor planned that was disbanded, the land has since returned to its forested state with accompanying flora and fauna that protect the riverbank. Please assess the economic value of carbon sequestration for the forest on this site during the years of reactor life (60 years?). How will the temperature of the coolant water be returned to the river in such a way as to not limit the well-being of aquatic species?

In conclusion one might ask who needs this energy? Given climate change impacts, the safety risks, high relative costs, waste issues, questionable designs, length of time to build, and damage to the environment, the non-action option A is the best choice. The real solution to meet energy demand is to quickly move to renewable energy with battery storage at suitable sites. If SMR research comes to fruition at all, other locations should be considered including brownfields. Surely, there are places in and around the already compromised Oak Ridge National Laboratory. The Clinch River site is better used as a forested carbon sequestration site in order to address climate change in the most meaningful, effective and low-cost way.

Respectfully,

Sandra L. Kurtz

Sandra Kurtz
For BEST (Bellefonte Efficiency & Sustainability Team)
[redacted]

TVA Advanced Reactor Scoping Comments for PEIS Advanced Reactor Technology Park - March 2021

These comments are respectfully submitted by the Tennessee Environmental Council and the Tennessee Chapter of the Sierra Club with the sincere hope they aid TVA making a comprehensive, unbiased Programmatic Environmental Impact Statement for the range of alternatives in this proposal for an advanced reactor technology park at the Clinch River Site.

It is the belief of both environmental advocacy non-profits that the successful completion of a comprehensive and unbiased PEIS should result in the adoption of Alternative A: The No Action Alternative. Unfortunately, TVA's pro-nuclear power biases make this unlikely. The very fact that TVA is willing to spend $4 million on this PEIS while eliminating consideration of construction of alternative energy generation sources is a key indicator. Even more troubling is TVA CEO Jeffrey Lyash's conflict of interest created by his role as Vice Chairman of the Nuclear Energy Institute (NEI). NEI is self-described as the voice of the US nuclear industry; its mission is "to promote the use and growth of nuclear energy."

It is troubling that after 70 years of commercial nuclear power in the US, billions upon billions of dollars of research world-wide, scores of failed reactor concepts and projects (thirteen of these TVA projects) that TVA can not identify a single proven reactor project to move forward with but is proposing 8 different technologies to consider.

How can TVA prolong its fascination with new nuclear power after its well-documented failed projects, cost over-runs, and schedule delays? Especially those in this century, after TVA should have already learned from its past mistakes. Watts Bar Unit 2 took over 40 years to complete: https://thebulletin.org/2015/10/watts-bar-unit-2-last-old-reactor-of-the-20th-century-a-cautionary-tale/ . Original cost estimates to finish both Watts Bar units was around $845 million. By the time both were finished somewhere around $13 billion had been spent.

What is an "advanced nuclear reactor"? It was defined in 2018 Federal legislation as "a nuclear fission reactor with significant improvements over the most recent generation of nuclear fission reactors" or a nuclear fusion reactor. (Fusion reactors are not being considered by TVA in this proposal.) Advanced reactors are really nothing new. According to the Congressional Research Service (Advanced Nuclear Reactors: Technology Overview and Current Issues (congress.gov)) most of these concepts have been studied since the dawn of the nuclear age, but relatively few, such as sodium-cooled reactors and the Fort St. Vrain high temperature gas cooled reactor have advanced to commercial scale demonstrations and that was decades ago in the US. Find a link to the history of the Fort St. Vrain reactor here: https://www.fsvfolks.org/FSVHistory.html . The Generation IV International Forum was formed over 20 years ago to promote the development of next generation reactors, with little to show for it in the way of electricity generation.

TVA is considering three different light water, small modular reactor (smr) designs and five non-light water reactor designs. (All power reactors operating in the US now are light water reactors.) TVA has been considering smrs and spending ratepayers' money on them for over a decade, with no electricity generated. The non-light water reactor designs are molten salt, fluoride salt, high temperature gas, molten chloride, and micro reactors.

Advanced nuclear power proponents provide an impressive list of unsubstantiated claims such as inherent safety features, lower waste yields, greater fuel utilization, superior reliability, nuclear weapons proliferation resistance, recycling used fuel, and on and on. None of these claims are proven, many are suspect and do not hold up to scrutiny. These claims are eerily like past, false claims of various proposed nuclear projects. In 1953 Admiral Hyman Rickover, the founder of the US Nuclear Navy, warned how trouble-free, economical, and uncomplicated proposed reactors sound and how problematic, expensive, and difficult they are to build and operate.

Please include the Union of Concerned Scientists' study: "Advanced" Isn't Always Better by Edwin Lyman in the PEIS. It was released to the public on March 18, 2021. It can be downloaded at this link: https://ucsusa.org/resources/advanced-isnt-always-better

Many of the non-light water reactor designs involve reprocessing highly irradiated used fuel, an extremely controversial process with intense environmental and weapons proliferation drawbacks. Many also involve using higher levels of enriched uranium or plutonium as fuel. The non-light water reactors offer many unresolved technical and safety challenges.

TVA should instead fully commit to transitioning to the least cost, fastest to deploy climate solutions: energy efficiency, wind and solar, and developing more energy storage technologies: https://www.reuters.com/article/us-usa-solar/u-s-solar-industry-predicts-installations-will-quadruple-by-2030-idUSKBN2B80AX?il=0; https://www.cnbc.com/2021/03/16/the-us-solar-industry-posted-record-growth-in-2020-despite-covid-19-new-report-finds.html; https://www.greentechmedia.com/articles/read/so-big-its-boring-the-rise-of-utility-scale-solar

This Nuclear Reactor Technology Park proposal is a highly speculative project that rises to the level of hyper overreach by TVA. It is a red flag that there are 8 possible reactor designs. This is not a power project; it is a hail mary pass to the failing nuclear industry. It is most certainly not an appropriate, productive, or cost-effective response to the climate crisis we are facing. Nuclear power is not clean power, it is not green power, it is not the least cost power or the lowest risk power.

It is a fundamental mistake for TVA to waste ratepayers' money on this costly technological overreach which is unlikely to ever generate any electricity. If an advanced reactor is ever completed it will certainly generate the most expensive electricity in TVA's portfolio. Given recent TVA and US experience with new reactors it will take until at least 2030 and probably much beyond that to complete any new reactor, advanced or not. It is far more likely that this project will never be completed.

Instead, TVA should put its considerable expertise and experience in building the clean, renewable energy grid of the future, utilizing a wide range of renewable resources including distributed and utility scale solar, wind, energy efficiency, and energy storage. Renewables are now the lowest cost power with the smallest negative environmental impact. Deployment of renewables and energy efficiency measures will also provide a strong economic boost to the Tennessee Valley. Please include this article: "Every Euro Invested in Nuclear Power Makes the Climate Crisis Worse" into the PEIS: https://www.dw.com/en/nuclear-climate-mycle-schneider-renewables-fukushima/a-56712368

TVA has a history of expensive, failed nuclear projects, much of the current debt was incurred from nuclear projects. TVA has started or planned 19 reactors (plus the Clinch River Breeder Reactor, which was a joint project), 7 are operating. Cost overruns of multiples of the original estimated costs are the rule, not the exception. TVA should know better by now than to continue to be fooled by the next false hope, or multiple false hopes, of the nuclear industry.

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Now TVA is contemplating changing course again and spending $4 million on this PEIS. It is entirely inappropriate for TVA to consider an "advanced" nuclear technology park given the experimental nature of the reactors. "Advanced reactors" is a catch-all term that is so broad it is meaningless. This is a bad financial bet for valley ratepayers.

TVA seems to have a blind eye to the immense negative environmental impacts of nuclear power. The entire nuclear fuel chain, from uranium mining through waste management needs to be recognized as harmful and factored into the analysis of environmental impacts. Nuclear reactors manufacture radiation.

Excess radiation, beyond background, is a biological threat. Man-made radiation must be contained and kept out of our biosphere until it decays into harmlessness, which can be millions of years for some isotopes. The most dramatic example is misleadingly named spent fuel. Spent fuel is millions of times more radioactive than new, unused fuel. All the highly irradiated used fuel generated by TVA's reactors is still onsite at those reactors, in the cooling pools or dry casks. At this time, after 70 or so years of nuclear power production, the United States has still not figured out what to do with this stuff. This is an immensely complicated issue, and when you dig deep into the details it gets more complicated, with many uncertainties in "aging management", especially the high-burnup fuel currently being discharged. Suffice it to say that we really do not know how to safely store "spent fuel". We are far from knowing how to dispose of it, how to keep it isolated for a million years: https://www.fairewinds.org/waste-and-spent-fuel.

TVA should be making every effort to stop making more radioactive waste, not looking for ways to create even more. That waste, accumulating in our nuclear communities is a threat to their and, indeed, the region's future. Current storage technologies have questionable safety protocols and are more of a risk than is acknowledged by TVA, the Nuclear Regulatory Commission, and the nuclear industry: https://sanonofresafety.org/nureg-2224-high-burnup-storage-and-transport/

The mythology around the benign characteristics of aging used nuclear fuel does not hold up to unbiased scrutiny. All of that radiation being contained by 5/8" thick, welded shut stainless steel canisters with no credible method to find cracks in the canisters, no way to fix them, no way to respond to an imminent or active leak, and no current method of moving the waste out of a failing canister into a new one. All this with a Chernobyl explosion's release amount of cesium in each canister. A breach of one pressurized, helium filled canister will result in massive amounts of radiation leakage and widespread contamination and disruption: (Please include this and all links in the issues to analyze for this PEIS) Spent Power Reactor Fuel: Pre-Disposal Issues (eesi.org).

The PEIS should consider the full range of environmental and safety issues around the used nuclear fuel for each of the proposed technologies. The consideration must cover both storage and disposal, and fuel aging management issues including deterioration of storage containment, breakdown of fuel structure over time, and the possibility of used fuel reaching spontaneous, uncontrolled fission during storage. Aging management over the course of decades, centuries, millennia, and eons should be carefully considered. The environmental impacts of major accidental releases of radiation from the stored fuel must be detailed for the EIS to be valid. The information available on this link should help with the analyses: https://fsi.stanford.edu/events/critical-analysis-nuclear-waste-management-consequences-small-modular-reactors .

The PEIS should evaluate the environmental impacts for the entire nuclear fuel chain separately for each of the proposed technologies.

The PEIS should consider the environmental and health impacts from uranium mining and milling: please include the following in your evaluation: After Decades of Uranium Mining, Navajo Nation Struggles With Legacy of Contamination - Bing video; The Toxic Legacy of Uranium Mining on Navajo Land: The Disproportionate Struggle of Indigenous Peoples and Water - (savethewater.org); Radioactive Waste From Uranium Mining and Milling | RadTown | US EPA; Uranium Mining and Milling Wastes: An Introduction (wise-uranium.org).

The PEIS should carefully and thoroughly consider the environmental and health impacts of processing the uranium and other fissionable materials into the specific fuel being considered for each of the proposed technologies, such as: high assay low enriched uranium (HALEU), tristructural isotropic (TRISO), and enriched uranium fuel for the light water reactors.

The PEIS should seriously and strenuously consider the environmental impacts of the most serious possible accident for each proposed technology. Past EIS's for TVA nuclear projects have dodged this issue by making the patently false claim that the chance of a serious, beyond design basis accident is so small that it is not necessary to do the work to calculate and postulate the environmental impact of such a disaster. Those words ring hollow in the aftermath of Chernobyl and Fukushima. The Fukushima melt-downs, explosions and massive radiation escape occurred to 3 General Electric Mark 1 reactors, almost identical to TVA's 3 Browns Ferry reactors.

The PEIS must consider the radiation released during normal operation, refueling, maintenance and repairs for each of the proposed technologies.

The PEIS must consider the low-level waste stream that will be created by each of the proposed technologies. This should include pathways for processing, disposal and possible reuse of any radioactive materials generated by the reactor and possible radiation exposure these cause to the public.

The PEIS must consider the eventual retirement and decommissioning of each of the proposed technologies. This should include all possible radiation exposure to the public and the environment from decommissioning.

The PEIS must consider the cumulative radiation load in and around Oak Ridge. Past activities have resulted in an enormous amount of man-made radioactivity that has been released into the environment in the area. This should include analysis of public health records for diseases know to be caused by exposure to radiation, even low doses.
http://www2.clarku.edu/mtafund/prodlib/global_green/Oak_Ridge.pdf

The PEIS should consider the nuclear weapons proliferation implications for each proposed nuclear reactor technology.

The PEIS should consider the increase in background radiation since the dawn of the nuclear age. It should consider the probable increases in background radiation in the future due to continued manufacture of man-made radiation and the inevitable release of some portion of that radiation into the environment world-wide. The PEIS should accurately translate those increases into likely radiogenic disease generation in humans, livestock, and wildlife.

Thank you for this opportunity to help in the scoping process.

Don Safer

[redacted]

March 18, 2021

J. Taylor Cates

NEPA Specialist

Tennessee Valley Authority

TVA Advanced Reactor Scoping Comments for PEIS Advanced Reactor Technology Park - March 2021

These comments are respectfully submitted by the Tennessee Environmental Council with the sincere hope they aid TVA making a comprehensive, unbiased Programmatic Environmental Impact Statement for the range of alternatives in this proposal for an advanced reactor technology park at the Clinch River Site.

It is our belief that the successful completion of a comprehensive and unbiased PEIS should result in the adoption of Alternative A: The No Action Alternative. Unfortunately, TVA's pro-nuclear power biases make this unlikely. The very fact that TVA is willing to spend $4 million on this PEIS while eliminating consideration of construction of alternative energy generation sources is a key indicator. Even more troubling is TVA CEO Jeffrey Lyash's conflict of interest created by his role as Vice Chairman of the Nuclear Energy Institute (NEI). NEI is self-described as the voice of the US nuclear industry; its mission is "to promote the use and growth of nuclear energy."

It is troubling that after 70 years of commercial nuclear power in the US, billions upon billions of dollars of research world-wide, scores of failed reactor concepts and projects (thirteen of these TVA projects) that TVA can not identify a single proven reactor project to move forward with but is proposing 8 different technologies to consider.

How can TVA prolong its fascination with new nuclear power after its well-documented failed projects, cost over-runs, and schedule delays? Especially those in this century, after TVA should have already learned from its past mistakes. Watts Bar Unit 2 took over 40 years to complete: https://thebulletin.org/2015/10/watts-bar-unit-2-last-old-reactor-of-the-20th-century-a-cautionary-tale/ . Original cost estimates to finish both Watts Bar units was around $845 million. By the time both were finished somewhere around $13 billion had been spent.

What is an "advanced nuclear reactor"? It was defined in 2018 Federal legislation as "a nuclear fission reactor with significant improvements over the most recent generation of nuclear fission reactors" or a nuclear fusion reactor. (Fusion reactors are not being considered by TVA in this proposal.) Advanced reactors are really nothing new. According to the Congressional Research Service (Advanced Nuclear

Reactors: Technology Overview and Current Issues (congress.gov)) most of these concepts have been studied since the dawn of the nuclear age, but relatively few, such as sodium-cooled reactors and the Fort St. Vrain high temperature gas cooled reactor have advanced to commercial scale demonstrations and that was decades ago in the US. Find a link to the history of the Fort St. Vrain reactor here: https://www.fsvfolks.org/FSVHistory.html . The Generation IV International Forum was formed over 20 years ago to promote the development of next generation reactors, with little to show for it in the way of electricity generation.

TVA is considering three different light water, small modular reactor (smr) designs and five non-light water reactor designs. (All power reactors operating in the US now are light water reactors.) TVA has been considering smrs and spending ratepayers' money on them for over a decade, with no electricity generated. The non-light water reactor designs are molten salt, fluoride salt, high temperature gas, molten chloride, and micro reactors.

Advanced nuclear power proponents provide an impressive list of unsubstantiated claims such as inherent safety features, lower waste yields, greater fuel utilization, superior reliability, nuclear weapons proliferation resistance, recycling used fuel, and on and on. None of these claims are proven, many are suspect and do not hold up to scrutiny. These claims are eerily like past, false claims of various proposed nuclear projects. In 1953 Admiral Hyman Rickover, the founder of the US Nuclear Navy, warned how trouble-free, economical, and uncomplicated proposed reactors sound and how problematic, expensive, and difficult they are to build and operate.

Please include the Union of Concerned Scientists' study: "Advanced" Isn't Always Better by Edwin Lyman in the PEIS. It was released to the public on March 18, 2021. It can be downloaded at this link: https://ucsusa.org/resources/advanced-isnt-always-better

Many of the non-light water reactor designs involve reprocessing highly irradiated used fuel, an extremely controversial process with intense environmental and weapons proliferation drawbacks. Many also involve using higher levels of enriched uranium or plutonium as fuel. The non-light water reactors offer many unresolved technical and safety challenges.

TVA should instead fully commit to transitioning to the least cost, fastest to deploy climate solutions: energy efficiency, wind and solar, and developing more energy storage technologies: https://www.reuters.com/article/us-usa-solar/u-s-solar-industry-predicts-installations-will-quadruple-by-2030-idUSKBN2B80AX?il=0; https://www.cnbc.com/2021/03/16/the-us-solar-industry-posted-

record-growth-in-2020-despite-covid-19-new-report-finds.html;
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Thank you for this opportunity to comment in the scoping process.

Don Safer

Board Member

Tennessee Environmental Council

[redacted]

March 18, 2021

From: Virginia Dale
To: nepa
Cc: [redacted]
Subject: Comments regarding TVA EIS Scope
Date: Friday, March 19, 2021 8:49:34 AM

These comments are in regard to the Notice of Intent (NOI) issued by TVA to prepare a Programmatic Environmental Impact Statement (PEIS) to address potential environmental effects associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at TVA's 935-acre Clinch River Nuclear (CRN) Site in Oak Ridge. The proposed site is a forest that provides many ecosystem services and habitat such as riparian areas, areas surrounding caves, and other potential habitat for bats, salamanders, and rare species. A brownfield site would be a much more appropriate location and there are brownfields that are available.

Half of the area was not cleared back in the 1970's when the Clinch River Breeder Reactor (CRBR) site work started and is a remarkable old hardwood forest. The area that was cleared for the CRBR more than 40 years ago is now a beautiful forest. Wildlife has returned in numbers to the extent that the Tennessee Wildlife Resources Agency in cooperation with TVA conducts permitted spring wild turkey hunting and deer hunting each fall. Furthermore, the site has been characterized as free of any legacy cold war era contamination.

The public expects TVA to be a responsible steward of public resources and to adhere to the fundamental principle of the preferred use of brownfields in site selection. Has this factor been included in the site reviews? The last thing we need be doing is creating another nuclear contaminated site, especially when there are many brownfield options.

No site options are discussed of the many (and growing number) of decommissioned fossil fuel power plants throughout the TVA system. These locations (such as the soon-to-be- closed Bull Run Fossil Plant) have the basic infrastructure needs for siting the SMR project including a railroad in most cases, as well as cooling water, highways, transmission lines, sewage system, potable water supply, etc. Thus saving 10's of millions of dollars over a greenfield site.
Thank you for considering these comments.

Best wishes,
Virginia Dale, [redacted]

From:	Tom Clements
To:	nepa
Subject:	Comment for PEIS record: NRC may end pursuit of rulemaking for reprocessing, impacting availability of plutonium fuels for "advanced reactors"
Date:	Friday, March 19, 2021 11:06:12 AM

Comment for PEIS on Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Submitted by Tom Clements, Director, Savannah River Site Watch, Columbia, SC, https://srswatch.org/, March 19, 2021

This comment is a day late but given the importance of the mentioned document, I request that this comment be accepted. This comment submits a NRC document which I believe supports the No Action Alternative.

I hereby file this March 5, 2021 NRC Policy memo, "DISCONTINUATION OF RULEMAKING SPENT FUEL REPROCESSING," for the PEIS record. The document is posted in the NRC's digital library (ADAMS) here:

https://www.nrc.gov/docs/ML2030/ML20301A388.pdf

From the document: "The purpose of this paper is to request Commission approval to discontinue the Spent Fuel Reprocessing rulemaking activity that was directed by Staff Requirements Memorandum (SRM) SECY-13- SECY-13-0093 Reprocessing Regulatory Framework 4, 2013 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13308A403). The U.S. Nuclear Regulatory Commission (NRC) staff has determined that a continued rulemaking effort is not currently justified, as there is limited interest expressed or expected from potential applicants for reprocessing facilities, including advanced reactor designers, in the near-term use of reprocessed spent fuel. Therefore, while a rule could provide additional clarity for potential applicants, it is not currently cost-justified. This paper does not contain any new commitments or resource implications."

The document also states: "...advanced reactor applicants indicated that they have limited near-term interest (within the next
decade or two) in the use of reprocessed spent fuel."

And, the document says: "NEI and industry representatives voiced their support for continuing the rulemaking primarily on the basis of a need for a clear and stable regulatory framework for reprocessing and to support advanced reactor licensing. However, no industry stakeholders indicated that they plan to submit an application to the NRC for a reprocessing facility in the foreseeable future. Other stakeholders, such as UCS and members of the public, indicated they do not support the continuation of the rulemaking because of proliferation and other concerns."

And it states: "NEI stated that developers with advanced reactor designs that may eventually source their fuel from the spent fuel of other reactors are generally not planning to do so in the near future." And: "NEI indicated that this group has not identified any near-term plans for developing reprocessing capabilities for advanced reactor designs and that it would inform the NRC of any such plans identified in the future..." And. also stated: "Based on these interactions, the staff concluded that current DOE efforts in the area of reprocessing are aimed at providing a limited near-term supply of high-assay low-enriched uranium (HALEU) for initial advanced reactor designs."

The document concludes: "Given the estimated costs and the limited interest, expressed or expected, from potential applicants and advanced reactor designers in building facilities involving reprocessing technologies in the near-term, the staff concludes that, while a rule could provide additional clarity for potential applicants, a continued rulemaking effort is not currently justified." And that the NRC staff recommends that the NRC Commission "Discontinue the Spent Fuel Reprocessing rulemaking."

The PEIS on the Clinch River Nuclear Site must take into account the impact on the provision of plutonium fuels for so-called "advanced reactors" if the Commission does terminate the rulemaking, essentially ending pursuit of commercial reprocessing in the US. The PEIS must discuss where plutonium fuel will come from if there is no reprocessing in the US. If "advanced reactor" proponents advocate plutonium fuels what will be the source of such plutonium - Europe or plutonium pits stockpiled by NNSA at the Pantex site? If there is a lack of plutonium for fuel, how can the plutonium-fueled reactors be pursued?

From:	Wufoo
To:	nepa
Subject:	Scoping Comments - Clinch River Nuclear Site EIS [#4]
Date:	Friday, March 19, 2021 11:57:58 PM

Name	D'Arrigo, Keegan
City	[redacted]
State	[redacted]
Organization	NIRS, CFNFGL
Email	[redacted]
Phone Number	[redacted]
Please provide your comments by uploading a file or by entering them below. *	Nuclear Information and Resource Service and Coalition for A Nuclear Free Great Lakes request a 6 month extension on the comment period and submit preliminary comments.
Upload File #1	nirs_cfnfgl_ext_req_comments_on_tva202100010001_fed_reg_no_202102144_peis_clinch_river_smnr_park.pdf 148.31 KB · PDF

From: [redacted]
To: nepa
Cc: [redacted]
Subject: Comments on scope of Programmatic EIS
Date: Friday, March 19, 2021 2:17:51 PM

Subject: comments on Notice of Intent to prepare a Programmatic Environmental Impact Statement (PEIS) to address potential environmental effects associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park at TVA's former Clinch River Breeder Reactor Nuclear Site in Oak Ridge.

Dear TVA,

1. Scope must review additional site alternatives. The options considered in the ESPA were too limited and the assumptions for the ESPA analysis are no longer valid or appropriate.

2. Scope must clearly define and categorize the different habitats and sensitive species that over the past two years (2019-2021) AND THAT CURRENTLY utilize the proposed sites.

3. Scope should identify sensitive natural areas including all riparian zones within 500 meters of the Clinch River, any ephemeral stream or standing water, and all caves and potential habitat for bats.

4. Scope should include development of specific definitions and mechanisms to safeguard natural areas and sensitive habitat, and focus any future disturbance on brown fields.

5. Scope should specifically include considerations to protect all flood plains from any potential disturbance.

6. Scope should consider provisions to facilitate future public access to the shoreline and floodplains.

7. Most critical change to proposed PEIS: Scope should prioritize a systematic analysis to identify and consider existing and future (soon to be idled industrial sites) brown field sites that will require investment in remediation, allowing multiple objectives to be achieved by the research park.

The current scope relies upon a flawed and limited analysis of alternative sites in the ESPA. Although the ESPA was approved by NRC, conditions and information have changed and these changes merit new review. The physical and policy context, and future plans for power plants and industrial site developments in the TVA region, have changed since the analyses for the ESPA were initiated. Therefore, a new assessment of alternative sites is required.

Specifically, please modify current proposed scope to consider and evaluate alternatives that include all other existing and idled power plant and large industrial sites, including former nuclear research sites, in the TVA Region, using the criteria above and in the current scope. Many of the alternative sites can provide adequate space for the infrastructure, industrial (rail) access, and would allow site development at lower cost than that being proposed.
Thank you for considering these comments,

-Keith Kline

[redacted]

From: Wufoo
To: nepa
Subject: Scoping Comments - Clinch River Nuclear Site EIS [#3]
Date: Friday, March 19, 2021 7:35:14 PM

Name	Laura Thurman
City	[redacted]
State	[redacted]
Organization	none
Email	[redacted]
Phone Number	[redacted]

Please provide your comments by uploading a file or by entering them below. *

I am opposed to the development of a nuclear power plant in Oak Ridge. Although nuclear energy is much cleaner than energy produced by fossil fuel plants, nuclear reactors produce waste hazardous to our environment that will outlive all of us. I previously lived within the 5-10 mile radius and evacuation region of the Watts Bar Nuclear Plant and was relieved to move away from that location. My childhood home was less than one mile from the Kingston Fossil Fuel Plant on Swan Pond Road in Midtown TN where I lived from 1977 to 1991. As a child I grew up swimming in those waters around the Kinston coal plant, eating the fish, and breathing the air. That house was purchased and destroyed following the coal ash spill of 2008. In 2018 I was diagnosed with an aggressive form of non-hereditary breast cancer. Although no definitive connection can be made for my personal health experiences, fossil fuel emissions have been determined harmful to humans and the environment. The 2008 Kingston coal ash spill itself and the handling of the cleanup gives me great concern and causes me to have great doubt in TVA's ability to operate any facility safely for the community's best interest. Like fossil fuel emissions, nuclear waste has been determined harmful to humans and to our environment. There are limits on how much the hazards of nuclear waste can be controlled. For all practical purposes, nuclear waste never goes away. It only becomes a problem for someone else. Primarily it is the poorer communities who are stuck with fence line proximity to hazardous waste producing plants and to the storage of hazardous waste. I know great efforts have been made in recent years to clean Oak Ridge of its hazardous nuclear waste by relocating it to other parts of the country. Why would we want to begin creating more hazardous nuclear waste in Oak Ridge now? I oppose the further development of nuclear power and fossil fuel power plants in general, and specifically in Oak Ridge where I now live and hope to remain living. I feel the development of solar and wind energy would be more appropriate for our current and future energy needs as well as the continuing benefit of our health and environment.

TVA Advanced Reactor Scoping Comments for PEIS Advanced Reactor Technology Park - March 2021

These comments are respectfully submitted by the Tennessee Chapter of the Sierra Club with the sincere hope that they aid TVA in making a comprehensive, equitable Programmatic Environmental Impact Statement for the range of alternatives in this proposal for an advanced reactor technology park at the Clinch River Site.

It is our belief that the successful completion of a comprehensive and unbiased PEIS should result in the adoption of Alternative A: The No Action Alternative. We feel that this Alternative A should be retitled as "Alternative A: The No Nuclear Action Alternative" since current advanced energy alternatives are renewable technologies such as solar and wind, with new energy storage methods.

It is troubling that after 70 years of commercial nuclear power in the US, billions upon billions of dollars of research world-wide, scores of failed reactor concepts and projects (thirteen of these TVA projects) that TVA can not identify a single proven reactor project to move forward with but is proposing 8 different technologies to consider.

Why should TVA prolong its fascination with new nuclear power after its well-documented failed projects, cost over-runs, and schedule delays? Especially those in this century, after TVA should have already learned from its past mistakes. Watts Bar Unit 2 took over 40 years to complete: https://thebulletin.org/2015/10/watts-bar-unit-2-last-old-reactor-of-the-20th-century-a-cautionary-tale/ . Original cost estimates to finish both Watts Bar units was around $845 million. By the time both were finished somewhere around $13 billion had been spent.

What is an “advanced nuclear reactor”? It was defined in 2018 Federal legislation as “a nuclear fission reactor with significant improvements over the most recent generation of nuclear fission reactors” or a nuclear fusion reactor. (Fusion reactors are not being considered by TVA in this proposal.) Advanced reactors are really nothing new. According to the Congressional Research Service (Advanced Nuclear Reactors: Technology Overview and Current Issues (congress.gov)) most of these concepts have been studied since the dawn of the nuclear age, but relatively few, such as sodium-cooled reactors and the Fort St. Vrain high temperature gas cooled reactor have advanced to commercial scale demonstrations and that was decades ago in the US. Find a link to the history of the Fort St. Vrain reactor here: https://www.fsvfolks.org/FSVHistory.html . The Generation IV International Forum was formed over 20 years ago to promote the development of next generation reactors, with little to show for it in the way of electricity generation.

TVA is considering three different light water, small modular reactor (smr) designs and five non-light water reactor designs. (All power reactors operating in the US now are light water reactors.) TVA has been considering smrs and spending ratepayers' money on them for over a decade, with no electricity generated. The non-light water reactor designs are molten salt, fluoride salt, high temperature gas, molten chloride, and micro reactors.

Advanced nuclear power proponents provide an impressive list of unsubstantiated claims such as inherent safety features, lower waste yields, greater fuel utilization, superior reliability, nuclear weapons proliferation resistance, recycling used fuel, and on and on. None of these claims are proven, many are suspect and do not hold up to scrutiny. These claims are eerily like past, false claims of various proposed nuclear projects. In 1953 Admiral Hyman Rickover, the founder of the US Nuclear Navy, warned how trouble-free, economical, and uncomplicated proposed reactors sound and how problematic, expensive, and difficult they are to actually build and operate.

Please review the Union of Concerned Scientists' study: "Advanced" Isn't Always Better by Edwin Lyman in the PEIS. It was released to the public on March 18, 2021. It can be downloaded at this link: https://ucsusa.org/resources/advanced-isnt-always-better

Many of the non-light water reactor designs involve reprocessing highly irradiated used fuel, an extremely controversial process with intense environmental and weapons proliferation drawbacks. Many also involve using higher levels of enriched uranium or plutonium as fuel. The non-light water reactors offer many unresolved technical and safety challenges.

This Nuclear Reactor Technology Park proposal is a highly speculative project - it is a red flag that there are 8 possible reactor designs. This is not a power project; it is a hail mary pass to the failing nuclear industry.

It is a fundamental violation of the Tennessee Valley Authority Act of 1933 mission to be "a national leader in technological innovation, low-cost power, and environmental stewardship" for TVA to waste ratepayers' money on this costly nuclear endeavor which is unlikely to ever generate any electricity. If an advanced reactor is ever completed, it will certainly generate the most expensive electricity in TVA's portfolio. Given recent TVA and US experience with new reactors, it will take until at least 2030 and probably much beyond that to complete any new reactor, advanced or not. It is far more likely that this project will never be completed.

TVA should instead fully commit to putting its considerable expertise and experience in building the clean, renewable energy grid of the future, utilizing a wide range of renewable resources including distributed and utility scale solar, wind, energy efficiency, and energy storage.: https://www.reuters.com/article/us-usa-solar/u-s-solar-industry-predicts-installations-will-quadruple-by-2030-idUSKBN2B80AX?il=0; https://www.cnbc.com/2021/03/16/the-us-solar-industry-posted-record-growth-in-2020-despite-covid-19-new-report-finds.html; https://www.greentechmedia.com/articles/read/so-big-its-boring-the-rise-of-utility-scale-solar

Renewables are now the lowest cost power with the smallest negative environmental impact. Deployment of renewables and energy efficiency measures will also provide a strong economic boost to the Tennessee Valley. Please consider this article: "Every Euro Invested in Nuclear Power Makes the Climate Crisis Worse" into the PEIS: https://www.dw.com/en/nuclear-climate-mycle-schneider-renewables-fukushima/a-56712368

TVA has a history of expensive, failed nuclear projects - much of the current TVA debt was incurred from nuclear projects. TVA has started or planned 19 reactors (plus the Clinch River Breeder Reactor, which was a joint project), only 7 are operating. Cost overruns of multiples of the original estimated costs are the rule, not the exception. TVA should know better by now.

In 2005 the dominant nuclear hope was the new, supposedly improved, and cost-effective Westinghouse AP 1000. TVA was originally slated to be the first US utility to build these (Bellefonte Units 3 and 4). TVA reversed course and the AP 1000 went on to bankrupt Westinghouse while taking its fiscal train wreck to South Carolina and Georgia. The South Carolina reactors were cancelled after some $9 billion was wasted: The failed V.C. Summer nuclear project: A timeline | Choose Energy®. The Georgia reactors are still under construction, more than 5 years behind schedule and the cost has doubled, from $14 to $28 billion: https://cleanenergy.org/blog/vogtle-units-3-4-vcm-23-six-more-months-700-million-more-dollars/ ; Is There More Trouble Ahead for Plant Vogtle Expansion? Experts testify that serious challenges remain - SACE | Southern Alliance for Clean EnergySACE | Southern Alliance for Clean Energy

TVA next pursued small modular reactors, first mPower in 2013 and then NuScale. The mPower project collapsed and NuScale filled the breach. TVA wisely decided to let UAMPS (Utah Associated Municipal Power Systems) lead the way and that project is teetering on the edge of abandonment. Current estimates of the first completed NuScale smr are now 2029, it was originally projected to be 2023, then 2027. There are serious doubts that any will ever be completed. Here is a link to a study of problems with the UAMPS project by M.V. Ramana:

https://d3n8a8pro7vhmx.cloudfront.net/oregonpsrorg/pages/21/attachments/original/1600287829/EyesWideShutReport_Final-30August2020.pdf?1600287829

Now TVA is contemplating changing course again and spending $4 million on this PEIS. It is entirely inappropriate for TVA to spend ratepayers money on an “advanced” nuclear technology park given the experimental nature of the reactors.

TVA also seems to have a blind eye to the immense negative environmental impacts of nuclear power. The entire nuclear fuel chain, from uranium mining through waste management needs to be recognized as harmful and factored into the analysis of environmental impacts. Nuclear reactors manufacture radiation which can take millions of years to decay into harmlessness for some isotopes. The most dramatic example is the misleadingly named spent fuel. Spent fuel is millions of times more radioactive than new, unused fuel. All the highly irradiated used fuel generated by TVA’s reactors is still onsite at those reactors, in the cooling pools or dry casks.

At this time, after 70 or so years of nuclear power production, the United States has still not figured out what to do with this stuff. This is an immensely complicated issue, and when you dig deep into the details it gets more complicated, with many uncertainties in “aging management”, especially for the high-burnup fuel currently being discharged. We are far from knowing how to safely store or dispose of "spent fuel", how to keep it isolated for a million years: https://www.fairewinds.org/waste-and-spent-fuel.

TVA should be making every effort to stop making more radioactive waste, not looking for ways to create even more. That waste, accumulating in our nuclear communities, is a threat to the region’s future. Current storage technologies have questionable safety protocols and are more of a risk than is acknowledged by TVA, the Nuclear Regulatory Commission, and the nuclear industry: https://sanonofresafety.org/nureg-2224-high-burnup-storage-and-transport/

The mythology around the benign characteristics of aging used nuclear fuel does not hold up to scrutiny. All of that radiation being contained by 5/8” thick, welded shut stainless steel canisters with no credible method to find cracks in the canisters, no way to fix them, no way to respond to an imminent or active leak, and no current method of moving the waste out of a failing canister into a new one - all this with a Chernobyl explosion’s release amount of cesium in each canister. A breach of one pressurized, helium filled canister will result in massive amounts of radiation leakage and widespread contamination and disruption: (Please include this and all links in the issues to analyze for this PEIS) Spent Power Reactor Fuel: Pre-Disposal Issues (eesi.org).

The PEIS should consider the full range of environmental and safety issues around the used nuclear fuel for each of the proposed technologies. The consideration must cover both storage and disposal, and fuel aging management issues including deterioration of storage containment, breakdown of fuel structure over time, and the possibility of used fuel reaching spontaneous, uncontrolled fission during storage. Aging management over the course of decades, centuries, millennia, and eons should be carefully considered. The environmental impacts of major accidental releases of radiation from the stored fuel must be detailed for the EIS to be valid. The information available on this link should help with the analyses: https://fsi.stanford.edu/events/critical-analysis-nuclear-waste-management-consequences-small-modular-reactors .

The PEIS should evaluate the environmental impacts for the entire nuclear fuel chain separately for each of the proposed technologies.

The PEIS should consider the environmental and health impacts from uranium mining and milling: please include the following in your evaluation: After Decades of Uranium Mining, Navajo Nation Struggles With Legacy of Contamination - Bing video; The Toxic Legacy of Uranium Mining on Navajo Land: The Disproportionate Struggle of Indigenous Peoples and Water - (savethewater.org); Radioactive Waste From Uranium Mining and Milling | RadTown | US EPA; Uranium Mining and Milling Wastes: An Introduction (wise-uranium.org).

The PEIS should carefully and thoroughly consider the environmental and health impacts of processing the uranium and other fissionable materials into the specific fuel being considered for each of the proposed technologies, such as: high assay low enriched uranium (HALEU), tristructural isotropic (TRISO), and enriched uranium fuel for the light water reactors.

The PEIS should seriously and strenuously consider the environmental impacts of the most serious possible accident for each proposed technology. Past EIS's for TVA nuclear projects have dodged this issue by making the claim that the chance of a serious, beyond design basis accident is so small that it is not necessary to do the work to calculate and postulate the environmental impact of such a disaster. Those words ring hollow in the aftermath of Chernobyl and Fukushima. The Fukushima melt-downs, explosions and massive radiation escape occurred to 3 General Electric Mark 1 reactors, almost identical to TVA's 3 Browns Ferry reactors.

The PEIS must consider the radiation released during normal operation, refueling, maintenance and repairs for each of the proposed technologies.

The PEIS must consider the low-level waste stream that will be created by each of the proposed technologies. This should include pathways for processing, disposal and possible reuse of any radioactive materials generated by the reactor and possible radiation exposure these cause to the public.

The PEIS must consider the eventual retirement and decommissioning of each of the proposed technologies. This should include all possible radiation exposure to the public and the environment from decommissioning.

The PEIS must consider the cumulative radiation load in and around Oak Ridge. Past activities have resulted in an enormous amount of man-made radioactivity that has been released into the environment in the area. This should include analysis of public health records for diseases know to be caused by exposure to radiation, even low doses.
http://www2.clarku.edu/mtafund/prodlib/global_green/Oak_Ridge.pdf

The PEIS should consider the nuclear weapons proliferation implications for each proposed nuclear reactor technology.

The PEIS should consider the increase in background radiation since the dawn of the nuclear age. It should consider the probable increases in background radiation in the future due to continued manufacture of man-made radiation and the inevitable release of some portion of that radiation into the environment world-wide. The PEIS should accurately translate those increases into likely radiogenic disease generation in humans, livestock, and wildlife.

Thank you for this opportunity to help in the scoping process.

William Moll - Conservation Chair - Tennessee Chapter, Sierra Club

Scott Banbury - Conservation Coordinator - Tennessee Chapter, Sierra Club

Don Safer - Know Nukes Chair - Tennessee Chapter, Sierra Club

March 19, 2021

From: [redacted]
To: nepa
Subject: COMMENTS ON PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT-CLINCH RIVER NUCLEAR SITE ADVANCED NUCLEAR REACTOR TECHNOLOGY PARK
Date: Saturday, March 20, 2021 12:01:35 AM

Erwin Citizens Awareness Network, Inc. (ECAN)

Linda Cataldo Modica, Vice President

[redacted]

19 March 2021

J. Taylor Cates
NEPA Specialist
1101 Market Street
BR 2C-C
Chattanooga, TN 37402 VIA EMAIL: nepa@tva.gov

RE: COMMENTS ON PROGRAMMATIC ENVIRONMENTAL IMPACT STATEMENT-CLINCH RIVER NUCLEAR SITE ADVANCED NUCLEAR REACTOR TECHNOLOGY PARK

Dear NEPA Specialist:

Erwin Citizens Awareness Network, Inc. (ECAN) is a community group comprised of families who live in or near Erwin &/or who are downwind &/or downstream of BWXT-Nuclear Fuel Services (NFS). Because NFS has had previous contracts with TVA, and because NFS is currently engaged in another agreement to down-blend highly-enriched uranium (HEU) to low-enriched fuel for TVA reactors, ECAN has a keen interest in TVA actions.

Known as the "sieve of the nuclear industry", NFS has been declared by the Agency for Toxic Substances and Disease Registry (ATSDR) as an Indeterminant Public Health Hazard, based on past conditions, even though ATSDR did not evaluate the health impacts of "radioactive materials released from this site". (p.22)

While the ATSDR did not investigate the health impact of specific processes like the HEU-to-LEU down-blending that NFS does for TVA, the National Nuclear Security Administration

(NNSA) has. In its Supplement Analysis on the Disposition of Highly Enriched Uranium, the NNSA found that the increased risk of a Latent Cancer Fatality from the down-blending process to the total offsite population was "1 chance in 71 for NFS". (p.11, Table 4.2-2, footnote c)

Additionally, ECAN has done extensive sampling downwind and downstream from NFS and -- through analysis of soil, water and sediment samples through mass spectrometry by Dr. Michael Ketterer – proved that, in part because NFS processes uranium for TVA reactors, that the Nolichucky River is contaminated with enriched uranium for 95 river-miles downstream of Erwin.

Because a 1-in-71 chance of a cancer death is being caused by the radioactive fuel needs of TVA's nuclear power program, TVA has failed to "foster the social…welfare of the people of the Tennessee Valley".

Because TVA's nuclear fuel supplier has caused widespread offsite contamination downwind and downstream through the down-blending of HEU-to-LEU for TVA 's nuclear power program, TVA has failed to "promote the proper use and conservation of the Valley's natural resources".

Instead, TVA's nuclear program has abused the bodies of our families and northeast Tennessee's drinking water sources – including our wells, springs and, especially, the Nolichucky River -- as sacrificial nuclear waste dumps. Given TVA's past record, ECAN expects that TVA's so-called "advanced" nuclear program will do the same.

Further, because women and girls are disproportionately harmed by radiation exposure yet Nuclear Regulatory Commission (NRC) regulations fail to protect those at greatest risk of cancer and because TVA clearly lacks a safety culture as demonstrated by the bullying that management has exerted when workers raise concerns, ECAN has zero confidence in NRC oversight of the TVA nuclear program or of its fuel supplier's operations either. Nor does ECAN have any confidence in TVA's ability to build and operate its nuclear wish list without worker intimidation and abuse of the public's health and safety.

Finally, in order to "foster the economic welfare of the people of the Tennessee Valley region" TVA must first restore the health of the people already harmed by the air and water borne effluents of its dirty and dangerous nuclear program.

Therefore, Erwin Citizens Awareness Network urges the NO ACTION ALTERNATIVE. Doing no further harm is the only way that TVA will "foster the social…welfare of the people…and promote the proper use and conservation of the Valley's natural resources" as the TVA's mission requires.

Thank you for your serious consideration of these comments.

Respectfully,

Linda Cataldo Modica, Vice President
Erwin Citizens Awareness Network, Inc.

From:	Diane D"Arrigo
To:	nepa
Cc:	Diane D"Arrigo; Mike Keegan
Subject:	NIRS CNFGL Extension Request and Comments on TVA 2021-0001-0001 Fed Reg 2021-02144
Date:	Saturday, March 20, 2021 12:09:09 AM
Attachments:	NIRS CFNFGL Ext Req Comments on TVA-2021-0001-0001 Fed Reg No 2021-02144 PEIS Clinch River SMNR Park.pdf advanced-isnt-always-better-full.pdf

Nuclear Information and Resource Service and **Coalition for A Nuclear Free Great Lakes**

Extension Request and Comments re TVA-202100001-0001

Programmatic Environmental Impact Statement: Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park

Federal Register Number 2021-02144

Please extend the comment period for 6 months on the future plans for the Clinch River Site.

The COVID-19 pandemic is still requiring significant attention by members of the public, making review of documents and new nuclear plans difficult and extra burdensome. Plans to develop nuclear facilities on this site have been proposed for decades and ultimately not proceeded. Please do not rush another effort at a nuclear for this site through under the cover of the continuing Covid-19 pandemic crisis. Both US House and US Senate letters have called on federal entities to hold off until after the Covid-19 crisis to embark on actions involving public participation and input. By proceeding, TVA is rushing through the first steps of the National Environmental Policy Act process. This is really a national issue affecting Tennessee, the TVA region, the parts of the country affected by the fuel chain necessary to fuel the proposed reactors at Clinch River, the parts of the country affected by the nuclear transportation and those that will be asked to sacrifice to store the long-lasting nuclear waste that would be generated.

There are many interpretations of what 'new' or 'advanced' nuclear reactors are thus commenters need more time to respond to the potential array of ideas being promoted at the site. It will take time to get the information needed to address this. Please review the Union of Concerned Scientists report on Small Modular Reactors (https://www.ucsusa.org/sites/default/files/2021-03/advanced-isnt-always-better-full.pdf) regarding technology, dangers, costs and wastes. It addresses many of the claims made by proponents of nuclear reactors which are not substantiated.

The Scope of the PEIS should consider as better alternatives--renewable, sustainable energy and energy storage. The Scope must assess what will be done with the very long-lasting high-level irradiated ('spent") fuel and low-level waste generated by every one of the nuclear power reactor designs and the routine releases into air and water, worker and public exposures and all of these at every step of the fuel chain to generate the fuel including mining and reprocessing.

We support the NO ACTION alternative especially in light of the inadequate time to fully address the proposed scope--involving one or more reactor designs that are incomplete and not licensed.

We submit for the record the Union of Concerned Scientists' new report on small modular nuclear reactors (https://www.ucsusa.org/sites/default/files/2021-03/advanced-isnt-always-better-full.pdf) and an article submitted by a retired geologist on Canada's proposal for small modular nuclear reactors. (https://www.acadienouvelle.com/mon-opinion/2021/02/24/un-desastre-economique-environnemental-social-et-politique-nous-attend/)***

Thank you for consideration of this urgent request.

Diane D'Arrigo
Nuclear Information and Resource Service

[redacted]

Michael J. Keegan

Coalition for a Nuclear Free Great Lakes

[redacted]

March 19, 2021

****New Brunswick:*

An economic, environmental,

social and political disaster looms

by Mark D. Connell, Retired Geologist, l'Acadie Nouvelle, February 24, 2021

https://tinyurl.com/3u6vxr8k

To the Premier of New Brunswick: your government's announcement to continue funding Small Modular Nuclear Reactor (SMNR) projects in the province is misguided and should be rescinded.

Canada does not produce enriched uranium. The enriched nuclear fuel needed for SMNRs, including plutonium, would, of necessity, be imported from the US nuclear waste stockpiles, even from its nuclear weapons programs.

Importing this material would make us a military and terrorist target. This is not a decision that a wise statesman would make.

The waste generated by SMNR creates several artificial radioactive elements, one of which has a half-life of more than one million years. Plutonium, the element used in the atomic bomb dropped on Nagasaki in 1945, has a half-life of 24,000 years. It will be present and generated both as fuel and as waste.

These diabolically toxic, mutagenic and carcinogenic elements must be kept out of the biosphere for 10 half-lives. This is hardly a good health care system for New Brunswickers, let alone the rest of the biosphere.

Over the past 1.5 million years, the planet has experienced three well-documented ice ages (recent research suggests as many as seven). Over the next 240,000 years (10 plutonium half-lives), there will be at least one ice age and the accompanying continental ice sheet will be up to 2.5 kilometers thick.

The unimaginable weight of these ice caps will push the continental crust into the underlying mantle of the earth for hundreds of meters while eroding and fracturing the surface of the continental crust in the process (the southern limits of the last continental ice cap were south of New York City).

As the earth emerges from an ice age, the ice caps melt, relieving the colossal weight imposed on the earth's crust, which bounces upward in response to the discharge, proliferating new fractures and reactivating faults that become channels for fluids, toxic or otherwise, to rise to the surface. Burial of nuclear waste can in no way safeguard the biosphere during these periods. There is no safe long-term way to dispose of nuclear waste. Once created, radioactive elements cannot be destroyed. There is no long-term technical solution.

We simply have to stop making them. Babcock and Wilcox, who built the Calandria *[reactor vessel]* at the Point Lepreau nuclear station, abandoned SMNRs as uneconomic in 2017. Transatomic Power did the same in 2018, and Westinghouse abandoned it after a decade of research in 2014.

Wall Street and U.S. banks will not finance SMNRs. Why then, Mr. Premier, should it be the role of our government to make New Brunswickers pay the bill if no one else does?

Especially considering that New Brunswick's deficit has already been created in large part by the publicly subsidized cost overruns for the construction and operation of the Point Lepreau nuclear reactor.

Throwing money out the window to pay in perpetuity for the disposal of our own radioactive waste is not a good idea in today's neo-liberal austerity orthodoxy.

Mr. Prime Minister, why would any jurisdiction willingly accept the costs of disposing of U.S. military waste in perpetuity?

If it is electrical energy that we need, wouldn't it be wiser to source it from more environmentally friendly and cheaper hydroelectric sources in Quebec or Labrador?

The entire SMNR project is an economic, environmental, social and political disaster that is just waiting to happen.

New Brunswick must cut its losses and get out of it.

Mark D. Connell, Retired Geologist

Sussex, New Brunswick

From: Steven Sondheim
To: nepa
Subject: No build alternative Peis Clinch River
Date: Saturday, March 20, 2021 12:09:52 AM

This is an EXTERNAL EMAIL from outside TVA. THINK BEFORE you CLICK links or OPEN attachments. If suspicious, please click the “Report Phishing” button located on the Outlook Toolbar at the top of your screen.

No, this project is not necessary and in the wrong direction. Use monies to ramp up EE/Renewable. Retire nucs on a stated timetable and build no new ones

Uneconomical

Unnecessary

Waste-no more

Dangerous-leaks radioactivity, accident

Too late-we can have replacement clean energies-not nuc or fossil-by the time advanced reactors would be ready if ever.

Steven Sondheim
[redacted]

From: [redacted]
To: nepa
Subject: Clinch River Nuclear Reactor Project
Date: Thursday, March 25, 2021 4:54:01 PM

Sorry to have missed your deadline by 6 days. It will give you the excuse to avoid answering these hard questions.

Justify why, with your record of management incompetence and lack of oversight by the TVA board, you are qualified to manage this project. Why, with TVA's history of top management impropities at Watts Bar, complete mismanagement at all management levels of the Kingston ash spill,0 and now an "F" on climate action from the Sierra Club for "talking green to the public but doing little to change practices," do you feel prepared to manage the Clinch River Project? Convince me and the public that you have the management expertise and commitment!

David Reichle
[redacted]

Appendix D – List of Authorizations, Permits, and Certifications

APPENDIX D

LIST OF AUTHORIZATONS, PERMITS, AND CERTIFICATIONS

TVA will obtain all necessary permits, licenses, and approvals required for the alternative selected. TVA anticipates the following may be required for implementing the proposed alternatives. Any other necessary permits would be evaluated based on site-specific conditions. Details of permitting requirements to be determined based upon final design.

Table D-1
Authorizations Required for Construction and Operation Activities

Agency	Authority	Requirement	Activity Covered
Federal Aviation Administration	Federal Aviation Act 49 U.S.C. § 106; 14 CFR Part 77	Construction Notice	Notice of erection of structures more than 200 fee high that potentially may affect air navigation
U.S. Department of Transportation (DOT)	Hazardous Material Transportation Act 49 CFR Part 107 Subpart G	Certificate of Registration	Transportation of hazardous materials
Tennessee Department of Transportation (TDOT)	TCA 54-5-302	Entrance Permits	This includes ramps, driveways, and other access points. Requires traffic studies and engineering designs to show design and potential impacts of proposed changes.
TDOT	TCA § 54-5-302	Right-of-way (ROW) Permit	Required for installing utilities in highway ROWs
U.S. Army Corps of Engineers (USACE)	Clean Water Act, 33 CFR Parts 323 and 330	Section 404 Permit	Disturbance, crossing, or filling-in of wetland areas or navigable waters from site
	Rivers and Harbors Act, 33 U.S.C. § 403 *et seq*.	Section 10 Permit	Construction and maintenance ofintake, discharge, and barge structures in navigable waters of the United States
U.S. Coast Guard	Ports and Waterways Safety Act, 33 U.S.C. §§ 1221 *et seq*.	Private Aids to Navigation Permit	Construction of discharge pipeline in navigable waters
U.S. Environmental Protection Agency (EPA) and Tennessee Department of Environment and Conservation (TDEC)	Resource Conservation and Recovery Act, Section 3010	Acknowledgement of Notification of Hazardous Waste Activity	Hazardous Waste Generation

Agency	Authority	Requirement	Activity Covered
	EPA Facility Response Plan (40 CFR Part 112), and the EPA Hazardous Waste Contingency Plan	Facility Response Plan Approval	Spill/Discharge Response Program
	Spill Prevention, Control and Countermeasures (SPCC) rule (40 CFR Part 112)	SPCC/Integrated Pollution Prevention (IPP) Plan	Spill/Discharge Response Program
U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act Section 7 (16 U.S.C. § 1536)	Consultation/Biological Assessment	Evaluation of effects on listed species
USFWS	Migratory Bird Act/Executive Order 13186	Responsibility of Federal Agencies to Protect Migratory Birds	TVA is exempt from the Act requirements, but complies voluntarily; TVA is subject to the Executive Order
City of Oak Ridge		Municipal Site Plan Approval	Coordination with the Planning Board and/or Zoning Board of Adjustment for development of the site in compliance with city ordinances
		Flood Encroachment Permit/Floodplain Permit	Compliance with City of Oak Ridge Zoning Article IX Special Districts 9.08 a, b, c Floodway Districts, Floodway Fringe Area; mostly covered in Stormwater Pollution Prevention Plan and grading permit
		Sanitary Sewer Connection	Compliance with the City Industrial Pre-treatment Program if required, or connection to the City Wastewater Treatment System
		Potable Water	A potable water line on the small modular reactor site would tap intothe existing City of Oak Ridge water line on Bear Creek Road. If the existing waterline has to be extended for TVA, additional planning and approvals would be necessary by the city.
		Construction Permits	Construction of the new plant facilities in compliance with city ordinances

Agency	Authority	Requirement	Activity Covered
TDEC	Federal Clean Water Act (33 U.S.C. §§ 1251 *et seq.*) and Tennessee Code Annotated (TCA) § 69-3-108: Tennessee Water Quality Control Act of 1977	Notice of Intent (NOI) for coverage under an Individual National Pollution Discharge Elimination System (NPDES) Permit for stormwater discharges associated with construction activities.	Compliance with Federal and State water-quality standards, discharges to waters of the state due to construction of the new plant, switchyards, and transmission lines (aboveground and underground). Construction/operation of stormwater control measures (detention basins, etc.). Provided that pollution prevention measures are implemented, the construction general permit covers discharges associated with: • construction activities • construction support activities (e.g., concrete or asphalt batch plants, equipment staging yards, material storage areas, excavated material disposal areas, borrow areas) • dewatering of work areas of collected stormwater and groundwater • water used to wash vehicles • water used to control dust • routine building washdown • uncontaminated groundwater • unpolluted foundation or footing drains. Appropriate dewatering controls include, but are not limited to, weir tank, dewatering tank, gravity bag filter, sand media particulate filter, pressurized bag filter, cartridge filter or other control units providingthe level of treatment necessary to comply with permit requirements.

Agency	Authority	Requirement	Activity Covered
	Federal Clean Water Act (33 U.S.C. §§ 1251 *et seq.*) and TCA § 69-3-108: Tennessee Water Quality Control Act of 1977 (continued)	Stormwater Pollution Prevention Plan, to include Common Plan of Development, Soil Erosion and Sediment Control Plan (structural control measures, engineering design of sediment basin/controls for projects 10 ac or greater), etc.	Compliance with Federal and State water-quality standards, discharges to waters of the state due to construction of the new plant, switchyards, and transmission lines (aboveground and underground)
		Aquatic Resource Alteration Permit required for alterations of a stream or wetland, including diversion of surface waters of the state.	Clinch River arm of the Watts Bar Reservoir water required for cooling purposes. Portions of the new plant site, proposed causeway, switchyards, and onsite and potential offsite transmission lines may be located in freshwater wetlands and transitional areas.
		NPDES Industrial Stormwater General Permit for plant operation activities; EPA Application Forms 2D (Application for Permit to Discharge Process Wastewater) and 2F (Application for Permit to Discharge Stormwater Discharges Associated with Industrial Activity)	Cooling water, service water, and stormwater runoff discharge from plant operations
		NOI for NPDES General Permit of Discharges from the Application of Pesticides (TNP100000)	Point source discharges of pesticides used for mosquito and other flying insect pest control, weed and algae control, animal pest control, and forest canopy pest control to waters of the state
		Sanitary Wastewater – Portable Facilities	Must use licensed wastewater hauler
		Permanent Sanitary Wastewater	Connect to Wastewater Treatment Plant

Agency	Authority	Requirement	Activity Covered
	Tennessee Water Resources Information Act, TCA §§ 69-7-301 *et seq*.	Water Resources Notification; Water Withdrawal Registration	Surface-water or groundwater withdrawal of an average of ≥10,000 gal/day
	Federal Clean Air Act, 42 U.S.C. § 7401 *et seq*.	Title V Operating Permit; Prevention of Significant Deterioration Preconstruction Permit	Discharge of air pollutants from cooling tower(s), emergency generators, auxiliary boiler(s), and ancillary equipment
TDEC Division of Radiological Health (DRH)	TCA § 68-202-201 *et seq*. TDEC Rule 0400- 20-10-.32	Obtain a License-for-Delivery from the DRH (Form RHS 8-30). Persons whose activities result in the generation of radioactive waste have the primary responsibility for assuring that a License-for-Delivery is obtained.	Transportation of radioactive waste within the State of Tennessee to a disposal/processing facility
TN State Historic Preservation Office (SHPO) Tribal Historic Preservation Officer (THPO)	Section 106 of the National Historic Preservation Act (NHPA)	As a Federal agency, TVA is required to comply with Section 106 of the NHPA, which includes SHPO/THPO, and identification of potentially affected resources, i.e., a site survey.	Protection of archaeological and historical resources

Appendix E – Coordination

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From: Hurley, Bobbie
To: Freeman, Carol; Horton, Ruth M
Subject: FW: Request for farmland conversion impact rating of Clinch River Reactor project
Date: Friday, October 16, 2015 8:43:13 AM
Attachments: ClinchRiverSMRProject_AD1006_10_16_2015.pdf

Bobbie Hurley
AECOM
864-234-8913 (W)
864-918-5836 (C)

From: Khiel, Anthony - NRCS, KNOXVILLE, TN [mailto:Anthony.Khiel@tn.usda.gov]
Sent: Friday, October 16, 2015 9:23 AM
To: Hurley, Bobbie
Subject: RE: Request for farmland conversion impact rating of Clinch River Reactor project

Bobbie:

Attached please find the AD-1006 with sections IV and V completed. If you need any additional information, please feel free to contact me at any time.

Thanks,
Anthony

Anthony Khiel, CPSS
Resource Soil Scientist
9737 Cogdill Rd
Suite 152C
Knoxville, TN 37932
W: 865-671-3830 x. 112
C: 865-243-0769
Anthony.khiel@tn.usda.gov

From: Hurley, Bobbie [mailto:Bobbie.Hurley@aecom.com]
Sent: Wednesday, October 14, 2015 2:12 PM
To: Khiel, Anthony - NRCS, KNOXVILLE, TN <Anthony.Khiel@tn.usda.gov>
Cc: Horton, Ruth M <rmhorton@tva.gov>; Freeman, Carol <Carol.Freeman@aecom.com>
Subject: RE: Request for farmland conversion impact rating of Clinch River Reactor project

Anthony,

Thank you for your review. Approximately 328 acres would be permanently converted within the

CRN Site, including the entire 240-acre area previously disturbed during the CRBRP. An additional approximately 140 acres within the CRN Site would be temporarily converted as a result of construction activities, mostly to the northeast of the main plant site. Within the offsite Barge/Traffic area approximately 30 acres would be permanently converted (of which approximately 12.1 acres have been previously disturbed) and an additional 15 acres would be temporarily converted. Overall, the entire 935 acres of the CRN site would be unavailable for use as farmland because the site would be restricted access. Much of the Barge/Traffic Area is DOE property that already has restricted access. Attached is a new Figure 4 that shows the permanently and temporarily cleared areas. The GIS files for these are also included for download in the link below. If you need additional information please let me know and we will be happy to assist.

This file will be available for download until 10/21/2015

File	Description	Size
USDA_Figure 4 Data.zip		13,495KB

Download all files (.zip)

Bobbie Hurley
AECOM
864-234-8913 (W)
864-918-5836 (C)

From: Khiel, Anthony - NRCS, KNOXVILLE, TN [mailto:Anthony.Khiel@tn.usda.gov]
Sent: Wednesday, October 07, 2015 12:31 PM
To: Hurley, Bobbie
Subject: RE: Request for farmland conversion impact rating of Clinch River Reactor project

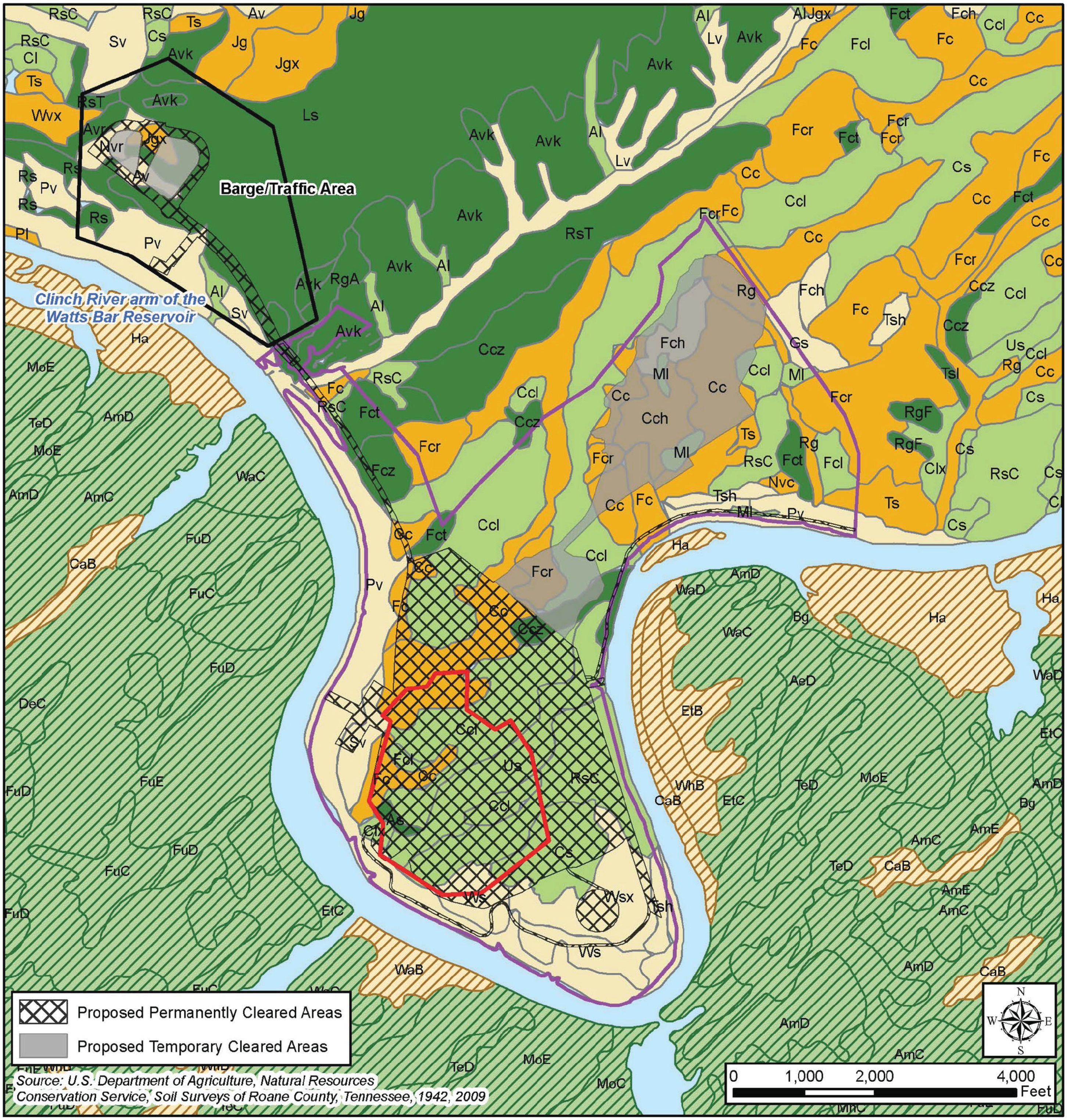
Roberta:

I received your request for Farmland Protection Policy Act (FPPA) review of the Clinch River Reactor project and I need to get a little more information that was not in the documentation that I had forwarded to me. On the enclosed AD-1006, you have listed that the entire 1131 acres will be converted and I wanted to make sure this was correct or is the area that was manipulated in 1983-1984 the area that will be impacted by the overall project (240 acres).

Thanks for your help.
Anthony

Anthony Khiel, CPSS
Resource Soil Scientist
9737 Cogdill Rd
Suite 152C
Knoxville, TN 37932

W: 865-671-3830 x. 112
C: 865-243-0769
Anthony.khiel@tn.usda.gov



Legend

Sensitive/Pre-decisional

1942 Soil Survey

- First-class (good to excellent cropland)
- Second-class (fair to good cropland)
- Third-class (poor to fair cropland)
- Fourth-class (best suited to pasture)
- Fifth-class (best suited to forest)

2009 Soil Survey

- Prime Farmland
- Not Prime Farmland
- Previously Excavated Area
- CRN Site
- Barge/Traffic Area

Figure 4. CRN Site Prime Farmland Soils

U.S. Department of Agriculture

FARMLAND CONVERSION IMPACT RATING

PART I *(To be completed by Federal Agency)*	Date Of Land Evaluation Request 9/30/15
Name Of Project Clinch River SMR Project	Federal Agency Involved Tennessee Valley Authority
Proposed Land Use Small modular reactor (SMR) facility	County And State Roane County, Tennessee
PART II *(To be completed by NRCS)*	Date Request Received By NRCS 10/8/15

Does the site contain prime, unique, statewide or local important farmland? *(If no, the FPPA does not apply -- do not complete additional parts of this form).*	Yes ☑	No ☐	Acres Irrigated na	Average Farm Size 88 acres

Major Crop(s)	Farmable Land In Govt. Jurisdiction	Amount Of Farmland As Defined in FPPA
corn	Acres: 19,476 % 8	Acres: 100,596 % 40
Name Of Land Evaluation System Used: LESA	Name Of Local Site Assessment System: na	Date Land Evaluation Returned By NRCS: 10/16/15 ARK 10/12

PART III *(To be completed by Federal Agency)*	Maximum Points	Site A	Site B	Site C	Site D
		Alternative Site Rating			
A. Total Acres To Be Converted Directly		1,131.0			
B. Total Acres To Be Converted Indirectly		0.0			
C. Total Acres In Site		1,131.0	0.0	0.0	0.0
PART IV *(To be completed by NRCS)* Land Evaluation Information					
A. Total Acres Prime And Unique Farmland		178.0			
B. Total Acres Statewide And Local Important Farmland		0.0			
C. Percentage Of Farmland In County Or Local Govt. Unit To Be Converted		0.2			
D. Percentage Of Farmland In Govt. Jurisdiction With Same Or Higher Relative Value		0.9			
PART V *(To be completed by NRCS)* Land Evaluation Criterion Relative Value Of Farmland To Be Converted *(Scale of 0 to 100 Points)*		37	0	0	0
PART VI *(To be completed by Federal Agency)* Site Assessment Criteria *(These criteria are explained in 7 CFR 658.5(b)*	Maximum Points				
1. Area In Nonurban Use		15			
2. Perimeter In Nonurban Use		10			
3. Percent Of Site Being Farmed		0			
4. Protection Provided By State And Local Government		0			
5. Distance From Urban Builtup Area		15			
6. Distance To Urban Support Services		0			
7. Size Of Present Farm Unit Compared To Average		0			
8. Creation Of Nonfarmable Farmland		10			
9. Availability Of Farm Support Services		5			
10. On-Farm Investments		0			
11. Effects Of Conversion On Farm Support Services		0			
12. Compatibility With Existing Agricultural Use		10			
TOTAL SITE ASSESSMENT POINTS	160	65	0	0	0
PART VII *(To be completed by Federal Agency)*					
Relative Value Of Farmland *(From Part V)*	100	37	0	0	0
Total Site Assessment *(From Part VI above or a local site assessment)*	160	65	0	0	0
TOTAL POINTS *(Total of above 2 lines)*	260	102	0	0	0

Site Selected:	Date Of Selection	Was A Local Site Assessment Used? Yes ☐ No ☐

Reason For Selection:

(See Instructions on reverse side) **Form AD-1006 (10-83)**

This form was electronically produced by National Production Services Staff

TVA TENNESSEE VALLEY AUTHORITY

400 West Summit Hill Drive, Knoxville, Tennessee 37902

August 26, 2021

Mr. E. Patrick McIntyre, Jr.
Executive Director
and State Historic Preservation Officer
Tennessee Historical Commission
2941 Lebanon Pike
Nashville, Tennessee 37243-0442

Dear Mr. McIntyre:

TENNESSEE VALLEY AUTHORITY (TVA) - CLINCH RIVER NUCLEAR (CRN) SITE ADVANCED NUCLEAR REACTOR TECHNOLOGY PARK PROJECT, CULTURAL RESOURCES SURVEY, LOUDON AND ROANE COUNTIES, TENNESSEE (35.89923, -84.37794) (TVA TRACKING NUMBER – CID 77972)

TVA is continuing to evaluate potential effects of siting one or more nuclear power plant(s) on the TVA CRN Site, located in Oak Ridge, in Roane County, Tennessee. The CRN Site occupies approximately 935 acres of TVA managed lands adjacent to the U.S. Department of Energy's (DOE) Oak Ridge Reservation. In May 2016, TVA submitted an application to the Nuclear Regulatory Commission (NRC) for an early site permit at the CRN Site for two or more new nuclear power units demonstrating small modular reactor (SMR) technology. Prior to submitting the application, TVA completed cultural resources investigations and consulted with your office and federally recognized Indian tribes regarding the SMR project's potential effects on historic properties. Our offices entered into a programmatic agreement in 2015 ("Programmatic Agreement Between the Tennessee Valley Authority and the Tennessee State Historic Preservation Office Regarding the Management of Historic Properties Affected by the Clinch River SMR Project"). This agreement defined the project's area of potential effects (APE) and allowed for the phased identification and evaluation of historic properties. In August 2016, our offices executed an Amended and Restated Programmatic Agreement (hereafter, "Agreement"). The Agreement implemented several changes to the original agreement: enlarged the scope of the Agreement to include SMR construction; corrected errors in the original agreement concerning the participating tribes and the acreage of DOE land exempted from a recent archaeological survey; and corrected minor drafting issues. That same month, we also consulted with your office regarding an expansion of the APE to include Melton Hill Dam and a half-mile radius surrounding it, as a result of TVA's consideration of possible changes at the dam related to the SMR project.

TVA is now assessing the potential environmental effects associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park ("Nuclear Park") at the CRN Site. TVA's project goal is to demonstrate new nuclear technology through the construction and operation of one or more advanced nuclear reactors at the CRN Site. The Nuclear Park would contain one or more advanced nuclear reactors (an SMR or another type of non-light water reactor) with a cumulative electrical output not to exceed 800 MW electric. This proposed project represents the further development of TVA's Clinch River SMR project. The purposes of the Nuclear Park would be to: evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities; support TVA's 2019 Integrated Resource Plan (IRP) by continuing to evaluate emerging nuclear technologies as part of technology innovation efforts aimed at developing future generation capacities; and support TVA's innovation mission as another way to serve the people of the Valley.

The advanced reactors being considered would be built within the 935-acre CRN Site, which is within the APE as defined in the Agreement. The potential effects of this project on archaeological sites or aboveground properties listed in or eligible for listing in the National Register of Historic Places (NRHP) do not differ substantially from the potential effects of the SMR project as we described it in our prior consultations, for the activities that would take place within the CRN Site. All potential physical and visual effects of the proposed Nuclear Park (including the demonstration project) in the CRN Site would be consistent with the types and scales of potential effects we took into consideration in those prior consultations and as described in the Agreement.

However, TVA also is considering two related actions that would require new construction outside the Clinch River SMR APE. We have not previously consulted on these actions:

1. TVA is considering possible roadway improvements along Jones Island Road in order to accommodate the traffic necessary for construction. Roadway improvements could include widening, turn lanes, and traffic signals, and a roundabout at the Jones Island Road/TN95 intersection. The affected property is owned by the DOE.

2. TVA is also considering the construction of a 161-kilovolt (kV) transmission line at the CRN Site, connecting to an existing TVA transmission line on adjacent DOE property. Construction of this transmission line would require extensive vegetation clearing and the installation of multiple steel transmission structures; some of this activity would take place outside the CRN Site.

The areas that could be affected by the newly proposed roadway improvements (approximately 69 acres), and the northern portion of the area that would be affected by the 161-kV transmission line (18 acres), were not included in our previous cultural resources surveys. Therefore, TVA proposes to enlarge the undertaking's APE to include these two areas. Figure 1 shows the CRN site and these two additional areas that we propose to include in the APE. Most of these areas are in Roane County, but a small portion of the Jones Island Road corridor is in Loudon County. Most of the 161-kV transmission line corridor is within the CRN Site, but an 18-acre portion extends onto DOE property north of the CRN Site.

To comply with the requirements of Section 106 of the National Historic Preservation Act and its implementing regulations at 36 CFR § 800, TVA conducted a new Phase I Cultural Resources survey to identify archaeological sites and above-ground historic properties that may be affected by the proposed road modifications. Although the majority of the transmission line corridor was included in our prior surveys and consultation, out of an abundance of caution we included the entire proposed 161-kV transmission line corridor in the archaeological survey.

TVA contracted with Wood E&I Solutions ("Wood") for the cultural resources survey that included an archaeological survey in the project corridors and a survey of historic architectural resources in the viewshed of Jones Island Road. To facilitate the historic architectural survey, TVA requested that Wood provide a GIS-based viewshed model. Wood completed both surveys in April 2021. The report, titled, *Phase I Cultural Resources Survey for the Proposed Jones Island Road/TN-95 Interchange, Clinch River SMR Project, Loudon and Roane Counties, Tennessee*, can be downloaded.

Seven previously recorded archaeological sites are located within the survey area. Sites 40RE156, 40RE159, 40RE162, and 04RE547 were previously identified within the proposed 161-kV transmission line corridor; sites 40RE101-40RE104 are located within the Jones Island Road corridor. Site 40RE159 has been destroyed by previous construction associated with the Clinch River Breeder Reactor project. Previous investigators recommended site 40RE104 as potentially eligible for the NRHP and sites 40RE156, 40RE162, and 40RE547 as ineligible. Despite close-interval shovel testing, none of the previously recorded sites was relocated during the current survey. The survey identified two additional sites, 40RE631 and 40RE632. Wood recommends that 40RE631, a late 19th/early 20th century homestead site with associated structural remains (and a minor precontact component), could be eligible for the NRHP and that if the project would result in ground disturbance at this location, that additional archaeological investigations be conducted to determine eligibility. Wood recommends that site 40RE632, a low-density precontact lithic scatter, is ineligible.

The historic architectural survey included areas within a half-mile radius of the proposed Jones Island Road improvements, which had not been included in TVA's prior historic architectural survey and desktop review. (The prior survey and desktop review are described in our May 20, 2015 letter to your office regarding the Clinch River SMR project). Wood's research indicated that 15 potentially historic aboveground resources (FS-1 through FS-15) fall within the half-mile radius; these include six historic cemeteries. Based on Wood's analysis, all but one of these resources (FS-1 through FS-4 and FS-6 through FS-15) should be considered ineligible for the NRHP. Wood recommends that FS-5, a ca. 1830 Colonial Revival house, should be considered eligible under Criterion C for architectural significance. Wood's viewshed analysis shows that this house would only have very limited visibility to the proposed project due to dense vegetation, which includes abundant evergreen vegetation (cedars in particular). Wood recommends, therefore, that the proposed modifications to Jones Island Road and the new 161-kV transmission line within the CRN Site would not result in an adverse effect on this property.

The northern extension of the proposed 161-kV transmission line would extend approximately 680 feet north of the CRN Site and tap into an existing TVA 161-kV transmission line running along the north side of Grassy Creek (Figure 2). This area was not included in the Phase I

Cultural Resources survey, and falls outside the area of the previous architectural reviews. Therefore, TVA Cultural Compliance staff conducted a desktop review of this approximately 18-acre area outside the CRN Site and surrounding areas within a half-mile radius in order to evaluate potential visual effects on any NRHP-listed or –eligible aboveground resources.

Construction of this new 161-kV transmission line would require vegetation clearing to create a 100-foot wide cleared corridor within an extensive wooded area. However, TVA would leave intact a wide buffer of forest on all sides. The visibility of the new transmission line would be greatly reduced by this vegetation, and also by topography. Grassy Creek runs through a narrow valley between Pine Ridge and Chestnut Ridge; both ridges rise over 300 feet in elevation above the floodplain (Figure 3). Bear Creek Road parallels Grassy Creek on the north side and provides access to three small light industrial facilities. TVA anticipates that the viewshed of the transmission line would essentially consist of the cleared transmission line right-of-way itself and the cleared area surrounding one of the industrial facilities. Figure 4, a photograph taken during the 2010 field review, shows the characteristic forest and slopes in this area.

The Tennessee Historical Commission Online Viewer indicates no inventoried properties within a half mile of this area, and there are no NRHP listings in this area. Historic maps (1941 editions of the U.S.G.S Bethel Valley, Tennessee and Elverton, Tennessee 7.5-minute quadrangles; see Figure 5) indicate three structures along Bear Creek Road. Satellite imagery suggests those structures may no longer be extant, but cannot confirm if that is the case. However, current satellite imagery and observations made during a 2010 field review document that the thick vegetation that characterizes this area would block views of the transmission lines from those three locations, and that the industrial development along Bear Creek Road has compromised the historic integrity of setting. TVA finds the construction of the 161-kV transmission line would affect no NRHP-listed or –eligible aboveground historic properties.

We have read Wood’s report and find that it represents a reasonable and good faith identification effort. We agree with Wood’s NRHP eligibility recommendations for archaeological sites 40RE631 and 40RE632. Site 40RE631 is located near the eastern end of the Jones Island Road corridor, near the interchange with Highway 95. TVA has not yet developed specific plans for the roadway improvements, but TVA will seek ways to avoid any potential adverse effects on this potentially eligible site. Pursuant to the PA, when those plans are developed, we will evaluate the project’s potential effects and consult further with your office regarding our effect finding. Once project plans are developed, if TVA is unable to avoid adverse effects on this site we will consult further to develop a treatment plan for the mitigation of the adverse effect on the site.

TVA agrees with Wood’s recommendations regarding the majority of the aboveground resources, with the exceptions of the Waller Cemetery (FS-12), Hensley Cemetery (FS-13), and the Gallaher Cemetery (FS-14). The Waller Cemetery was established in 1878 and appears to retain integrity of setting and feeling. Wood’s scope of work did not include extensive genealogical or historical research on the Waller family; therefore, the cemetery’s potential eligibility under Criteria A and B has not been fully evaluated. Similarly, TVA did not have Wood perform extensive genealogical or historical research on the Hensley Cemetery (established ca. 1920s) or Gallaher Cemetery (ca. 1872-1876). The Gallahers were one of the early Euroamerican families who initially settled land on James White's original grant in the 1820s (Barrett et al. 2011:35). This cemetery also appears to retain some integrity. TVA considers the Waller, Hensley, and Gallaher cemeteries to be of undetermined eligibility for the NRHP.

As shown by Wood's photographic documentation, the Waller Cemetery (FS-12) is entirely surrounded by a thick stand of mixed vegetation. This vegetation would block views from the Waller Cemetery toward the project. The Hensley Cemetery (FS-14) and the Gallaher Cemetery (FS-15) are both located in small clearings within thickly wooded areas, and would have no clear views toward the project. Therefore, none of these cemeteries would have a direct line of sight to the proposed Jones Island Road changes or the proposed 161-kV transmission line. In addition, none of TVA's plans for the Nuclear Technology Park project, including the proposed 161-kV line and Jones Island Road improvements, would physically affect any of the cemeteries. TVA finds that all three cemeteries are located outside the undertaking's APE. As project plans are developed, TVA will ensure that the undertaking will include no physical effects on any of the six cemeteries identified in the cultural resources survey, regardless of their NRHP eligibility status.

TVA finds that a single NRHP-eligible resource, FS-5 (Colonial Revival House) is located within the APE. TVA finds further that the proposed Jones Island Road improvements and 161-kV transmission line would result in no adverse effects on any properties that are included in or eligible for the NRHP.

Pursuant to 36 CFR Part 800.3(f)(2), TVA is consulting with federally recognized Indian tribes regarding properties within the proposed project's APE that may be of religious and cultural significance to them and eligible for the NRHP.

Pursuant to 36 CFR Part 800.5(c) we are seeking your agreement with TVA's eligibility determinations, finding that the undertaking as currently planned will have no adverse effects on historic properties, and intention to follow the Clinch River SMR PA regarding the undertaking's potential effects on archaeological site 40RE631.

Please contact Steve Cole by email, sccole0@tva.gov, with your comments.

Sincerely,

Clinton E. Jones
Manager
Cultural Compliance

SCC:ABM
Enclosures
cc (Enclosures):
Ms. Jennifer Barnett
Tennessee Division of Archaeology
1216 Foster Avenue, Cole Bldg. #3
Nashville, Tennessee 37210

Reference Cited

Barrett, Jared, Kelly Hockersmith, Ted Karpynec, and Larry McKee
2011 *Phase I Archaeological Survey of the Clinch River small Modular Reactors Project (SMR), Roane County, Tennessee*. Prepared by TRC Environmental Corporation, Nashville, Tennessee, for Tennessee Valley Authority, Norris, Tennessee.

INTERNAL COPIES NOT TO BE INCLUDED WITH OUTGOING LETTER:

S. Dawn Booker, BR 2C-C
J. Taylor Cates, BR 2C-C
Stephen C. Cole, WT 11C-K
Michael C. Easley, BR 2C-C
Carol Freeman, BR 2C-C
Brandon J. Hartline, BR 2C-C
Ruth M. Horton, WT 11B-K
Susan R. Jacks, WT 11C-K
Dana M. Nelson, WT 11B-K
Rebecca C. Tolene, WT 11C-K
William B. Wells, BR 2A-C,
W. Douglas White, WT 11C-K
ECM, ENVRecords

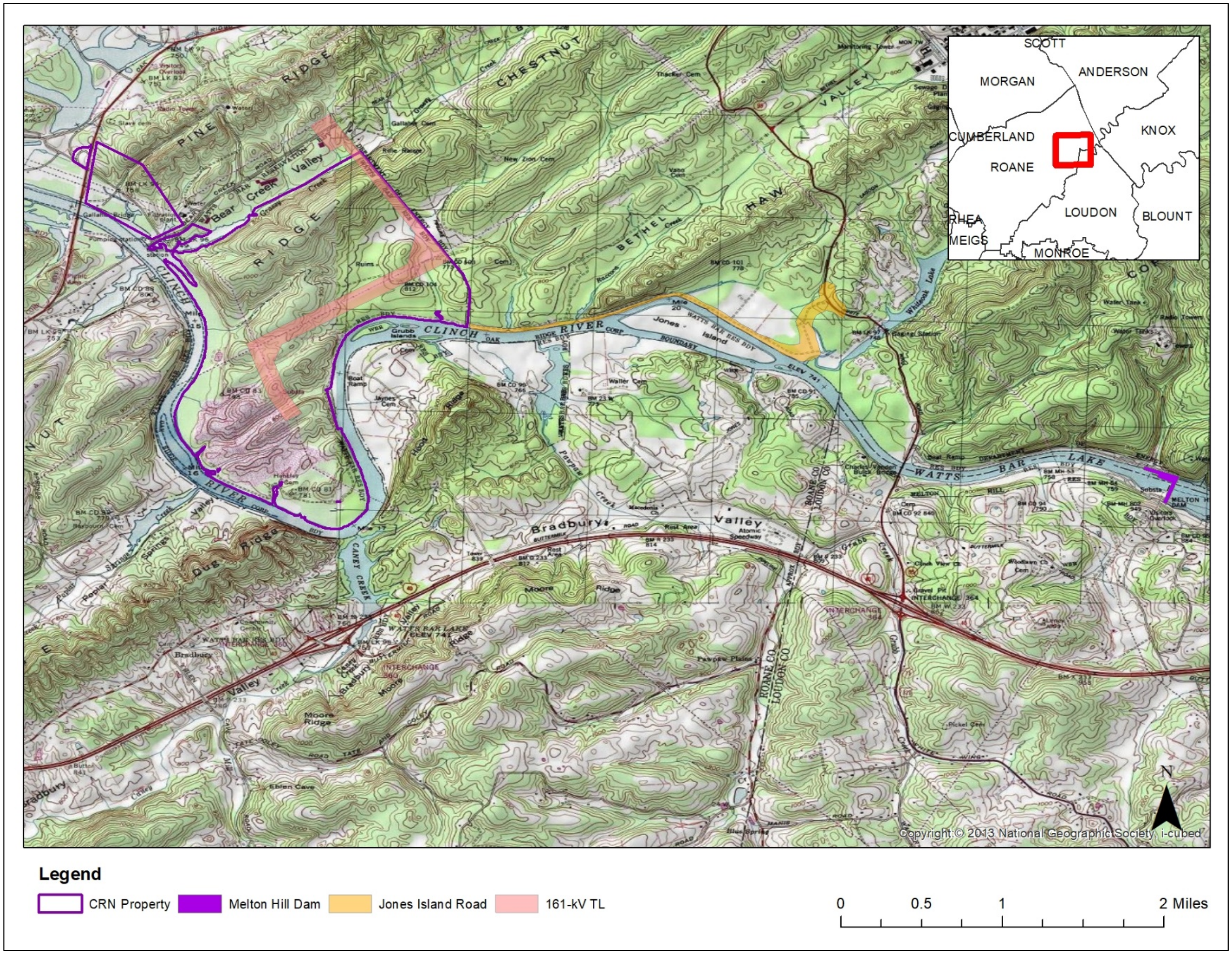


Figure 1. Proposed modified project footprint: CRN Site, Melton Hill Dam, area to be affected by proposed Jones Island Road improvements, and proposed 161-kV transmission line corridor.

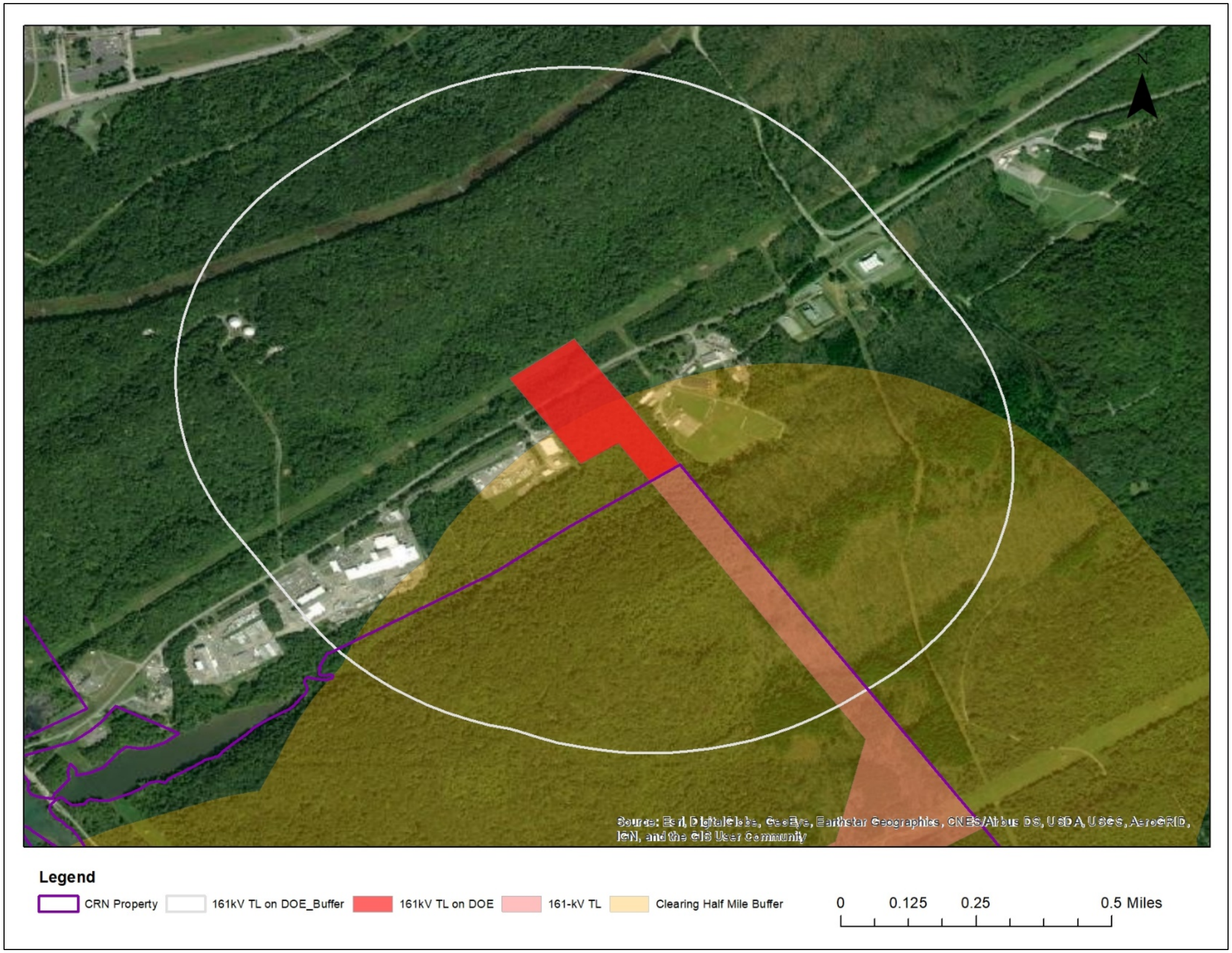


Figure 2. Section of proposed 161-kV transmission line corridor on DOE property, with associated half-mile radius. “Clearing Half Mile Buffer”: area of 2015 historic architectural review, as described in our May 20, 2015 letter to the Tennessee SHPO.

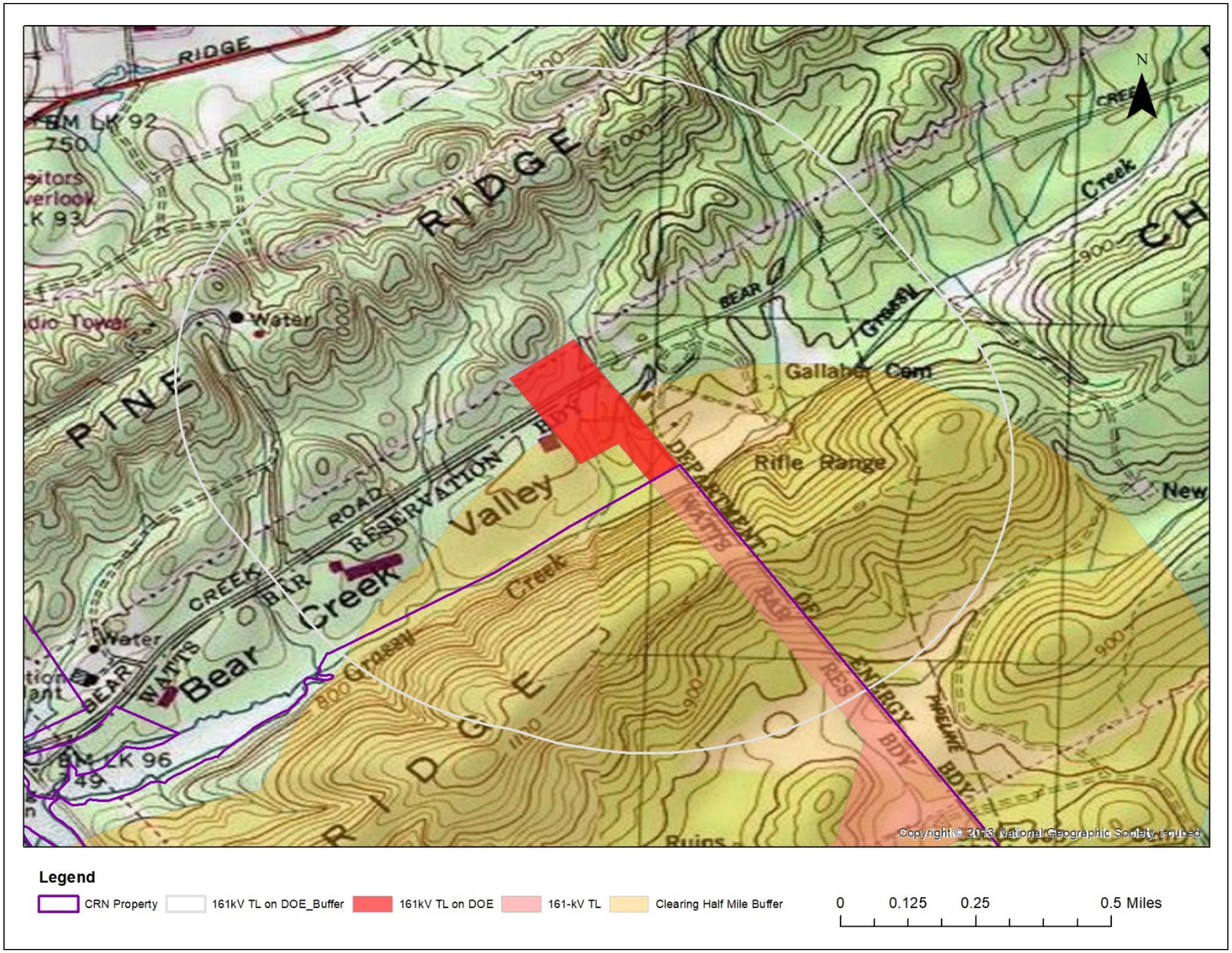


Figure 3. Section of proposed 161-kV transmission line corridor on DOE property, with associated half-mile radius. U.S.G.S Bethel Valley, TN and Elverton, TN 7.5-minute quadrangles.

Figure 4. General view of Grassy Creek area, near proposed 500-kV transmission line corridor. View to northeast along TVA/DOE property line.

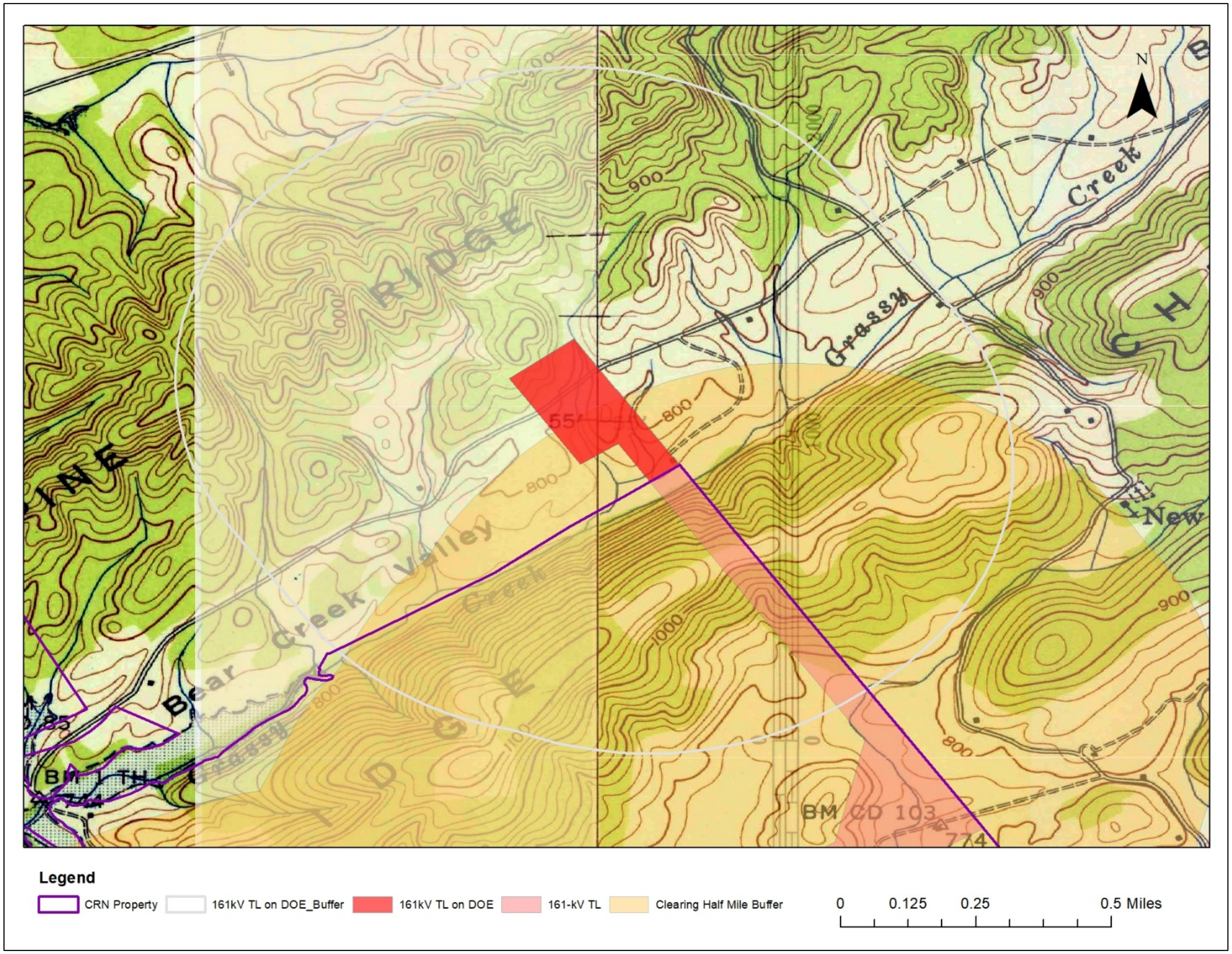


Figure 5. Section of proposed 161-kV transmission line corridor on DOE property, with associated half-mile radius. U.S.G.S Bethel Valley, TN and Elverton, TN 7.5-minute quadrangles (1941 editions).

TENNESSEE HISTORICAL COMMISSION
2941 LEBANON PIKE
NASHVILLE, TENNESSEE 37243-0442
OFFICE: (615) 532-1550
www.tnhistoricalcommission.org

August 27, 2021

Mr. Clinton E. Jones
Tennessee Valley Authority
Biological and Cultural Compliance
400 West Summit Hill Drive
Knoxville, TN 37902

RE: TVA / Tennessee Valley Authority, Clinch River Nuclear Site, Jones Island Road Improvements and New 161-KV Line, Loudon and Roane Counties, TN - Archaeological Review

Dear Mr. Jones:

In response to your request, we have reviewed archaeological documentation submitted regarding your proposed undertaking. Our review of and comment on your proposed undertaking are among the requirements of Section 106 of the National Historic Preservation Act and the signed programmatic agreement for the Clinch River SMR Project.

The report does not meet the Tennessee State Historic Preservation Office Standards and Guidelines for Archaeological Resource Management Studies. Please address the following comments:

1. Updated site records for previously recorded sites 40RE156, 40RE159, 40RE162, 40RE547, 40RE101, 40RE102, 40R3103, and 40RE104 must be submitted to the Tennessee Division of Archaeology (TDOA). While these sites may have not been relocated or were previously destroyed, the site records must be updated to reflect this current data.
2. Per the TN SHPO Standards and Guidelines, "Background research must be completed prior to beginning fieldwork." The report notes that archaeological background information was requested from the TDOA on February 24, 2021 and that fieldwork was conducted between February 22nd and 26th. The background information was not requested until the third day of fieldwork. The TDOA responded with the background research information on March 9th. Fieldwork should not have begun until after the consultants had received this information on March 9th. Please detail the steps that TVA will take to ensure that all archaeological consultants follow the correct steps necessary prior to beginning fieldwork.

Considering available information, we find that the project as currently proposed may adversely affect properties that are eligible for listing in the National Register of Historic Places. Site 40RE631 should either be avoided by all ground-disturbing activities, or subject to additional archaeological evaluation per the stipulations of the programmatic agreement.

You should continue to consult with our office to resolve these potential adverse effects and archaeological documentation deficiencies. Please direct questions and comments to Jennifer M. Barnett (615 687-4780). We appreciate your cooperation.

Sincerely,

E. Patrick McIntyre, Jr. JB

E. Patrick McIntyre, Jr.
Executive Director and
State Historic Preservation Officer

EPM/jmb

TENNESSEE HISTORICAL COMMISSION
STATE HISTORIC PRESERVATION OFFICE
2941 LEBANON PIKE
NASHVILLE, TENNESSEE 37243-0442
OFFICE: (615) 532-1550
www.tnhistoricalcommission.org

September 2, 2021

Mr. Clinton E. Jones
Tennessee Valley Authority
Biological and Cultural Compliance
400 West Summit Hill Drive
Knoxville, TN 37902

RE: TVA / Tennessee Valley Authority, Architecture Review, Clinch River Nuclear Site Advanced Nuclear Reactor Technology Park, Jones Island Rd Improvements and new Transmission Line, Loudon and Roane Counties, TN

Dear Mr. Jones:

In response to your request, we have reviewed the architectural survey report and accompanying documentation submitted by you regarding the above-referenced undertaking. Our review of and comment on your proposed undertaking are among the requirements of Section 106 of the National Historic Preservation Act. This Act requires federal agencies or applicants for federal assistance to consult with the appropriate State Historic Preservation Office before they carry out their proposed undertakings. The Advisory Council on Historic Preservation has codified procedures for carrying out Section 106 review in 36 CFR 800 (Federal Register, December 12, 2000, 77698-77739).

Considering the information provided, we find that the properties identified in the APE labeled FS-1 through FS-15 are not eligible for listing in the National Register of Historic Places. Further, we find that no architectural resources eligible for listing in the National Register of Historic Places will be affected by this undertaking.

If project plans are changed or archaeological remains are discovered during project construction, please contact this office to determine what further action, if any, will be necessary to comply with Section 106 of the National Historic Preservation Act. Questions or comments may be directed to Kelley Reid (615) 770-1099.

Your cooperation is appreciated.

Sincerely,

Kelley J Reid

for: E. Patrick McIntyre, Jr.
State Historic Preservation Officer

Kelley Reid
Historic Preservation Specialist/Coordinator
Section 106 Review and Compliance Program
Tennessee State Historic Preservation Office

TVA TENNESSEE VALLEY AUTHORITY

400 West Summit Hill Drive, Knoxville, Tennessee 37902

January 7, 2022

Mr. E. Patrick McIntyre, Jr.
Executive Director
and State Historic Preservation Officer
Tennessee Historical Commission
2941 Lebanon Pike
Nashville, Tennessee 37243-0442

Dear Mr. McIntyre:

RE: TENNESSEE VALLEY AUTHORITY (TVA), CLINCH RIVER NUCLEAR SITE (CRN), ADVANCED NUCLEAR REACTOR TECHNOLOGY PARK PROJECT, CULTURAL RESOURCES SURVEY, LOUDON AND ROANE COUNTIES, TENNESSEE (35.89923, -84.37794) (TVA TRACKING NUMBER – CID 77972)

TVA consulted with your office by letter dated August 26, 2021 regarding TVA's assessment of the potential environmental effects associated with the construction, operation, and decommissioning of an advanced nuclear reactor technology park on the CRN located in Oak Ridge, Roane County, Tennessee. We contracted with Wood E&I Solutions ("Wood") for a Phase I Cultural Resources survey of two areas that would be affected by road improvements along Jones Island Road and construction of a new 161-kilovolt transmission line, which were not fully included in any of the prior surveys that TVA has completed at the CRN Site. TVA found that the proposed Jones Island Road improvements and 161-kV transmission line would result in no adverse effects on any properties that are included in or eligible for the National Register of Historic Places (NRHP).

In your response letter dated September 2, 2021, you agreed with our eligibility assessments for FS-1 through FS-4 and FS-6 through FS-15, but indicated that you disagree with TVA's assessment that FS-5 (Colonial Revival House) is eligible. You agreed with our finding that no NRHP-eligible architectural resources would be affected by the undertaking. In your letter of August 27, 2021, you agreed with TVA's finding that site 40RE631 should be avoided by ground-disturbing activities or subject to additional archaeological investigations per the stipulations of our project Programmatic Agreement. However, you also requested updated site records for previously recorded sites 40RE156, 40RE159, 40RE162, 40RE547, 40RE101, 40RE102, 40R3103, and 40RE104. In response to your request, we asked Wood to provide the updated site forms to the Tennessee Division of Archaeology; they did so on September 17.

Your letter also noted that Wood began fieldwork prior to completing the required background research. As you stated, fieldwork should not have begun until after the consultants had received the background information on March 9. You requested that we detail the steps that TVA will take to ensure that all archaeological consultants follow the correct steps necessary prior to beginning fieldwork.

We have taken steps to address the error, and we will take additional steps. In requesting proposals for cultural resource surveys, our current practice includes inserting language in each proposal request requiring background research (especially site files checks) prior to fieldwork. The consultants generally copy this information into their proposal, which is included with the project contract as supporting documentation. This is what was done in this case, and in this manner, Wood committed in writing to performing the background research prior to fieldwork on the CRN Advanced Reactor/Jones Island Road project (please see excerpt from their proposal, attached below). Unfortunately, this was not enough to prevent the mistake.

Wood performs cultural surveys for TVA under a Master Services Agreement (MSA). Under that agreement, Wood must meet certain performance standards. For example, we require our consultants to adhere to state guidelines for cultural resources identification surveys, including the need to complete background research prior to beginning field surveys. As noted, Wood failed to meet that requirement in this case. After learning about it we spoke with Wood and reminded them of the need to adhere to this requirement, and they acknowledged their mistake. In addition, each of the consultants on our MSA undergoes an annual performance review with TVA's Supply Chain staff. Any performance issues are noted during this review. Each consultant's continued participation in the contract is dependent on being able to meet all contractual requirements. During the next review, we will remind Wood that any repeated performance issues could jeopardize their contract with TVA. Finally, we will make a point of underscoring that requirement in upcoming proposal requests for which Wood submits a bid.

Please contact Steve Cole by email, sccole0@tva.gov, with any questions or comments.

Sincerely,

James W. Osborne, Jr.

James W. Osborne, Jr.
Manager
Cultural Compliance

SCC:ABM
Enclosure
cc (Enclosure):

Ms. Jennifer Barnett
Tennessee Division of Archaeology
1216 Foster Avenue, Cole Bldg. #3
Nashville, Tennessee 37210

INTERNAL COPIES NOT TO BE INCLUDED WITH OUTGOING LETTER:

S. Dawn Booker, BR 2C-C
J. Taylor Cates, BR 2C-C
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W. Douglas White, WT 11C-K
ECM, ENVRecords

Appendix F – Seismology Characteristics Relating to the CRN Site

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Appendix F
Seismology Characteristics Relating to the CRN Site

In 2012, the Central and Eastern United States Seismic Source Characterization for Nuclear Facilities (CEUS SSC) Project was published (EPRI et al. 2012). The study, co-sponsored by EPRI, DOE, and NRC, was conducted to provide a regional seismic source model for use in probabilistic seismic hazard analyses (PSHAs) for nuclear facilities. The CEUS SSC Project devoted a major effort to developing a comprehensive and uniform earthquake catalog for use on the project. Starting with the U.S. Geological Survey (USGS) national catalog and a number of regional catalogs, the various catalogs were updated to include all earthquakes through 2008. The CEUS SSC Report (EPRI et al. 2012) earthquake catalog, covers a period from 1568 through 2008 and contains 3,298 individual earthquakes of uniform moment magnitude E[**M**] 2.9 and larger and 10,984 earthquakes of uniform moment magnitude[1] E[**M**] 2.2 and larger within the entire CEUS SSC study area.

With the occurrence of the common moment magnitude **M** 5.8 August 23, 2011, Mineral, Virginia, earthquake, it was recognized that this event comprised significant new data that needed to be evaluated under Regulatory Position 1 of RG 1.208. Therefore, as part of the CRN Site Site Safety Analysis Report (SSAR), a chronological update of the CEUS SSC earthquake catalog for the time period of all 2009 through mid-September 2013 was performed for a rectangular area encompassing the entire CEUS SSC study area (TVA 2019). The same primary input data sources and analysis procedures as were used to develop the published CEUS SSC Report, as specifically described in its *Chapter 3, Earthquake Catalog* and summarized above, were used in this update. As with the original CEUS SSC earthquake catalog, the focus of the earthquake catalog update was on events of uniform moment magnitude E[**M**] 2.2 and larger.

In 2015, EPRI published the results of a peer review of the CEUS SSC earthquake catalog for the southeastern United States that focused on the presence of reservoir-induced seismicity and on the aftershock sequence that followed the 1886 Charleston earthquake. This review resulted in the elimination of several non-tectonic or false events, and the relocation of several aftershocks of the Charleston earthquake. EPRI (2015a) concludes that the revised CEUS SSC catalog (Rev 8) is the appropriate catalog for use in assessing recurrence rates in the southeastern United States. Using Rev 8 of the CEUS SSC catalog, the number of independent earthquakes (mainshocks) with E[**M**] 2.2 or larger within 320 km (200 miles) of the CRN Site is 959, of which 314 occurred within 80 km (50 miles) of the CRN Site (EPRI 2015a).

In 2018, TVA conducted a re-assessment of the seismic hazard of its dam projects in the Tennessee Valley Region (TVA 2020). As part of that study the CEUS SSC catalog was updated inside a rectangular search area sufficiently large enough to include the Tennessee Valley Region and a 640-km buffer around it. The temporal extent of the catalog update covered the period January 1, 2009, through January 31, 2018. After removing events identified as non-tectonic, the update added a total of 1,672 earthquakes with E[**M**] 2.2 and larger, of which 807 are mainshocks. TVA (2020) concluded that the observed number of mainshocks from 2009 to 2018 is consistent with the number of earthquakes predicted by the CEUS SSC model (EPRI et al. 2012) as updated in EPRI (2015a), and that the observed pattern of seismicity in the 2009-2018 time period is consistent with the distribution of seismicity in the 1568-2008 time period. It

[1] Note: 'M' will often be cited in the SSAR for the common moment magnitude, as distinguished from the uniform moment magnitude value 'E[M]'

also confirmed that the maximum observed earthquake (Mineral, Virginia) is consistent with the maximum magnitude estimates from CEUS SSC as updated in EPRI (2015b).

Table E-1 summarizes the update to the CEUS SSC earthquake catalog conducted for the CRN SSAR (TVA 2019) and the catalog update conducted as part of the re-assessment of the seismic hazard for the Tennessee Valley Region (TVA 2020). As discussed above, the TVA (2020) update did not cover the entire CEUS catalog region, which is why the overall number of events with E[**M**] 2.2 and larger is smaller than in TVA (2019). Focusing on the earthquakes that occurred within 200 miles of the CRN Site, the total updated catalog (from 1568 to 2018) contains 355 earthquakes of uniform moment magnitude E[**M**] 2.9 and larger, of which 315 are identified as independent events (mainshocks).

Table E-1 summarizes the update to the CEUS SSC earthquake catalog, conducted for the CRN SSAR (TVA 2019) and the catalog update conducted as part of the re-assessment of the seismic hazard for the Tennessee Valley Region (TVA 2020). As discussed above, the TVA (2020) update did not cover the entire CEUS catalog region, which is why the overall number of events with E[**M**] 2.2 and larger is smaller than in TVA (2019). Focusing on the earthquakes that occurred within 320 km (200 miles) of the CRN Site, the total updated catalog (from 1568 to 2018) contains 355 earthquakes of uniform moment magnitude E[**M**] 2.9 and larger, of which 315 are identified as independent events (mainshocks).

Table E-1. Original and Updated CEUS SSC Earthquake Catalog Summary

	Number of All Earthquakes			Number of Mainshock (Independent) Earthquakes		
	CEUS SSC[a]	TVA (2019)	TVA (2020)	CEUS SSC(a)	TVA (2019)	TVA (2020)
E[M] ≥ 2.2						
All Distances from CRN Site	10,946	5,427	1,418	6,914	1,675	1,102
Dist ≤ 200 miles	1,249	185	387	959	157	346
Dist ≤ 50 miles	397	76	151	314	67	135
E[M] ≥ 2.9						
All Distances from CRN Site	3,262	684	188	2,552	308	153
Dist ≤ 200 miles	317	9	38	281	9	34
Dist ≤ 50 miles	94	3	15	82	3	13

[a] Source: EPRI 2015a

Brief descriptions of the largest earthquakes (E[**M**]≥5) within 200 miles of the CRN Site are presented below using the Modified Mercalli Intensity (MM or MMI) scale to measure the qualitative site-specific effects of an earthquake using intensity ranges from Roman numeral I (not felt) through XII (extreme):

- **August 31, 1861: Wilkes County, North Carolina/Southwestern Virginia** – The August 31, 1861, earthquake measured E[**M**] 5.63 occurred about 5 a.m. (local time). The actual epicentral location of this event is unknown but is thought to be approximately

140 km (87 miles) northeast of the CRN Site. It is suggested that the epicenter was probably in extreme southwestern Virginia or western North Carolina. The CEUS SSC catalog locates the epicenter near Hot Springs, North Carolina, near the North Carolina/Tennessee border. The most severe shaking was reported at Wilkesboro, North Carolina, where bricks were shaken from chimneys, doors jarred open, and clocks stopped, consistent with MMI VI.

This earthquake was felt over an area of at least 280,000 square miles along the Atlantic Coast from Washington to Charleston, South Carolina, and westward into Cincinnati, Ohio; Louisville, Kentucky; Gallatin, Tennessee; and Columbus, Georgia. Although this earthquake was felt at points north, west, and south of Virginia, curiously no specific statements that it was actually felt within Virginia have been found. The lack of felt reports in Virginia may be attributed to the fact that the Civil War was under way and there was rather heavy fighting in Virginia at the time.

- **February 21, 1916: Waynesville, North Carolina** – The 1916 Waynesville earthquake measured E[M] 5.13 and had an epicenter that was located 175 km (109 miles) northeast of the CRN Site. The USGS report assigned (unspecified) magnitude 5.2 to this event and described it as the largest earthquake in North Carolina with the maximum intensity, MMI VII. Reports indicate that tops of chimneys were thrown to the ground, windowpanes were broken in many houses, and people rushed into the streets in Waynesville. There were reports of damage consistent with MMI VI to VII in several towns in Tennessee and North Carolina. Shaken bricks from chimneys were reported in Sevierville, 70 km (44 miles) northwest of Waynesville. There were observations of increases of the flow of water and some muddying of the water in springs in Wear's Cave, 16 km (10 miles) southwest of Waynesville. There were minor damage reports in eastern Tennessee at Athens, Knoxville, Maryville, Morristown, and Newport. Minor damage was also reported at Tryon, North Carolina, and at Bristol, Virginia. There are also reports that tremors were felt in Alabama, Georgia, Kentucky, South Carolina, and West Virginia
- **July 27, 1980: Sharpsburg, Kentucky** – The 1980 Sharpsburg earthquake measured E[**M**] 5.01 and had an epicenter that was located 258 km (160 miles) north of the CRN Site. This northeast Kentucky earthquake with short-period surface wave magnitude (m_{bLg}) of 5.3 was observed with MMI V-VI. Some researchers estimated a slightly smaller magnitude of m_b = 5.2 and a depth around 12 km. At a distance of 52 km (32 miles) from the epicenter, the city of Maysville reported a higher intensity of MM VII, but this may be due to local higher shaking effects attributable to 30 meters of underlying Late Quaternary Ohio River flood plain alluvium per Woolery et al. This event caused in excess of three million dollars' worth of property damage (at the time of the earthquake) to private residencies, business, schools, churches, and a state park in north-central Kentucky. The earthquake was followed by around 70 aftershocks, the largest among them having a magnitude of m_{bLg} = 2.2.
- **August 23, 2011: Mineral, Virginia** – The 2011 Mineral earthquake measured E[**M**] 5.71 and had an epicenter that was located 615 km (382 miles) northeast of the CRN Site. While it occurred more than 320 km (200 miles) from the CRN Site, the recent M 5.8 (E[**M**] 5.71) Mineral, Virginia, earthquake was felt throughout a large portion of the eastern U.S., and it is of interest to mention some details of this significant recent CEUS earthquake. The earthquake epicentral region lies within the Appalachian Piedmont, about 130 km (81 miles) southwest of Washington, D.C., and within or near the Central Virginia Seismic Zone (CVSZ), a previously recognized zone of seismicity that has produced numerous small and moderate historical earthquakes. The Mineral earthquake mainshock hypocenter originated at a depth of about 8.0 km. Shaking was widely felt in

several major metropolitan areas, including the greater Washington, D.C. region, Philadelphia, and parts of New York State. The overall felt area of the earthquake was significant, with perceptible shaking reported as far west as Minnesota and as far south as Florida. To the northeast it was felt as far as Fredericton, New Brunswick, Canada.

- **August 9, 2020: Sparta, North Carolina** – The 2020 Sparta earthquake measured E[**M**] 5.1 and had an epicenter that was located approximately 300 km (186 miles) northeast of the CRN Site. The earthquake was widely felt across a large portion of the eastern U.S., as confirmed by over 60,000 felt reports on the USGS “Did You Feel It?” website. The earthquake occurred as a result of oblique-reverse faulting in the upper crust of the North American plate. Focal mechanism solutions for the event indicate rupture occurred on a moderately dipping fault either striking to the northwest or south. This earthquake was preceded by at least four small foreshocks ranging from **M** 2.1-2.6, beginning about 25 hours prior to the mainshock (USGS 2021).

- Within the vicinity of the CRN Site, the Eastern Tennessee Seismic Zone (ETSZ), is a well-defined, northeasterly trending belt of seismicity, 186 miles long by less than 62 miles wide, within the Valley and Ridge and Blue Ridge physiographic provinces of eastern Tennessee and parts of North Carolina, Georgia, and Alabama. The largest recorded earthquakes in the ETSZ are:

- **November 30, 1973: Maryville, Tennessee** – E[M] 4.01; 35 km (22 miles) from the CRN Site]

- **April 29, 2003: Fort Payne, Alabama** – E[M] 4.57; 192 km (119 miles) from the CRN Site

- **December 12, 2018: Decatur, Tennessee** – Mw 4.4 (USGS)**;** 44 km (27 miles) from the CRN Site

ETSZ is one of the most active seismic regions in eastern North America in terms of the rate of small earthquakes. Generally, earthquakes in the ETSZ produce minor or no damage (e.g., chimney collapse, cracks in plaster, and broken windows), consistent with MMI VI.

Recent geologic and paleoseismologic studies suggest that the ETSZ may have produced large prehistoric earthquakes. The CEUS SSC project (EPRI et al. 2012) evaluated geologic evidence of outcrop-scale faulting and fracturing, and disrupted features in river terrace alluvium, along with minor paleoliquefaction as reported in the literature, and concluded that while the ETSZ may have produced one or more large magnitude earthquake in the Quaternary, the evidence was insufficient to qualify the ETSZ as a Repeated Large Magnitude Earthquake (RLME) source. Additional evidence of past large (**M** 6.0-6.5) magnitude earthquakes in the ETSZ observed by Hatcher et al. (2012) and by Warrell et al. (2017) indicates that at least one earthquake occurred in the Quaternary in the ETSZ. However, the current recent studies do not quantify parameters (i.e., recurrence interval, magnitude) necessary to demonstrate that the ETSZ produces RLMEs. Based on sensitivity analyses conducted for the Clinch River SSAR (TVA 2019), the inclusion of paleoseismic events in the ETSZ would not determine the need to revise Mmax for the seismic source zones. Furthermore, TVA (2019) shows that the CEUS SSC seismic hazard model generates moderate- to large-magnitude earthquakes with sufficient frequency in the ETSZ area to explain field observations

See SSAR Section 2.5.2 for more detailed considerations of seismology and vibratory ground motion at the CRN Site.

References:

Electric Power Research Institute (EPRI), U.S. Department of Energy (DOE), and U.S. Nuclear Regulatory Commission (NRC). 2012. Technical Report: Central and Eastern United States Seismic Source Characterization for Nuclear Facilities. EPRI, Palo Alto, CA, DOE, and NRC, NUREG-2115, EPRI Report 1021097. Retrieved from Central And Eastern United States Seismic Source Characterization For Nuclear Facilities (NUREG-2115) | NRC.gov (accessed September 2021).

Electric Power Research Institute (EPRI). 2015a. Central and Eastern United States Seismic Source Characterization for Nuclear Facilities, Review for Reservoir-Induced Seismicity (RIS) in the Southeast and Earthquakes in South Carolina Near the 1886 Charleston Earthquake, Technical Report 3002005288, September 2015.

_____. 2015b. Central and Eastern United States Seismic Source Characterization for Nuclear Facilities, Maximum Magnitude Distribution Evaluation, Technical Report 3002005684, June 2015.

Hatcher, R.D., Jr., J.D. Vaughn, and S.F. Obermeier, 2012. Large Earthquake Paleoseismology in the East Tennessee Seismic Zone: Results of an 18-month Pilot Study in Cox, R.T., M.P. Tuttle, O.S. Boyd, and J. Locat, eds., Recent Advances in North American Paleoseismology and Neotectonics East of the Rockies: Geological Society of America Special Paper 493, p. 111–142, doi:10.1130/2012.2493(06).

Warrell, K.F., R.T. Cox, R.D. Hatcher, Jr., J.D. Vaughn, and R. Counts. 2017. Paleoseismic Evidence for Multiple M_w ≥6 Earthquakes in the Eastern Tennessee Seismic Zone during the Late Quaternary. Bulletin of the Seismological Society of America, v. 107, p. 1610-1624, https://doi.org/10.1785/0120160161.

Tennessee Valley Authority (TVA). 2019. "Clinch River Nuclear Site Early Site Permit Application, Part 02—Site Safety Analysis Report (Revision 2)." Chattanooga, Tennessee.

_____. 2020. Appendix A of 2018 Seismic Hazard Analysis of TVA Dams and the Tennessee Valley Region, RSOGENROGCDX0003262018000012, Rev0, May 25, 2020.

U.S. Geological Survey (USGS). 2021. M 5.1 - 4 km SE of Sparta, North Carolina. Retrieved from https://earthquake.usgs.gov/earthquakes/eventpage/se60324281/executive (accessed October 6, 2021).

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Appendix G – CRN Project Area Baseline Conditions: Threatened and Endangered Species

CRN Project Area Baseline Conditions: Threatened and Endangered Species

1 Introduction and Purpose

This appendix provides supporting information to the CRN Programmatic EIS (PEIS) regarding the distribution and extent of species of concern that may be affected by construction and operational activities at the CRN Site and associated offsite areas. Information is presented that provides a listing of relevant species of concern within the potentially affected area, the potential availability of habitats within the CRN Project Area that may be used by each species, and their potential occurrence on or near the CRN Site.

2 Compilation and Review of Existing Data

2.1 Records Review

TVA reviewed the TVA Natural Heritage Database (TVA 2021a) to produce records of state and federally listed aquatic and terrestrial plant and animal species and other sensitive species tracked by the state of Tennessee that have been documented within the ten-digit Hydrologic Unit Code (HUC), within Roane County, and/or within certain radii of the Project Area. According to the database, records of federally and state-listed and tracked species include 19 aquatic animal species (six fish, 11 mussels, and two snails), 22 plants, and 14 terrestrial animals. No federally designated critical habitat exists within 5 miles of the project area. No federally listed plants have been previously reported from within 5 miles of the CRN Site.

2.2 Field Studies

In addition to the review of TVA's Natural Heritage Database, TVA also conducted comprehensive field studies to identify and evaluate the potential presence of sensitive species on the CRN Site and associated offsite areas. Table G-1 provides a listing of both historic field studies conducted during the Early Site Permit Application (ESPA) process and conducted during 2021 as part of the PEIS.

Table G-1. List of Prior TVA CRN Reports and Studies

Author	Year	Title
TVA Interdisciplinary Team	2015	Clinch River Nuclear Site Sensitive Resources
TVA, Biological and Water Resources	2013	Biological Monitoring to Characterize the Aquatic Community near the Site of the Proposed Clinch River Small Modular Reactor, 2011
TVA, Biological and Water Resources	2012	Temporal Occurrence, Composition, Abundance and Estimated Entrainment of Fish Eggs and Larvae at the Proposed Clinch River Small Modular Reactor Site, 2011
TVA, Cox, P.B. et al.	2011	Clinch River Small Modular Reactor Site, Terrestrial Plant Communities and Botanical Resources Survey Report, Revisions 1-4
TVA, Dattilo, A.J.	2015	Clinch River Barge/Traffic Area, Terrestrial Plant Communities and Botanical Resources Survey Report

Table G-1. List of Prior TVA CRN Reports and Studies

Author	Year	Title
TVA, Dattilo, A.J.	2021	Clinch River Advanced Reactor Site Terrestrial Plant Communities and Botanical Resources Survey Report.
TVA, Fisher, A.B.	2015	Clinch River Small Modular Reactor Site, Groundwater Quality Monitoring Report, Revisions 0-1
TVA, Hamrick, E.B.	2015	Clinch River - Addendum Barge/Traffic Area, Terrestrial Animal Survey Report, Revisions 0-1
TVA, Hamrick, E.B.	2021	*Clinch River – Comprehensive Site Study Technical Report*.
TVA, Hart, H.M.	2011	Technical Report from assessment of Natural Areas (Managed Areas and Sites) in the vicinity of the Clinch River Small Modular Reactor Site (SMR)
TVA, Henderson, A.R. and C.L. Phillips	2015	Clinch River Small Modular Reactor and Barge/Traffic Site, Stream Survey Report, Revision 1
TVA, Howard C.S. et al.	2012	Clinch River Small Modular Reactor Site, Aquatic Habitats and Protected Aquatic Animals, Revisions 1-4
TVA, Howard C.S. et al.	2015	Clinch River Small Modular Reactor and Barge/Traffic Site, Evaluation of Aquatic Habitats and Protected Aquatic Animals Technical Report, Revisions 1-2
TVA, LeGrand, H.G. et al.	2012	Clinch River Small Modular Reactor Site, Terrestrial Animal Survey Report, Revisions 1-6

3 Affected Environment

3.1 Aquatic Animals

A review of the TVA Natural Heritage Database (TVA 2021a) indicated records of 19 state and/or federally listed aquatic animal species (six fish, 11 mussels, and two snails) within Roane County and/or within the ten-digit Hydrologic Unit Code (HUC) (0601020704) Clinch River watershed of the CRN Site (Table G-2). No federally designated critical habitat for aquatic species exists within 10 miles of the project area.

Table G-2. Records of Federally and State-Listed Aquatic Animal Species Known from Roane County and/or within Ten-digit HUC (0601020704) Clinch River Watershed of the CRN Site (Clinch River Miles 14 - 19)[1]

Common Name	Scientific Name	Element Rank[2]	Federal Status[3]	State Status[3]	State Rank[4]
FISHES					
Blue sucker	*Cycleptus elongatus*	E		T	S2

Common Name	Scientific Name	Element Rank[2]	Federal Status[3]	State Status[3]	State Rank[4]
Highfin carpsucker	*Carpiodes velifer*	E		D	S2S3
Snail darter	*Percina tanasi*	E	T	T	S2S3
Spotfin chub	*Erimonax monachus*	E	T	T	S2
Tangerine darter	*Percina aurantiaca*	E		D	S3
Tennessee dace	*Phoxinus tennesseensis*	E		D	S3
MUSSELS					
Alabama lampmussel	*Lampsilis virescens*	H	E	E	S1
Fanshell	*Cyprogenia stegaria*	H	E, XN	E	S1
Fine-rayed pigtoe	*Fusconaia cuneolus*	H	E, XN	E	S1
Orangefoot pimpleback	*Plethobasus cooperianus*	H	E, XN	E	S1
Pink mucket	*Lampsilis abrupta*	E	E	E	S2
Purple bean	*Villosa perpurpurea*	H	E	E	S1
Pyramid pigtoe	*Pleurobema rubrum*	E			S2S3
Ring pink	*Obovaria retusa*	H	E, XN	E	S1
Sheepnose	*Plethobasus cyphyus*	E	E	E	S2S3
Spectaclecase	*Cumberlandia monodonta*	H	E	E	S2S3
Tennessee clubshell	*Pleurobema oviforme*	H			S2S3
SNAILS					
Ornate rocksnail	*Lithasia geniculata*	H			S3
Spiny riversnail	*Io fluvialis*	E			S2

[1] Source: TVA Natural Heritage Database queried on 07/19/2021 (TVA 2021f)
[2] Heritage Element Occurrence Rank; E = extant record ≤25 years old; H = historical record >25 years old
[3] Status Codes: E = Endangered; T = Threatened; E, XN = Experimental, non-essential population; D = Deemed in Need of Management
[4] State Ranks: S1 = Critically Imperiled; S2 = Imperiled; S3 = Vulnerable

The lake sturgeon (*Acipenser fulvescens*), although not identified in Roane County, has recently been reported in the Watts Bar Reservoir in the vicinity of the Clinch River (Saidak 2015).

Of these aquatic animal species, five are federally listed as endangered, two are federally listed as threatened, and four are listed as endangered, experimental non-essential populations (Table G-2). Nine of the 19 aquatic species records are considered historical (records >25 years old). Therefore, because these species have not been detected in many decades (including no detection during the 2011 survey) and due to apparent continuation of unsuitable habitat conditions for mollusks, TVA has determined that nine of the mollusk and snail species

(Alabama lampmussel, fanshell, fine-rayed pigtoe, orangefoot pimpleback, purple bean, ring pink, spectaclecase, Tennessee clubshell, and ornate rocksnail) either do not occur or occur at extremely low (undetectable) levels near the CRN Site. Therefore, these species will not be addressed further in this analysis.

A brief description of state and federally listed aquatic animal species potentially occurring within or adjacent to the CRN Site and associated offsite areas are presented below. These descriptions and additional information about species' habitat and ecology can be found in Etnier and Starnes (1993) for fish, in Parmalee and Bogan (1998) for mussels, and NatureServe (2021) for snails and other aquatic species.

3.1.1 Fishes

The blue sucker is listed as threatened by the State of Tennessee. The blue sucker is found in deep pools of large, free-flowing rivers with swift currents. Spawning occurs in April through May in deep riffles with substrates of cobble and bedrock. Characteristic habitats have very swift flow and cobble or bedrock substrates. Juveniles are found in shallower and less turbulent areas. Blue sucker populations have declined drastically due to the effects on large rivers from impoundments and increased siltation. The blue sucker is extremely unlikely to occur in the project area due to the unsuitable impounded habitat conditions present in the Clinch Arm of the Watts Bar Reservoir.

The highfin carpsucker has been designated by the state of Tennessee as in need of management. This species inhabits areas of gravel substrate in relatively clear medium to large rivers. It is more susceptible to change by impoundments and siltation than other carpsucker species. The highfin carpsucker is extremely unlikely to occur in the project area due to the unsuitable impounded habitat conditions present in the Clinch Arm of the Watts Bar Reservoir.

The snail darter is federally listed as threatened and is listed by the state of Tennessee as threatened. This species is known to occur in larger creeks and rivers where it frequents sand and gravel shoal areas. It can also occur in deeper portions of rivers and reservoirs where current is present. Although this species has been collected in Roane County downstream in the Clinch River and within 10 miles of the CRN Site, it is extremely unlikely that this species would still occur in the Clinch River Arm of the Watts Bar Reservoir within the project vicinity due to lack of available shoal habitats with sand and gravel substrates.

The spotfin chub is federally listed as threatened and is listed by the state of Tennessee as threatened. This species inhabits clear upland rivers in swift currents over boulder substrates. Spawning for this species occurs May through August. The spotfin chub existed historically in 24 streams in the upper and middle Tennessee River system, including the Clinch River, but is now found in only four rivers. Reasons for the decline of this species include habitat destruction by impoundment, channelization, pollution, turbidity or siltation, temperature changes, and possible over-collecting and interspecific competition. Critical habitat has been designated for the spotfin chub in North Carolina and Virginia and in Cumberland, Fentress, and Morgan Counties in Tennessee. The spotfin chub has been observed and collected in the City of Oak Ridge and could be present on the ORR, as an individual was found in East Poplar Creek in 2002 during an Oak Ridge National Laboratory stream sampling event. Although it has been recorded in Roane County, the spotfin chub is unlikely to occur in the Clinch River arm of the Watts Bar Reservoir due to the unsuitable impounded habitat conditions present in the reservoir.

The tangerine darter has been designated by the state of Tennessee as in need of management. This species inhabits clearer reaches of moderate to large headwater tributaries of the upper Tennessee River drainage and is most abundant in smaller tributaries. Preferred habitats most of the year are deeper riffles and runs with substrates of bedrock, boulders, and large rubble, but in winter, deeper pools are used. Spawning occurs in May through July in gravel-bottomed riffles. The tangerine darter potentially could occur in some sections of Grassy Creek or streams potentially affected by offsite transmission line upgrades; however, it is unlikely to occur and was not found in surveys of streams on the CRN Site or the BTA due to the unsuitable habitat conditions.

The Tennessee dace has been designated by the state of Tennessee as in need of management. This species can be found inhabiting shallow pools in association with undercut banks and debris in small low gradient woodland tributaries in the upper Tennessee River drainage. Spawning for this species occurs from April through July. The Tennessee dace has been observed in the vicinity of the project area on the ORR and potentially could occur in some sections of Grassy Creek and streams within aquatic habitats associated with the potential future offsite transmission upgrades within the 500-kV transmission line. TVA will conduct additional surveys to assess these habitats based on future planning needs. However, it is unlikely to occur and was not found in surveys of streams on the CRN Site or BTA due to the unsuitable habitat conditions.

Lake sturgeon populations in Tennessee are considered state-endangered, and stocking efforts have been implemented in an effort to reestablish or supplement existing populations. Over 202,000 juvenile lake sturgeon have been released into the upper Tennessee River system (TVA 2021b). Sturgeon fitted with acoustic tags have been tracked as far upstream in Watts Bar Reservoir as river mile 576, near upper Paint Rock Refuge (Saidak 2015). Suitable aquatic habitat for the lake sturgeon, including strong current over gravel and sand substrates, may exist within the area subject to disturbance by the proposed project. However, due to siltation and other characteristics of impoundments, high quality spawning habitat is not likely present in the project area.

3.1.2 Mussels

The pink mucket mussel is federally listed as endangered and is listed by the state of Tennessee as endangered. The pink mucket is typically a big river species but occasionally individuals become established in small to medium sized tributaries of large rivers. It inhabits rocky bottoms with swift current usually in less than three feet of water but appears to be tolerant of reservoir conditions with some measure of flow. However, pink muckets prefer free-flowing reaches of large rivers, typically in silt-free and gravel substrates. Fish hosts for the larval stage include largemouth bass, smallmouth bass, spotted bass, and walleye. This species spawns August through September and releases larvae the following year between May and July.

Historically, the pink mucket was recorded from the Mississippi, Ohio, and Cumberland Rivers and in the Tennessee River up to the lower Clinch River. Currently, it occurs only in the riverine reaches downstream of Wilson Dam in Tennessee and downstream of Guntersville Dam in Alabama and in the Cumberland River in Smith County, Tennessee. Declines in the number of pink mucket mussels are assumed to be the result of impoundment, siltation, and pollution. The most recent siting of a pink mucket in the Clinch River was in 1984 at CRM 19.1, slightly upstream of the CRN Site. No pink muckets, either living or as relic shells, were found in 2011 TVA mollusk surveys of the Reservoir at the CRN Site. The Clinch River arm of the Watts Bar Reservoir adjacent to the CRN Site lacks the appropriate habitat for the pink mucket mussel.

Due to the extent to which zebra mussels have invaded this area and the lack of recent sightings of any individual pink muckets, it is unlikely that the pink mucket is present in the vicinity of the project area.

The pyramid pigtoe is a rare species that is tracked by the state of Tennessee but is not listed. It prefers rivers with strong current and substrate comprised of firm sand and gravel. It is believed to be a long-term brooder, but the fish host for the larval stage is unknown. The pyramid pigtoe is unlikely to occur in the Clinch River arm of the Watts Bar Reservoir due to the unsuitable, impounded habitat conditions for mussels present in the reservoir at the CRN Site.

The sheepnose mussel is federally and state-listed as endangered. The sheepnose is found in large streams in shallow shoals with moderate to swift currents. Substrates inhabited include sand, gravel, mud, cobble, and boulders, though the species prefers substrate of mixed coarse sand and gravel. It is tachytictic with most reproductive activity occurring in the summer. The larval host fish has been identified as sauger. The sheepnose can be found in the Ohio, Cumberland, and Tennessee River systems and the upper Mississippi River north to Minnesota. Individuals have been recorded in the Clinch River as recently as 2006. A living sheepnose was collected in 1994 at CRM 21.4. Habitat destruction and degradation are the reasons for the decline of this species. The 2011 surveys of the Clinch River arm of the Watts Bar Reservoir adjacent to the CRN Site did not find any live or relic specimens of the sheepnose. The sheepnose is extremely unlikely to occur in the Clinch River Arm of the Watts Bar Reservoir due to the unsuitable, impounded habitat conditions for mussels present in the reservoir at the CRN site.

3.1.3 Snails

The spiny riversnail is a rare species that is tracked by the state of Tennessee but is not listed. It is found in shallow waters of shoals that are rapid to moderate and well-oxygenated. This species may occur in surrounding headwater habitats but is not likely to occur in the Clinch River arm of the Watts Bar Reservoir in the project vicinity due to impoundment and other unsuitable habitat conditions.

3.2 Plants

A review of the TVA Regional Natural Heritage database (TVA 2021a) and the USFWS IPaC report (USFWS 2021) indicated that no federally listed plants have been previously reported from within 5 miles of the CRN Site, but three plants that are federally listed as threatened have been previously reported within Roane County, Tennessee: American hart's-tongue fern (*Asplenium scolopendrium* var. *americanum*), white fringeless orchid (*Platanthera integrilabia*), and Virginia spiraea (*Spiraea virginiana*) (Table G-3).

American hart's-tongue fern grows in shaded, moist deciduous forests where it prefers small cracks in limestone boulders and ledges. This fern usually is found in areas with outcrops of dolomitic limestone, including gorges and limestone sinkholes in mature hardwood forests. It needs the high humidity and deep shade provided by mature forest canopies or overhanging rock cliffs. The report of American hart's-tongue fern in Roane County is a historical record and the population is thought to be extirpated at the Roane County location where it was previously recorded. Virginia spiraea, a perennial shrub of the rose family, is typically found on scoured banks of high-gradient streams or on meanders, point bars, natural levees, and braided features of lower-gradient stream segments. The soils in which Virginia spirea is found typically are sandy, silty, or clayey, and it occurs at elevations ranging from 1,000 to 2,400 feet. The typical habitat of white fringeless orchid is partially shaded, flat, boggy areas at the heads of streams or seepage slopes. This orchid is usually found in acidic muck or sand in association with sphagnum moss and cinnamon fern, netted chain fern, and New York fern.

These three federally listed plants have not been observed in TVA field surveys of the CRN Site (TVA 2021c), and their preferred habitats were not found to be present. Federally designated critical habitat for plants also does not occur on the CRN Site or associated offsite areas. Therefore, federally listed plant species are not expected to occur on the Project Area.

The TVA Regional Natural Heritage database indicates that 19 species tracked by the state of Tennessee have been reported from within 5 miles of the CRN Site (Crabtree 2016). In preparation for 2021 field surveys, the TVA botanist considered the unique habitat requirements of each of the species and used remotely sensed data, including aerial photos, geologic quadrangle maps, National Wetland Inventory data, and topographic maps to identify areas where rare species would be most likely to occur. Specifically, glade/barrens habitat, rich calcareous forest, and forested wetlands were prioritized as areas of interest. Efforts during the 2021 field survey were subsequently focused on locating these habitats to maximize the likelihood that rare plants would be found if present on the property (TVA 2021c).

Of the 19 species tracked by the state of Tennessee, two (spreading false-foxglove [*Aureolaria patula*] and pale green orchid [*Platanthera flava* var. *herbiola*]) were observed during 2021 field surveys within the Project Area. One additional state endangered plant that has not been previously observed near the CRN Site (rigid sedge [*Carex tetanica*]) was also documented during the 2021 field surveys. Spreading false-foxglove (*Aureolaria patula*) was observed within Area 1 of the CRN Site, in steep floodplain forest associated with bluffs along the Watts Bar Reservoir (Figure 3-15 in the PEIS). Rigid sedge (*Carex tetanica*) and pale green orchid (*Platanthera flava* var. *herbiola*) were observed in a calcareous wetland within the proposed offsite transmission line ROW just south of Bear Creek Road (Figure 3-15 in the PEIS).

Spreading false-foxglove is a perennial member of the figwort family that is parasitic on the roots of oaks. It grows on steep, partially shaded calcareous slopes above large streams and rivers and is often found near the edge of TVA reservoirs, including Watts Bar Reservoir. Within Area 1 of the CRN Site, spreading false-foxglove was observed growing in this habitat along the reservoir and was common along at least 600 feet of shoreline along an east facing slope. The species was frequently encountered in this area and many individuals had flowered the previous year (TVA 2021c).

Rigid sedge is a grass-like species that is distributed across the northeastern United States, with a few isolated occurrences in the southeast (SERNEC 2021). In the southern part of its range, rigid sedge only occurs in high quality habitats with other species of conservation concern. At the CRN Site, rigid sedge is located within a calcareous wetland just southeast of Bear Creek Road, and the population straddles the CRN Site boundary. In Tennessee, this species has only been documented from one other location, a calcareous seep in Campbell County about 30 air miles north northeast of the CRN Site (TVA 2021c; SERNEC 2021). Given the clonal nature of the species it is difficult to estimate how many individual plants occur onsite, but the species is common over about 0.5 acres.

Pale green orchid occurs in high quality swamps and floodplains (TDEC 2021c) throughout the northeastern United States (SERNEC 2021). While the species is wide ranging, it is listed as rare in most states where it occurs. In Tennessee, pale green orchid has been documented from eight counties (SERNEC 2021), but the vast majority of occurrences are located near the City of Oak Ridge in close proximity to the CRN Site. This species is low growing with inconspicuous flowers, which makes it difficult to see amongst other vegetation growing in the wetland of the Project Area. While a census of plants onsite was not conducted, several hundred plants likely occur throughout the wetland complex southeast of Bear Creek Road.

Table G-3. Plant Species of Conservation Concern Previously Reported from within 5 Miles of the CRN Site and Federally Listed Plants Known from Roane County, Tennessee.[1]

Common Name	Scientific Name	Federal Status[2]	State Status[2]	State Rank[3]
Earleaf foxglove	*Agalinis auriculata*		E	S2
American hart's-tongue fern[4]	*Asplenium scolopendrium* var. *americanum*	T	E	S1
Spreading false-foxglove[5]	*Aureolaria patula*		S	S3
River bulrush	*Bolboschoenus fluviatilis*		S	S1
Rigid sedge[5]	*Carex tetanica*		E	S1
Tall larkspur	*Delphinium exaltatum*		E	S2
Northern bush-honeysuckle	*Diervilla lonicera*		T	S2
Branching whitlow-wort	*Draba ramosissima*		S	S2
Waterweed	*Elodea nuttallii*		S	S2
Godfrey's thoroughwort	*Eupatorium godfreyanum*		S	S1
Naked-stem sunflower	*Helianthus occidentalis*		S	S2
Butternut	*Juglans cinerea*		T	S3
Short-head rush	*Juncus brachycephalus*		S	SH
Slender blazing-star	*Liatris cylindracea*		T	S2
Loesel's twayblade	*Liparis loeselii*		T	S1
Pale green orchid[5]	*Platanthera flava* var. *herbiola*		T	S2
White fringeless orchid[4]	*Platanthera integrilabia*	T	E	S2S3
Heller's catfoot	*Pseudognaphalium helleri*		S	S2
Prairie goldenrod	*Solidago ptarmicoides*		E	S1S2
Virginia spiraea[4]	*Spiraea virginiana*	T	E	S2
Shining ladies'-tresses	*Spiranthes lucida*		T	S1S2
Ozark bunchflower	*Veratrum woodii*		E	S1

[1] Source: TVA Natural Heritage Database (TVA 2021a) and USFWS IPaC (USFWS 2021), queried July 2021
[2] Status Codes: E = Listed Endangered; S = Listed Special Concern; T = Listed Threatened
[3] State Ranks: S1 = Critically Imperiled; S2 = Imperiled; S3 = Vulnerable; S4 = Apparently Secure; SH = Possibly Extirpated (Historical); S#S# = Denotes a range of ranks because the exact rarity of the element is uncertain (e.g., S1S2)
[4] Federally listed species occurring within the county where work would occur, but not within 5 miles of the project area
[5] State-tracked plant species observed during 2021 field surveys of the CRN Site

3.3 Wildlife

Review of TVA's Regional Natural Heritage Database for terrestrial wildlife in July 2021 (TVA 2021a) indicated that there are records of 10 state-listed or tracked species and two federally listed species within 5 miles of the CRN Site and associated offsite areas (Table G-4). One additional federally protected species (bald eagle) is known from Roane County. The USFWS also has determined that the CRN Site and associated offsite areas are in the range of the federally endangered Indiana bat (USFWS 2021). No records of this species are currently known from Roane County. No federally designated critical habitat exists within 5 miles of the project area.

Table G-41. Federally and State-listed Terrestrial Animal Species Documented Within Roane County, and Within 5 Miles of the CRN Site and Associated Offsite Areas[1]

Common Name	Scientific Name	Federal Status[2]	State Status[2]	State Rank[3]
Amphibians				
Four-toed salamander	*Hemidactylium scutatum*	-	D	S3
Hellbender	*Cryptobranchus alleganiensis*	PS[4]	E	S3
Birds				
Bachman's sparrow	*Aimophila aestivalis*	-	E	S1B
Bald eagle	*Haliaeetus leucocephalus*	DM	D	S3
Cerulean warbler	*Setophaga cerulea*	-	D	S3B
Sharp-shinned hawk	*Accipiter striatus*	PS		S3B,S4N
Swainson's warbler	*Limnothlypis swainsonii*	-	D	S3
Mammals				
Gray bat	*Myotis griscesens*	E	E	S2
Northern long-eared bat	*Myotis septentrionalis*	T	T	S1S2
Indiana bat	*Myotis sodalis*	E	E	S1
Little brown bat	*Myotis lucifugus*	-	T	S3
Meadow jumping mouse	*Zapus hudsonius*	PS	-	S4
Southeastern shrew	*Sorex longirostris*	-	-	S4
Tricolored bat	*Perimyotis subflavus*	-	T	S2S3

[1] Source: TVA Natural Heritage Database (TVA 2021a), queried 07/19/2021, USFWS 2021.
[2] Status abbreviations: D = Deemed in Need of Management; DM = Recovered, delisted, and being monitored, E = Endangered, T = Threatened; PS = Partial Status.
[3] State Rank Definitions: S1 - critically imperiled; S2 - imperiled; S3 - rare or uncommon; S4 - widespread, abundant and apparently secure, but with cause for long-term concern; S#B = Status of Breeding population; S#N = Status of non-breeding population.
[4] Species in this table with Partial Status are federally listed elsewhere in the United States but are not federally listed in Roane County, Tennessee.

Four-toed salamanders have been observed on the ORR, which is in the vicinity of the CRN Site. Adults of this species live under objects or among mosses in swamps, boggy streams, and wet, wooded, or open areas near ponds. Mossy pools or pools with moss-lined edges comprise typical larval habitat. Sphagnum moss is commonly abundant in suitable habitat (Petranka 1998). Lowland/riparian forest along and adjacent to the Clinch River Arm of the Watts Bar Reservoir and along Grassy Creek in the northwest section of the CRN Site within the proposed transmission line corridor provide potentially suitable habitat. Suitable habitat for the four-toed salamander also exists in the BTA along a moss-lined spring and stream in forested habitat adjacent to Water Tank Road. However, no specimens of the four-toed salamander were observed during field surveys.

Hellbenders have been encountered in the tail water below Melton Hill Dam and historically have been observed in other locations along the Clinch River Arm of the Watts Bar Reservoir. Hellbenders are completely aquatic, large-bodied salamanders that can reach a length of up to 74 centimeters (Redmond and Scott 1996). In this region the hellbender breeding season occurs between mid-August and mid-September. During the breeding season, males dig shallow depressions under a rock or log in which females deposit strings of eggs, which are fertilized by the male as they are laid. The males brood the eggs in the nest for 1.5 - 2.5 months. Hellbenders become sexually mature at five to eight years old and can live up to 30 years. Lack of suitable large objects in rivers and creeks has been proposed as a population-limiting factor for the hellbender. Where rocks do occur, siltation that fills in the spaces under large rocks also prevents nesting. The hellbender usually is found in medium to large streams and rivers with fast flowing water and rocky substrates (Petranka 1998). The Clinch River Arm of the Watts Bar Reservoir adjacent to the CRN Site provides potentially suitable habitat for hellbenders; however, the last known record of this species in the Clinch River occurred in 1989.

Bachman’s sparrows have been recorded during summer months within 5 miles of the CRN Site. Historically this species would inhabit grassy openings of pine forests subject to frequent fires. Bachman’s sparrows are able to colonize recent clear cuts and early seral stages of old field succession, but such habitat remains suitable only for a short time. In the region of the CRN Site, breeding habitat usually is found in overgrown fields with scattered saplings and occasionally in open woods with thick grass cover (Nicholson 1997). Early successional habitat in the southern half of the CRN Site (Area 1), as well as transmission line ROWs across the CRN Site and BTA, provides suitable habitat for Bachman’s sparrows. However, no specimens of Bachman’s sparrows were observed during field surveys.

Bald eagles are protected under the Bald and Golden Eagle Protection Act (USFWS 2013). This species is associated with larger mature trees capable of supporting its massive nests. Suitable trees are usually found near larger waterways where the eagles forage (USFWS 2007). The species has increased in numbers in east Tennessee in the past decade. Numerous nests occur along the nearby Watts Bar Reservoir and the species may also reside in nearby forested habitats. The closest documented nest is approximately 8 miles from the CRN Site on Watts Bar Reservoir. A juvenile bald eagle was observed flying overhead during field surveys conducted by TVA Biological Permitting and Compliance staff on the BTA in 2015 and 2021 (TVA 2021d). TVA Biological and Water Resources staff also observed bald eagles in flight during their quarterly visual encounter surveys along the Clinch River arm of the Watts Bar Reservoir in 2013. However, no bald eagle nests were observed during field surveys.

Cerulean warblers prefer large tracts of deciduous forest with numerous well-spaced, large trees. These areas are typically within mature, old-growth deciduous communities, particularly in mesic areas or floodplains (Nicholson 1997). The closest record of these species is approximately 5.0 miles away from the CRN Site. Suitable habitat for this species occurs along the ridge in the Grassy Creek HPA adjacent to the CRN Site. However, no specimens of Bachman's sparrows were observed during field surveys.

Sharp-shinned hawks have been observed on the ORR in the vicinity of the CRN Site during their breeding season. An individual was observed from a boat during a 2011 TVA winter survey along the Clinch River arm of the Watts Bar Reservoir. This species inhabits forest and open woodland particularly. Preferred nesting habitat is young, dense, coniferous or mixed forests (NatureServe 2021). Suitable habitat is available for this species within the upland ridge and valley forest habitat in the northern half of the CRN Site (Area 2). Suitable nesting habitat for this species exists in three areas of dense pine forest within the BTA: along the edge of ROW near the Clinch River arm of the Watts Bar Reservoir, in the eastern section next to the large wetland, and in the northwestern section. Additional suitable pine or mixed forest habitat occurs sporadically along Jones Island Road. However, no specimens of sharp-shinned hawks were observed during 2021 field surveys.

Swainson's warblers breed in deciduous floodplains and rich, forested wetlands with deep shade from both the mid-story and canopy. They construct their nests in understory shrubs, vines, and thickets. This species forages on the ground in areas with little to no ground cover (NatureServe 2021). Swainson's warblers have been reported on the ORR approximately 3.5 miles from the CRN Site (TVA 2021a). Suitable habitat for this species exists in forested wetlands along the Clinch River arm of the Watts Bar Reservoir within the CRN Site and BTA and along Jones Island Road. However, no specimens of sharp-shinned hawks were observed during 2021 field surveys.

Gray bats roost in caves year-round and migrate between summer and winter roosts during spring and fall (Brady et al. 1982, Tuttle 1976a). Bats disperse over bodies of water at dusk where they forage for insects emerging from the surface of the water (Tuttle 1976b). Gray bat numbers are stable and are increasing in portions of the species range, and the species has responded positively to conservation measures. Gray bats have large foraging areas and foraging habitat exists along the Clinch River arm of the Watts Bar Reservoir.

A cave that is likely a gray bat transitional roosting cave was identified across the Clinch River arm of the Watts Bar Reservoir from the CRN Site in March 2021. A known summer maternity roost cave is located approximately 3.3 miles from the CRN Site in Anderson County. One gray bat was captured in a mist net on the CRN Site during summer 2011 bat surveys, and they were detected on the CRN Site during 2011 and 2013 acoustic surveys in each of the three seasons surveyed. Gray bats were also detected on the BTA in 2014 and 2015 with acoustic surveys during each of the three seasons surveyed. Four gray bats, three of which were pregnant, were captured during mist net surveys in 2021; one of these was on the CRN Site and three were on the adjacent ORR near Jones Island Road. Gray bats were also acoustically detected at six of the seven sites surveyed during 2021 (TVA 2021d).

Federally listed bats, including gray bats, were not detected during surveys conducted inside of caves within the Grassy Creek HPA in 2021 (TVA 2021d). Therefore, these caves are likely not used by federally listed bats. As mentioned above, one gray bat was observed roosting in winter inside of a cave across the Clinch River arm of the Watts Bar Reservoir adjacent to the CRN Site. Recently deposited guano piles were also observed in this cave, suggesting that gray bats may use the cave during additional seasons of the year. However, no bats were observed emerging from the cave during subsequent June 2021 emergence count surveys (TVA 2021d).

Indiana bats hibernate in caves in winter and use areas around them for swarming (mating) in the fall and for staging in the spring, prior to migration back to summer habitat. During the summer, Indiana bats roost under the exfoliating bark of dead snags and of living trees in mature forests with an open understory and a nearby source of water (Pruitt and TeWinkel 2007, Kurta et al. 2002). Indiana bats are known to change roost trees frequently throughout the season, while still maintaining site fidelity by returning to the same summer roosting areas in subsequent years (Pruitt and TeWinkel 2007).

The closest summer record of Indiana bat to the CRN Site is a mist net capture of an adult male on the ORR in 2013 approximately 9.9 miles from the CRN Site. The closest winter record of Indiana bat to the CRN Site is a known hibernaculum approximately 27 miles to the northeast in Campbell County, Tennessee. However, Indiana bats have not been observed in this cave for over 20 years. Internal surveys of caves within the Grassy Creek HPA in 2021 determined that none of these caves are being used by federally listed bats, including Indiana bats (TVA 2021d). The closest records of Indiana bat summer roosts are 27-29 miles to the southeast in the Cherokee National Forest, which is in Monroe County, Tennessee.

Suitable summer roosting habitat for Indiana bat occurs in mature forests throughout the CRN Site and associated offsite areas (Figure 3-15 in the PEIS). Suitable foraging habitat occurs over streams, wetlands, and ponds across the site as well as over the Clinch River arm of the Watts Bar Reservoir (TVA 2021d). Mist net and acoustic surveys for bats were performed at the CRN Site (2011, 2013, 2021), at the proposed new transmission line ROW (2021), along Jones Island Road (2021), and acoustic surveys were performed at the BTA (2015). No Indiana bats were captured or detected in 2011 or 2021, but they were detected acoustically in 2013. Calls were identified as Indiana bat calls by acoustic software during acoustic surveys at the BTA in 2015 and on the ORR near Jones Island Road in 2021. However, when qualitatively assessed by TVA Biological Staff, these calls did not exhibit characteristics that would definitively indicate these were Indiana bat calls (TVA 2021d).

Little brown bats primarily hibernate in caves and mines during the winter. During summer this species can be found in hot buildings, hollow trees, and bridges, where females form maternity colonies. Colonies are usually close to water bodies where these bats prefer to forage. Foraging also occurs among trees in open areas (Harvey et al. 2011, NatureServe 2021). The nearest record of little brown bat is from a 2011 mist net survey on the ORR approximately 2.5 miles from the CRN Site (TVA 2021a). No little brown bats were observed in caves on the CRN Site during winter surveys in March 2021. There are no buildings within the project area, and the only bridge is a temporary wooden bridge constructed over Grass Creek in recent years. No colonies of roosting bats exist under this bridge. Suitable summer roosting habitat does occur in mature forested areas across the northern portion of the CRN Site, the BTA, and along Jones Island Road. Suitable foraging habitat for little brown bat is present in the project area over and along streams, wetlands, and the Clinch River arm of the Watts Bar Reservoir (TVA 2021d).

Northern long-eared bats predominantly overwinter in large hibernacula, such as caves and abandoned mines, with high humidity and no air flow. During the fall, and occasionally in spring, this species utilizes entrances of caves and surrounding forested areas for swarming (mating). In the summer, northern long-eared bats roost singly or in colonies beneath exfoliating bark or in crevices of both live and dead trees. Roost selection by northern long-eared bats is similar to Indiana bats; however, it is thought that northern long-eared bats are more opportunistic in roost site selection. This species also is known to roost in abandoned buildings and under bridges. Northern long-eared bats emerge at dusk to forage below the canopy of mature forests on hillsides and roads, and occasionally over forest clearings and along riparian areas (USFWS 2014).

Northern long-eared bat was listed as federally threatened in 2015. This species was captured on the CRN Site during 2011 mist net surveys, captured on the ORR approximately 9.9 miles from the site in 2013, and detected during 2011, 2013, and 2015 acoustic surveys on the CRN Site and BTA. The closest known hibernaculum was identified by TVA biologists in January 2014 in Roane County approximately 9 miles from the site.

As stated above, there are no buildings that may be used by bats within the Project Area. The only bridge in the Project Area is a temporary wooden bridge constructed in recent years over Grassy Creek, and no colonies of roosting bats exist under this bridge. Suitable summer roosting habitat for northern long-eared bats does occur in mature forested areas across the northern portion of the CRN Site, the BTA, along Jones Island Road. Suitable foraging habitat for northern long-eared bats is present in the project area over and along streams, wetlands, and the Clinch River Arm of the Watts Bar Reservoir.

Tricolored bats hibernate in caves, mines, and rock crevices. In summer they roost in dead or live vegetation within live trees. They are associated with forested landscapes where they forage near trees and along waterways, especially in riparian areas (Harvey 2011). Summer roost trees that were selected by this species in the Great Smoky Mountains National Park were often oak and yellow poplar (Carpenter 2017). In middle Tennessee, tricolored bats were observed roosting within clumps of dead foliage hanging from branches of live trees. The dead foliage was typically comprised of hickory or oak leaves (Thames 2020). Between one and three individuals of this species were observed roosting in caves in winter in three different caves on the Grassy Creek HPA adjacent to the CRN Site. Suitable summer roosting habitat for this species occurs throughout the project area in forested habitat. One individual was captured during 2011 mist net surveys on the CRN Site. One post-lactating female tricolored bat was captured during 2021 mist net surveys on the ORR along Jones Island Road, indicating a maternity site exists in the vicinity of the site (TVA 2021d). Suitable foraging habitat for this species occurs throughout the project area over wetlands, streams, and the Clinch River arm of the Watts Bar Reservoir.

Throughout their range, southeastern shrews are found primarily in bogs, marshy/swampy areas, dense ground cover in wooded areas, and occasionally in upland fields some distance from water. This species primarily lives underground and comes above ground after a rain event or on dewy nights (NatureServe 2021). Extant records of this species exist on the ORR within the vicinity of the CRN Site, and the closest record to the site is a historical record (1958) approximately 283 feet from the Project Area along Jones Island Road (TVA 2021a). Early successional habitat and riparian forest scattered throughout the CRN Site and associated offsite areas provide potentially suitable habitat for southeastern shrew.

Meadow jumping mice inhabit wet, lowland areas with thick vegetation often near marshes, swamps, and streams. During periods of inactivity, the meadow jumping mouse occupies burrows underground beneath logs or in clumps of grass (NatureServe 2021). This species has been reported on the ORR approximately 3.5 miles from the CRN Site (TVA 2021a). Suitable habitat for this species exists on the CRN Site, BTA, and along Jones Island Road in forested wetlands and emergent vegetation along the Clinch River arm of the Watts Bar Reservoir and around wetlands. However, no specimens of meadow jumping mouse were observed during field surveys.

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